FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT: SELECTED REPORTS 1996 - 2000

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Volume 3. Farmer participation in development of IPM strategies

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

SELECTED PROJECT REPORTS 1996-2000

VOLUME 3: Farmer participation in development of IPM strategies

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SELECTION OF FARMERS FOR PARTICIPATION IN ON-FARM TRIALS: OCTOBER 1996

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Farmers were selected for participation in the FSIPM Project on farm trials by socio-economic indicators through social mapping techniques in accordance with the specified target group; by lineage groups and in order to include farmers who had shown interest in the project and cooperated in the diagnostic exercise phase of the research; this latter group includes the chief of each village.

Target group

The target group for the FSIPM project is 'resource poor' farmers, particularly female headed households. In the original project documentation it was suggested that up to 50% of participating farmers should be women. Given that our social mapping exercise revealed a figure closer to 30% for female headed households, it was felt that we should aim to include between 30-50% of female headed households in our trials.

Social and Economic Indicators

Farmers were selected for participation in the On-Farm trials of the FSIPM project by the technique [from the Participatory Rural Appraisal repertoire] of **social mapping**. Social mapping is an exercise carried out with a group of people who draw, on a large sheet of paper [or several sheets], a box for each household in the village. Each box is given the name of the head of the household and the boxes are then 'interrogated' for a series of social and economic indicators. The aim is that, in a relatively short period of time, an efficient visual representation of key factors for all the households in a village is produced. This social and resource mapping then enables a rough and ready assessment of the relative economic, social or educational situation of each household.

Clearly, such a technique can only offer an approximate representation of complex reality. It is important that the social and economic indicators that are to be used be developed in close consultation with local staff and/or villagers themselves. The situation is further complicated in Malawi by widespread sensitivity to information gathering that may lead to the targeting of resources such as food aid. Consequently we were reluctant at this early stage in our development of friendly relations to risk our credibility by conducting exercises that were obviously aimed at creating a ranking of rich and poor. It is for this reason that the potentially useful tool of Wealth Ranking was felt unsuitable.

The following crude economic indicators were therefore employed to differentiate households: employment in the formal sector, businesses that supported families, ownership of assets (bicycles, livestock), male or female headship of house, numbers of adults and dependents in households. Due to farmers' anxieties about targeting, it was crucial that such indicators were seen less as tools for targeting per se than as a means of identifying farmers whose interests would be compatible with the work of the project; that is, the farmer would be principally a farmer and thus willing to devote time and energy to means of improving agriculture, the farmer would be available for participation in the project.

Lineages

A further factor taken into account was to make sure that the selected farmers represented as many as possible of the lineages found in the village concerned. Although the precise function and meaning of lineages remains unclear at this stage, it is known that these are households who claim descent from a common ancestor, perhaps an original settler of the village. Rights to land and other resources may well cohere at the lineage level on some occasions and, historically, a powerful lineage would lead to the formation of a new village or claims to a chief of their own. For these reasons and to attempt a fair distribution of participation, we collected information about lineages (often from lineage heads who came to tell us about their own lineage members). An attempt was also made to ensure that by only choosing one or two households from each lineage, we would not select farmers who lived in the same matrilineal cluster.

Cooperating farmers
The final criterion for choice was that over the period of time [July-October] when the diagnostic exercises were being carried out, in each village, we found that a certain group of interested farmers met us on our weekly visits; this group varied from two to fifteen in different villages. Having taken so much of their time and shared their knowledge over this period of time, we felt that we must recognise the enthusiasm and engagement of these farmers and attempt to give them a 'first refusal'. This phenomenon was particularly marked in Chiwinja village where a large group of women from mainly female-headed households regularly worked with us; elsewhere, the project had a greater ability to select on objective indicators.

Chiefs
The etiquette of working in Malawian villages has required us to work within the framework of the traditional authorities and the chief of each village or his/her close relatives have had an important role as project brokers. Furthermore, the cooperation of the chief has made the task of the project much easier. For this reason, each chief was invited to take part in the on-farm trials; the example of their participation has, for the most part, served to legitimize project activity.

With regard to the selection of farmers, it is important to recognize that the continuation of in-depth social and economic research throughout the lifetime of the project will further refine our understanding of the status of these indicators. This long term qualitative and quantitative information will allow us to move beyond crude indicators and the assumption that households are independent to comprehend wider livelihood strategies and the economic role of other units within the village such as the matrilineal cluster or the lineage. The social mapping exercise was thus a tool for immediate use, in allowing selection of resource poor farmers, but will also be a benchmark to which we can look back to assess the quality of this earlier data and the methodology by which it was gathered.

After using these criteria, a tentative list of required participants was drawn up for each village by the project. This was then discussed with the chief and his advisors (mostly lineage heads) to make sure that the selected farmers had fields were of good character and hard working. During these meetings some names were approved while some were substituted with spare eligible names on the list. The approved farmers were then invited to a meeting to explain to them how they were selected and the details of the trials. Later each of the selected farmers was contacted individually at their homes to explain to them the various facets of the trials and to get their consent and assurance of participation. During these visits some farmers showed some resistance/reluctance to participate (mainly in Kambuwa village) due to their conceived or perceived uncertainties/risks in the project's work. Those farmers were then substituted (second substitution) and similar visits were made to the new candidates. It is therefore important to realize that the process of farmer selection was complex and time consuming so as to ensure success in running of the trials which required continuous participation till harvest. Below are some of the substitutions, which were made during the process in the four villages.

Substitutions in farmer selection for on-farm trials

(a) KAMBUWA VILLAGE – FIRST SUBSTITUTION

NAME	CLAN	SUBSTITTE	CLAN	REASON FOR SUBSTITUTION
Mr. Sipiki	Buledi	Mr. Bibi	Buledi	Mobile and lazy
Mai Wanyanga	"	Mai Butao	"	Her church restricts her association
Mr. Chimwaza	Kambuwa	Mr. Basikolo	Kambuwa	Mobile, not steady in village-Doing business
Ester Bamusi	Chikumba	Mr. P. Chikoti	Chikumba	Mai Bamusi is elderly
Mai Nasimango	Kosima	Mr. Kamoto*	Kosima	She has no field in the village
Mai Mtamba	Misoya	Mai Baluti	Misoya	She works at an estate
Filipi Wanyanga	Wanyanga	Mr. Nolomani	Wanyanga	Now lives in Lalimbuka

KAMBUWA VILLAGE – SECOND SUBSTITUTION

NAME	CLAN	SUBSTITUTE	CLAN	REASON FOR SUBSTITUTION
Mr. Bibi	Buledi	Mr. Mafaiti	Buledi	Hesitant to participate but Mafaiti interested
Mai Gowero	Kambuwa	Mai Kwizombe	Kambuwa	Hesitant to participate
Mai Mnango	Jana	Luka Dinala	Kambuwa	Not interested
Mr. Nolomani	Wanyanga	Mai Chelewani	Wanyanga	Not interested
Mai Beni	Jana	Mai Vakala	Jana	Field far in Chingazi hill

Notes

1. First substitutions made by chief and his advisors (lineage heads) during a meeting with FSIPM project staff.
2. Second substitution made by FSIPM project staff in collaboration with chief after meeting individual farmers about the trials

*farmer deceased in September 1997 so there is need for replacement

(b) MAGOMERO VILLAGE

ORIGINAL NAME	CLAN	SUBSTITUTE NAME	CLAN	REASON FOR SUBSTITUTION
Stanford Mulamba	Magomero	Simeon Magomero	Magomero	Mr. Mulamba does not have land in the village
Mai Mphole	Mondiwa	Mr. Matemba	Mondiwa	
Mai Marichi	Marichi	Mr. Yasini	Marichi	
Simeon Magomero	Mawuwa	W. Simeon	Mawuwa	W. Simeon is the son of the chief but his wife is in this lineage, Simeon Magomero is the chief himself and is included above

(c) CHIWINJA VILLAGE

ORIGINAL NAME	CLAN	SUBSTITUTE NAME	CLAN	REASON FOR SUBSTITUTION
Mai Kaipa	Lingome	Mai Tepatepa	Lingome	Not enough land for experiments
Bambo Lingome	Lingome	Mai Limani	Khalani	Not enough land for experiments
Ela Jumbe	Chiwinja	Dinah Chilinkonde	Chiwinja	Not enough land for experiments
Mrs Kaipa	Misinde	Enelesi Kaminyu	Misinde	Mrs Kaipa could not be identified from social map
Bambo Mpoya				*Passed away*

(d) LIDALA VILLAGE

Jivan Ahammed	Lidala	Byson Chimwaza	Lidala	Mr. Ahammed is the Chief and has too many responsibilities to be able to work with us (lives and works elsewhere).
M. Chapakhwani	Kampira	Dorothy Ayimu	Kampira	Not a full member of the village - recently married in.
Angasemeleka Mcheka	Njoka	Eluby Nankhonya	Njoka	Mrs Mcheka is too old to work full time and is being replaced by the daughter who looks after her.
Bambo Austin	Mgomba	Linny Mpenda	Mgomba	Bambo Austin could not be identified from the social map
Wyson Taimu	Sidine	Daina Chipakula	Sidine	Mr. Taimu could not be identified from the social map
Bambo Matola	Chaola	Mai Chaola	Chaola	This lineage was left out because it is small and we had too many people.
Evelyn Nkoma	Misi	Felia Matchado	Misi	Felia Matchado is the mother of Evelyn Nkoma and the mother says that the marked field is hers
Patuma Mussa	Chiunda	Emily and Ali Mustafa	Chiunda	Ms Mussa has gone to look after her mother in Balaka, Emily is her sister in law and will take her place

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

Great Suspicions and Lesser Expectations: an investigation into farmer perceptions of the Farming Systems Integrated Pest Management Project

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Abstract

This research was undertaken in response to anxieties within the FSIPM Project concerning farmers' perceptions and attitudes towards our on-farm trial research. An open-ended questionnaire was asked of 59 farmers in the four target villages in order to understand more about the historical context for development and barriers to participants' understanding of the project. The study demonstrates that the project's participatory technology development research was new in style and content. Previous experience of development interventions had been disappointing in these villages, particularly in agriculture. Initially, suspicions concerning project intentions were widespread and included fears of land confiscation, resettlement and forced labour. This did not prevent a high level of cooperation in the trials. The majority of participants understood trials where the pest was visible and important, where the treatment was familiar or obvious or where training had been given on the biology of the pest or disease. Considerable variation was found in farmers' understanding of the trials, however. This is attributed to different levels of engagement with project objectives due to farmers having their own agendas. Farmers vary in their skills and interest in farming, experience different levels of pest attack or view the project as a conduit for material resources. Cultural norms of respect and the avoidance of conflict also inhibit open feedback.
Gender analysis of the results suggests that the project is succeeding in reaching both men and women farmers and that there is no discrimination between areas.

Executive Summary

- The objectives of this research were to understand better the context regarding attitudes to development interventions into which the project had been introduced.

- The FSIPM Project was very novel in purpose and style for all villages. There had been little history of success with agricultural interventions: about 65% had failed. Villagers had never been asked to take part in technology testing or evaluation.

- Suspicions about the intentions of the project were more widespread and serious than we had realised. Although farmers told us that their own expectations were broadly positive from the start, they recounted their fellow villagers' opinions in much more negative terms, in particular, rumours of land stealing or resettlement were rife.

- Farmers showed that they best understood the whitegrub, termite and *Striga* trials. This fits experience elsewhere in pest management research. Participants understood the purpose of the trials where the pest was visible, was considered a serious problem and the treatment was either easy to understand or where training was provided on pest or disease biology.

- These findings suggest that it is hard to overestimate how much training or education about pest or disease biology is required where a treatment or pest is not visible but important.

- We found no evidence of a gender bias. Possibly men found the project easier to understand at the start due to previous experience. Women seemed more aware of the content of trials involving legumes, this fits with their greater interest in legumes.

- Allowing for differences in resources, there is, of course, variation between farmers in enthusiasm, interest or capacity to understand which researchers should not underestimate as a factor when setting up on-farm trials. A project such as the FSIPMP must, therefore, expect to find gradations of engagement among trial participants.

- The quality of the feedback we receive as a project may be a problem. During interviews with farmers for this research, project staff sometimes felt that the responses they were getting were bland and that some farmers did not say what they really thought.. In general, Malawian society is characterised by low levels of trust and, historically, open feedback of problems to the authorities has not been encouraged.

- We might also ask why many respondents should take the risk of finding fault with a project providing free inputs. when little in their experience encourages them to feel a sense of ownership towards the trials. It is noticeable. that resistance to the project has come over key resources or where local frameworks of understanding differ from project models.

- The results of this questionnaire strongly suggest that if the project had been able to carry out a needs assessment. few farmers would have asked for a pest management project. Throughout the life of the project. farmers have shown more active interest in gaining access to inputs. particularly fertiliser. than to any of the pest management technologies.

- The realisation that not all farmers suffered equally from pest damage led the project in the final year of trials to work with specialist problem groups. Encouragingly. however. many farmers said that the best aspect of the trial was the opportunity to learn about new methods or technologies in agriculture.

- One aspect of the context regarding attitudes to development interventions that has emerged is that barriers to communication exist because farmers and researchers have different agendas. This may mean that participants pursue different ends through the same activities but do not wish to talk openly about their different ends.[1] The project's agenda was to identify pest management strategies for resource poor households that fitted into local farming systems. This mitigated against a large package of inputs. Many farmers hoped that contact with the project would give access to the best model of farming practice and to large input packages.

- This variation in engagement with project objectives must be set in the context of declining food security and farmers' knowledge that the project has a limited life span.

- It is important that any project acknowledges that participants are operating in their own 'life worlds' and that they will not necessarily share our view of agricultural or project priorities unless these are verified in advance (and even then there will be different levels of engagement).

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[1] It is a truism of late 20th century social science that knowledge 'emerges out of a complex process involving social. situational. cultural and institutional factors' (Long and Long. 1992. p211). This insight has certainly proved true in research activities carried out by the FSIPMP team. The social anthropology team has encountered a number of situations where it has been clear that individual opinions given in a 'safe' environment can be very different from those expressed by individuals in more formal contexts or in groups. Work done by the socio-economic team on local management techniques for termites and whitegrubs also demonstrates that investigations in groups can suppress information about individual strategies.

- Participation has improved (if unevenly over the three years). The project has acknowledged that the criteria of yield or time of yield prevail where the need for food security is paramount. Trials have been simplified. disliked technologies dropped and there has been consultation about when and why we should meet. Where farmers and researchers have very different views about practice. as with fertiliser timing. further research has been carried out or trials have been set up so that we can learn together about what works best.

1.0 Introduction

1.1 Rationale and objectives

This study arose as a result of conversations with farmers in Magomero village in September and October 1997 which indicated that there was a considerable gap between farmers' perceptions of the FSIPM project and how project staff viewed both the project and its relationship with these farmers. At this point, the FSIPM project had just finished conducting its first year of on-farm trials with 74 farmers and was preparing to initiate the second year of trials.[2] Project staff had assumed that farmers viewed our project in a neutral or even positive light although we had encountered difficulties with some farmers whom we came to label 'uncooperative'. There had been, after all, a sustained attempt to create a participatory environment in the planning and management of the on-farm trials. This effort had been somewhat hampered by an overly sophisticated trial layout in the first season due to the needs of statistical analysis and the constraints of staff shortages, but we had been confident that the purpose of the project was more or less clear to farmers.

This confidence was undermined by reports to staff meetings by the technical team (agronomic and pest management junior staff) of problems arising in implementing the trials. A minority of farmers harvested plots early, failed to bank, did not mulch or earth up beans while a majority complained about our not applying fertiliser and a significant number abandoned dambo plots due to heavy rain (and the lack of fertiliser). Further issues emerged during the monitoring and evaluation exercise carried out by the socio-economic team during the 1996-97. These problems suggested to us that understanding of both project purpose and the experimental methodology were much more limited than we had thought. The problems were then aired by the social anthropology team with a group of farming households in Magomero village, Matapwata EPA, which were being interviewed regularly to create a set of case studies. Discussions with these households had ranged over a wide range of subjects and their familiarity with the social anthropology team permitted a greater degree of liberty than found elsewhere at this stage. These discussions threw up various complaints and enquiries ranging from contact with the project team to aspects of the trials. The probability of a gap between farmer and project expectations was raised at the 1997 DFID Output to Purpose Review which recommended that a wider survey be undertaken in the four target villages.

The aims of such a study were:

[2] There were 64 participants in the main trial in 1996-97 and 61 in 1997-98. In the *Striga* trial, there were 10 participants in the first year and 6 in the second year.

1. To understand better the context regarding attitudes to development interventions into which the project had been introduced.
2. To identify barriers to farmer understanding within the on-farm trial group of farmer.

The information obtained would help us to think about what adjustments should be made for the final year of trials. It would also provide an example of the conceptual and historical starting point of our partner communities from which other projects might draw lessons for future work. The results are presented in Section 3 after a description of methodology and sample selection in Section 2. The presentation follows the order of the question checklist so that the purpose of each question and the results are discussed by turn.

1.2 The Project and study region[3]

The FSIPM project has been working since 1996 in Chiradzulu North (Mombezi) and Matapwata Extension Planning Areas (EPAs) of the Blantyre Shire Highlands Rural Development Project (RDP). Matapwata EPA has since been transferred to Thyolo North RDP. The staple cereal of the area is maize. Maize is intercropped with pigeonpea *(Cajanus cajan)*, beans *(Phaseolus spp.)* and a variety of other legumes, tubers and vegetables. This maize ecology is representative of 40% of the area planted to maize in Malawi (Heisey and Smale, 1995, cited in Orr and Koloko, 1998). Low average yields (836kg/ha for local varieties and 1765 kg/ha for hybrid semiflint varieties) reflect poor soil fertility and low use of inorganic fertiliser. The main cash crops are burley tobacco and dimba garden vegetables (grown for the markets of Blantyre and Limbe). Sixty percent of land holdings in this area are under 0.5 hectares. Women head thirty-eight percent of households in the RDP.

The project objective is to improve the welfare of poor farm families by developing pest management recommendations to reduce losses of maize, beans and pigeon peas in the field from pests, weeds and diseases. The target pests and diseases, identified as priorities by professionals and farmers, are *Striga asiatica*, termites and whitegrubs in maize, *Fusarium* wilt of pigeon pea and the bean stem maggot (*Ophiomyia* spp.) on common beans. Participatory research methods focused on on-farm trials have been used to develop appropriate pest management strategies, sustainable within the constraints of the smallholder farming systems (FSIPM Project Memorandum, 1995). In order to ensure that these constraints are recognised, it has been a priority of the FSIPM Project to analyse the farming system as a whole.

[3] The information in the following paragraph is taken from Orr and Koloko, 1998.

2.0 Methodology

2.1 Semi-structured interview format

The semi-structured interview (See Annex ?) discussed below was pilot tested in Magomero village in January 1998 with eight households in four *mbumbas* (co-resident, extended matrilineal family groups) in the social anthropology case study. A revised version (see Annex A) was then used to interview fifty-five households in the other project sites between February and June, 1998. Approximately half the interviews were administered between January-February, 1997, the remainder were completed in June 1998.[4] Feedback through informal discussion and a results summary paper were provided in August 1998 to the project to inform the 1998-99 season of trials.

An interview format with open questions was chosen in preference to a more tightly structured questionnaire.[5] This was in order to encourage participants to give their opinions and criticisms as freely as possible. We were not sure what respondents might say or what frameworks of understanding they brought to the project work so qualitative insights into the ideas and reasoning of trial participants were needed. However, the results of open-ended questioning are not easily quantified because different respondents talk about what is important to them. This lack of uniformity in ideas or information means, for example, that it is difficult to assess how many knew that maize seeds were dressed with pesticide to inhibit whitegrub damage if respondents did not mention this aspect because for them it was not relevant. However, since the point of the exercise was to grasp farmers' perceptions and to see what was important and what not worth mentioning from their perspective, this approach seemed most suitable.

The results have, however, been quantified inasmuch as responses have had to be categorised and counted. We have also analysed the data in terms of gender or village of origin to see if there are any significant divisions that might indicate a bias on the part of the project or systematic differences on the part of groups of respondents.[6] It should be noted that throughout the discussion of findings, there are often more responses than respondents because participants made more than one comment in reply to a question. To avoid confusion, results as frequencies and percentages for both responses and respondents are normally presented. Summary tables of responses are presented in the main text where the data are discussed in detail. Otherwise, main results in table form are found in Annex B and lists of all answers with total responses and responses by gender are presented in Annex C.

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[4] The delay was due to a decision to expand the sample size from thirty to sixty after consultation with the project's visiting statistician in March 1998.

[5] For further discussion of the merits of open-ended versus 'closed' questionnaires, see Ashby et al. 1991.

[6] Where the interview was conducted with both husband and wife, it has not been included in the gender analysis.

2.2 Sample

Respondents for the main questionnaire were selected randomly from the list of on-farm trial farmers. The following table is a summary of respondents by village, gender and participation in on-farm trials

Table 1: Respondents to questionnaire by village, gender and trial participation

Village	Men	Women	Couples	OFT	NOFT	Total
Chiwinja	3	12	0	15	0	15
Lidala	5	12	0	17	0	17
Magomero	4	11	3	14	4	18
Kambua	4	3	6	13	0	13
Total	**16**	**38**	**9**	**59**	**4**	**63**

Seventy-four farmers took part in the 1996-97 trials so approximately 80% of trial participants were included. The interview was conducted with the person most closely involved with the trial which is why there are more women than men interviewed. Where husband and wife were both interviewed, the husband is the person formally responsible for the trial. Forty-three male headed households and 20 female headed households were represented.

3.0 Results

Question 1: Have you had any previous experience here or elsewhere with outsiders and projects (agricultural, health, education or otherwise?) Have any projects that were promised failed to start?

Behind this question was a desire to know what sort of experiences had preceded the introduction of the FSIPM project. Project staff had wondered whether some of the difficulties that we were having were attributable to a history of negative encounters with other development interventions.

Thirty-two different types of intervention were cited across the four villages (see Table 1, Annex C). Out of 161 comments, 126 (74%) were concerned with nine major, government led interventions. These were: attempts at contour ridging from the 1960s until quite recently, home economics classes in the 1980s and pre- and post-democracy maize clubs. The 1990s saw village and home hygiene advisors, burley tobacco clubs, borehole digging and part grant and part self-help well projects. Even individuals who had not been involved in these projects, for example, who had not been members of any credit clubs, knew about these major interventions.

The remaining 23 interventions were cited only by a few individuals: 13 projects were only mentioned by one person, 8 projects by two people and 2 projects by three people. It is not clear how we should interpret such scattered information. One explanation that was explored was that projects that fail are not well remembered. This turned out not to be the case, since equal numbers (36%) of projects rated as successes and failures were only mentioned by one person. What the data may suggest is that many interventions are limited in their impact so are only remembered by a few individuals.

Approximately half (52.8%) of all interventions or projects were judged to have been successful while around a third (38%) were considered failures. Opinions differed about the remaining 8.7% of interventions.[7]

When we look at the individual village experience (Table 2), Lidala interviewees reported the most positive experience of development interventions followed by Chiwinja and Magomero. In all villages except Lidala, approximately half of all schemes failed.[8] These findings suggest that previous experience in these villages would make villagers sceptical about interventions but that one would not expect particular differences between villages from earlier experiences.

Table 2: Individual Village Experience

Village	Failed	*Unknown/ Incomplete*	Successful	Total
Chiwinja	15	*3*	18	36 (22.4%)
Kambuwa	13	*1*	16	30 (18.6%)
Lidala	9	*5*	**33**	47 (29.2%)
Magomero	**25**	*5*	18	48 (29.8%)
Total	62 (38.5%)	*14 (8.7%)*	85 (52.8%)	161 (100.0%)

[7] For example, the long-running farmers clubs in the pre-democracy period were an example of an activity that was successful for its members until a combination of political and climatic changes led to widespread defaulting and the collapse of the system. Some farmers would say that the clubs were successful while others would disagree because they ended in failure.

[8] If one excludes the schemes where the result is not known, in Chiwinja, 45% or 15/33 failed, in Kambuwa 43% or 13/30 and in Magomero, 52% or 25/48.

Agricultural initiatives

If we only look at agricultural initiatives, the record for failure is worse (Table 3). Out of 54 initiatives concerned with agriculture, 30 were considered to have failed, 20 have been successful and there is no information concerning the remaining 4. This means that out of those agricultural projects where the outcome was known, 60% had failed. Contour bunding had not been broadly adopted, most maize credit clubs had folded due to defaulting and there was little engagement with extension work (and probably not much extension being carried out). There had been one minor initiative on pest management.

Table 3: Success and failure of agricultural projects in the four villages

Village	Failed	*Unknown/ Incomplete*	Successful	Total
Chiwinja	7	*0*	4	11
Kambuwa	4	*0*	6	10
Lidala	6	*1*	2	9
Magomero	13	*3*	8	24
Total	30 (60%)	*4*	20 (40%)	54

When we compared the answers given by men and women (Table 4) it appears that women had experienced more failures in agricultural intervention than men: 65.6% compared to 23.1% for men. These results may suggest that the more successful projects have been targeted at men, such as burley tobacco or maize clubs.

Table 4. Question 1. Gender analysis of whether agricultural interventions were successful or unsuccessful.

Respondent type	Failed	*Unknown/ Incomplete*	Successful	Total
Couple	6 (66.7%)	0	3 (33.3%)	9 (100.0%)
Female	21 (65.6%)	3 (9.4%)	8 (25.0%)	32 (100.0%)
Male	3 (23.1%)	1 (7.7%)	9 (69.2%)	13 (100.0%)
Total	30	4	20	54

A new style of project?

Accounts of previous experience of development interventions revealed that both style and content of the FSIPM Project were substantially different to anything that had gone before. The closest model with which the project can be compared is that of the extension demonstration plots, mentioned by two farmers. There were no examples of on-farm trials or experiments run with farmers.

There also seems to have been little research. One interviewee remembered researchers who had come to look at child survival but could not remember what aspect of the problem they were studying and there had been no feedback of findings. Where farmers did have a framework of how farmers learnt about research, it was of the classic transfer of technology model: 'modern' farming methods devised elsewhere would be brought to the village by outsiders.

The only projects mentioned with a participatory philosophy are borehole or well projects where villagers may have been consulted about location or were obliged to contribute labour. Rather, farmers were normally required to learn how to do something from the expert who had come to teach them or to work under instructions. For example, the hygiene and sanitation experts (presumably from the Ministry of Health) came to teach farmers about hygiene rather than to investigate farmers' existing practices and build on these. MASAF (Malawi Social Action Fund) projects are often participatory in intention but decision making is in the end dominated by the chief.

Given this context, the work of the FSIPM Project begins to look much more unusual than we had imagined. Outsiders and foreigners came from a research station, asked ordinary farmers (as opposed to the primarily better off farmers involved in extension demonstrations) for land for experiments on pest management and invited them to play an active role in running and assessing the trials. As far as we can see from these results, respondents had never been involved in suggesting, choosing, designing or evaluating technologies in a formal context. This may explain why farmers, in seeking to understand the work of the project, had few reference points.

Question 2: (a) What did you think or expect last year when the FSIPM Project came to the village? (b) What were other people saying? (c) Did you go to any introductory meetings? (d) How was the text that was handed out – were you or someone in your family able to read it?

These questions aim to understand what farmers thought about us at the moment of implementation.[u] The timing of this question is likely to have influenced the answers that were given, that is, by the time it was asked, many suspicions or fears had been laid to rest. Farmers were in the second year of trials and had received free inputs two years in a row (with all important fertiliser included in the second year's package) and compensation had been given for shortfalls in the first year's harvest. All this had established confidence in the good, if limited, intentions of the project. Other villagers were now asking if they could

[u] Question 5, 'Last year, what did you understand to be the purpose of the trials?' interrogates farmer understanding after this point.

take part. On the other hand, to whatever extent answers were informed by the positive project experiences of the first year, the question could not easily have been asked before confidence was established. Several times in the first year we asked farmers if they had any problems or questions they would like to put to us and we received few responses. The principle topic on which farmers showed interest or resistance to the trial design was the absence of fertiliser on the plots.

(a) What did you think or expect last year when the FSIPM Project came to the village?

Expectations were generally positive (Table 5). There were 63 respondents. Of the 75 responses that resulted, 51 comments (68%) were broadly positive and only 15 (20%) negative while 9 (12%) did not know what to expect.[10]

Table 5. Question 2 (a): Negative and positive expectations of project at beginning

Category	Men	Women	Couples	Total	% of total
Negative (theft of land, harvest or forced labour)	3	12	0	15	20
Positive (learning modern agricultural techniques, receiving inputs)	17	26	8	51	68
Don't know	1	8	0	9	12
Total no. of comments	**21**	**46**	**8**	**75**	**100**

Table 6 below presents the five most common replies to Question 2a. The most common positive comment was that people expected to learn improved farming methods from the project followed by hopes of a bumper harvest. Ongoing anxiety about shortages of inputs was reflected in farmers anticipating free inputs or a maize or fertiliser credit club. Negative comments focused on land stealing and an absence of expectations in the form of 'don't know' or 'nothing'. At this stage, only 4 (5.3%) answers related to pest control.

[10] As we warned above, with an open ended interview style, results are not easily quantifiable. Here, for example, several farmers gave a mixture of positive and negative comments (such as they hoped to learn modern farming methods but feared they might lose the harvest or rights to land).

Table 6. Question 2a: Main answers from men, women and couples (all respondents)

Responses	**Frequency**	**% of Respondents (58)***	**% of Responses (75)**
To learn good/modern farming methods	18	31.0%	24.0%
Don't know/nothing	9	15.5%	12.0%
Land stealing	9	15.5%	12.0%
Bumper harvest	8	13.8%	10.7%
Free inputs	5	8.6%	6.7%

*3 women and 2 couples gave no answers

Interestingly, women made more negative comments than men (see Table 7 and Table 8, n.b. couples were omitted from this table). For example, seven women said that they had been afraid that we might steal their land (compared to only two men). It is possible that men had a better acquaintance with the idea of on-farm research or had understood our explanations more easily but it could also be that women were readier than men to risk looking foolish and admit anxieties after the event.

Table 7. Question 2a: Main answers given by women

Responses	**Frequency**	**% of respondents (35)***	**% of responses (46)**
To learn good/modern farming methods	8	22.9%	17.4%
Don't know/nothing	8	22.9%	17.4%
Land stealing	7	20.0%	15.2%
Bumper harvest	5	14.3%	10.9%
Free inputs	3	8.6%	6.5%
Other	15	42.9%	32.6%
Total	46	N/A	100

*Answers not given by 3 farmers

Table 8. Question 2a: Main answers by men

Responses	**Frequency**	**% of respondents (16)**	**% of responses (21)**
To learn good/modern farming methods	6	37.5%	28.6%
Don't know/nothing	1	6.3%	4.8%

Land stealing	2	12.5%	9.5%
Bumper harvest	1	6.3%	4.8%
Free inputs	2	12.5%	9.5%
Other	9	56.3%	42.9%
Total	21	N/A	100

There was also little difference in expectations at this stage between villages (Annex B. Table 1) except that respondents from Lidala. the village reporting most successful development interventions. gave the most negative answers concerning what they expected from the FSIPMP.

b) What were other people saying?

This question was intended to give an opportunity to individuals to tell us about suspicions (that they may well have shared) without public 'ownership' of these fears. It should be kept in mind that none of our participants took these fears seriously enough to refuse to take part in the trials. Sixty-three comments were recorded from 55 respondents. The results are presented in Table 9 below.

Forty-four respondents told us that other people had suspected the project was planning to confiscate land. Three people told us that it was said that the people would also be relocated. In two villages. three respondents told us of a rumour that the chief had conspired with the project to sell both land and people. The chief of Chiwinja told us that our first meeting there had been badly attended because of fears that we would confiscate land. Chief Magomero said that it was thought whites had come to establish a plantation. Only 6 reports of what others had said were positive. that the project was bringing inputs or would be training farmers in modern farming techniques. Men and women answered this question similarly: 87.9% of women and 78.6% of men reported fears of land appropriation (see Annex B. Table 2 and 3). There was also little difference between villages (see Annex B. Table 4).

Table 9. Question 2b: Main responses (including couples)

Responses	**Frequency**	**% of respondents (55)**	**% of responses (63)**
Land stealing	44	80.0%	69.8%
People stealing and selling	3	5.5%	4.8%
Relocation	2	3.6%	3.2%
Forced labour	2	3.6%	3.2%

Research	2	3.6%	3.2%
Other	10	18.2%	15.9%
Total	63	N/A	100.1

Discussion

Given the widespread level of distrust in the villages, it seems remarkable in retrospect that so few farmers refused to let us use their land. As far as we know, only five farmers out of the original 64 invited to take part did not do so. Various explanations were given for this. Only one farmer, from Kambuwa, told us that she was refusing because she was worried about the project collapsing and failing to give her compensation or that she might lose her rights to the land. Four other farmers, also from Kambuwa, said only that they were not interested in the project work. A further 14 farmers were deselected by chiefs and lineage heads. The reasons given for this were to do with small landholdings, absentee owners or infirmity. It now seems that this may not have been the whole story. A respondent in Magomero said that two people she knew had refused to take part in the trials because they were worried about losing their land. Similarly, a woman in Lidala who had spent time at Makoka Research Station told us that she stepped in when her mother was too scared to take part.

Why did most farmers cooperate?

It may be that rumours were rife but not believed by the majority. A few said that they had heard the rumours but could not believe that anyone would want to steal such a small and infertile piece of land. Some farmers said that they knew about agricultural research or how the government worked so were sure that they could not lose their land. Selected farmers who had attended several pre-selection meetings and become acquainted with project personnel were informed about the project's objectives and were well placed to disregard gossip. It is also possible that at least some farmers were anxious about the consequences of participation but felt obliged to co-operate with high status outsiders and foreigners legitimised by the chief and extension services. Finally, it is likely that some rumour-mongering was fuelled by jealousy so was discounted by the participating farmers.

(c) Did you attend any introductory meetings?

Farmers were asked if they had attended any of the meetings held by the FSIPM Project. This was to give us a sense of how widespread attendance had been and how much the participating farmers had known about the project before the trials began. The question covered any pre-implementation meetings held by the trial. These meetings fell into two parts. Several diagnostic meetings were held in each village before farmer selection took place. The first meeting, a half-day exercise, to which all villagers were invited through the chief, was attended by extension officers who introduced project personnel and gave their support to the project work. A project representative outlined the work and aims of the project. During this meeting village mapping, natural resource mapping, seasonal labour, health and income calendars and a timeline were all carried out. This preliminary context-setting exercise was followed by a series of meetings focusing on crop and pest problems and social mapping with lineage heads. Villagers who attended a high proportion of the diagnostic meetings were invited to take part in the on-farm trials (and as we shall see below, considered themselves to be volunteers for the trials). Other farmers were selected by lineage group and socio-economic criteria elicited from the social mapping.

Those villagers invited or volunteering to join the trials then took part in pre-trial meetings with the FSIPM Project team in order that the team could describe and explain the trials. This information was repeated when the inputs were handed out to farmers and reinforced by handouts in Chichewa summarising the trials and the rationale behind the experiments.

Results

There were fifty two eligible respondents for this question (those farmers not participating in the 1996-97 on-farm trials are excluded).

Encouragingly, 44 out of 52 participants had some information concerning the project before the trials were implemented. All the men and about 80% of women who answered the question had attended all or some of the meetings. A comparison of answers between villages also shows little difference (see Annex B, Table 5).

Table 10. Question 2c: Main answers overall and by gender

Response	Frequency (52 including couples)	Female Respondents (31)*	Male Respondents (12)*
All	12 (23.1%)	10 (32.3%)	2 (16.7%)
Yes	30 (57.6%)	12 (38.7%)	10 (83.3%)
One	2 (3.8%)	2 (6.5%)	0
None/no	8 (15.4%)	7 (22.6%)	0
Total	52 (100%)	31 (100%)	12 (100%)

* answers not given by 7 women and 4 men

(d) How was the text that was handed out – were you or someone in your family able to read it?

This question was asked, partly because project staff were interested to know if the handouts had been useful, but also because staff were beginning to think ahead to dissemination of project findings and what means might prove most suitable. Who, then, had benefited from this written material? The handout in Chichewa text described the first year trials for the farmers. The actual explanation of purpose of the trial was brief but the instructions for each trial comprehensive. Every farmer had a different combination of interventions being tested in the trials so was given information sheets to match.

Of the 42 farmers who answered this question, 20 either read the text themselves or had a relative read it for them. Some farmers mentioned that they had not shared the text with others. This is not surprising considering the specific nature of the information. Five farmers were sure that they had not received the handout. Of the 17 remaining, the majority said that they had read or asked someone to read the handout to them but that they could not now remember its contents. The results of the first year trial might also influence how farmers remembered these handouts. Several of the technologies tested did not work, did not suit the agro-ecological zone or were inappropriate in terms of resources available to farmers.

Given that male literacy is higher than female, it was thought likely that men would have been able to use this written material more easily than women (Table 11). Unfortunately the sample of respondents for this question is small, particularly for men. However, the results seem to approximate to what we know of male and female literacy. Fifteen out of 26 women gave negative responses. They told us that they had read (or had read to them) the handout but had forgotten its contents or that they had not read the handout. Only 2 out of the 10 men said that they had not understood or had forgotten the contents of the sheets. On the positive side, a third of women and half of the men said that they had read and understood the document. There was no obvious difference between the villages (see Annex B, Table 6).

Table 11. Question 2d: Main answers overall and by gender

Responses	**Total (42) (including couples)**	**% of respondents (42)**	**% of responses (42)**	**Women* (26)**	**Men* (10)**
Read and understood	17	40.5%	40.5%	8	5
Read but has forgotten contents	10	23.8%	23.8%	10	0
Did not get handout	5	11.9%	11.9%	1	2
Relative read out, now has forgotten	4	7.1%	7.1%	2	1
Relative read for farmer	1	2.4%	2.4%	0	1
Have not read or had read to me	3	7.1%	7.1%	3	0

Read and did not give to anyone else	2	4.8%	4.8%	2	0
Read but did not understand	1	2.4%	2.4%	0	1
Total	42	100%	100%	26	10

Question 3: Did you wonder why you had been chosen?

Some farmers had asked project staff why they had been chosen for participation in the trials. This interview provided an opportunity to find out more about what perceptions farmers had of this process.

Farmers had been selected for participation in the FSIPM Project on-farm trials according to socio-economic status (the project's target group was resource-poor households), by lineage groups and to include farmers who had shown interest in the project and co-operated in the diagnostic exercise phase of the research: this latter group included the chief of each village. The socio-economic indicators were derived from social mapping and, while approximate, permitted the selection of 'resource poor' farmers, particularly female headed households.[11] An attempt was also made to ensure that the selected farmers represented as many village lineages as possible. Although the precise function and meaning of lineages was unclear at this stage, it was hoped that by choosing one or two households from each lineage, we would spread participation widely and facilitate communication about the project between participating and non-participating households. Project personnel were open about all criteria except poverty. Anecdotal information from development professionals concerning problems with identification of resource poor households for the purpose of targeting led us to play down this aspect of our selection procedure. The project's focus upon affordable and appropriate pest management strategies that would fit into the farming system of even the poorest households was, however, emphasised at all meetings.

The question was answered by 58 respondents. Forty three, (71.7%), said that they had not wondered why they had been chosen and 38 (59%) went on to explain why. Fifteen (25.4%) were unconcerned as to the actual selection procedure but were happy because the trials were for official research into agricultural improvements. Eleven (18.6%) said that they had volunteered. Four (6.8%) said that they were selected because they were good farmers. Two men said that they were picked because they were known locally as leaders. Two women in Lidala thought that they had been chosen because they were very poor and were

[11] In the original project documentation it was suggested that up to 50% of participating farmers should be women. Given that our social mapping exercise revealed a figure closer to 30% of the population for female headed households, it was felt that we should aim to include between 30-50% of female headed households in our trials.

being targeted for aid. In other words, it seems that these participants had a clear enough idea about the benefits of taking part in the trial to accept or justify their inclusion as a positive or voluntary event.

By contrast, 16 (27.1%) respondents wondered why they had been chosen. Nine had asked their chief, team members or fellow participants about it. They were told that they were selected as representatives of their lineages or because they stayed in the village for much of the time (and so would be available to work with the team on the plots). Seven women said that they did not know why they were chosen but decided to wait and see what would happen. (One of these women said that she was still wondering why she'd been chosen). Of this group, three women said that they had been very worried about taking part. It appears from our small sample that men displayed more confidence than women. Only one man admitted to being worried about being selected and he asked the team for the reason. Twelve women in total said that they were anxious about being selected.

Table 12. Question 3: Did you wonder why you had been chosen? Replies by gender

Responses	**Frequency**	**Female**	**Male**	**Couples**
No because it was for agriculture/ research	15	6	7	2
No because volunteer/keen	9	7		2
Lineage-Yes	8	5	1	2
No	5	3	2	
Yes and was worried	5	5		
No – known as good farmer	4	1	2	1
No - known as a leader	3		3	
Yes	2	2		
No- because poor	2	2		
No- registration	2	1		1
No- because young	1		1	
No – because not mobile	1	1		
Yes, so asked the team (research)	1		1	
No- because old	1	1		
Total	59	34	17	8
Not applicable	5	4	0	1

The main results are compared by gender percentages in the two tables below.

Table 13, Question 3: Main responses by women

Responses	Frequency	% of respondents (34)	% of responses(34)
No because volunteer/keen	7	20.6%	20.6%
No because it was for agriculture/ research	6	17.6%	17.6%
Yes but accepted due lineage membership	5	14.7%	14.7%
Yes and was worried	5	14.7%	14.7%
No	3	8.8%	8.8%
Other	8	23.5%	23.5%
Total	34	100	100

Table 14, Question 3: Main responses given by men

Responses	Frequency	% of respondents (16)	% of responses(17)
No because it was for agriculture/ research	7	43.8%	41.2%
No because known as a leader	3	18.8%	17.6%
Yes because known as a good farmer	2	12.5%	11.8%
No	2	12.5%	11.8%
Other	3	18.8%	17.6%
Total	17	N/A	100

Comment

It is reassuring to see that so many farmers felt positively about taking part in the on-farm trials and that as a result did not worry about the selection or exclusion procedure. It is also encouraging that about half (9/17) of those who had some doubts as to why they were chosen were able to ask either their chief or the FSIPM team.

Question 4: What did you hope to see on the plots?

The objective of this question was to find out more about trial participants' expectations of us. The sample was 55 respondents. Fourteen farmers also told us what they actually saw and why. Three farmers only said what they had seen rather than what they hoped to see. Thirty-one farmers just told us what they had hoped to see.

The top five answers concerned hopes for a good harvest, low expectations because there was no fertiliser, the desire to learn new farming methods, the comment that there were poor crops because no fertiliser was applied and uncertainty about what to expect. It is more interesting, however, to look at the answers in terms of positive, negative and sceptical categories. Some farmers were initially sceptical in their replies but conceded that they had hoped to see a good harvest. Others told us that they initially hoped to see a good harvest but when told that we would not be applying fertiliser, they knew that this was not possible.

It is encouraging that 39 respondents hoped to see positive results on the trial plots while 20 were sceptical and only 7 had negative expectations. For half our respondents, hopes focused on a large harvest of good quality crops. Ten percent hoped to learn about new farming methods. Of the "sceptical" category, 11 farmers were worried when they saw that we were not going to apply any fertiliser while 9 said that they either did not know what to expect or expected nothing special. Negative comments reflected what had actually happened and focused on the damage done to the harvest by the lack of fertiliser and the bad weather. In total, 16 comments concerned the absence of fertiliser in this first year.

Table 15, Question 4, What did you hope to see on the plots (1996-97 season): Comments by category

Category	Comment	No. of comments	% of respondents (58)	% of comments (68)*
Positive	Good crops/big harvest	30	52%	43%
	New farming methods	6	10%	9%
	To learn about soil fertility	2	3%	3%
	Reduced pest attack	1	2%	1%
	Total	**39**	**67%**	**57%**
Sceptical	Wondered what would happen without fertiliser	11	19%	16%
	Nothing special	4	7%	6%
	Don't know	5	9%	7%
	Total	**20**	**34%**	**29%**
Negative	Poor harvest because lacked fertiliser	5	9%	7%
	Poor harvest due to boxed ridges in dambo	1	2%	1%
	Poor crops	1	2%	1%
	Total	**7**	**12%**	**10%**

*n.b. the total of comments includes 2 comments about beans, see Annex C, Table 6

As before, there is little difference between men and women (see Annex B, Table 8). A slightly greater percentage of men than women made negative comments and a slightly greater percentage of women made positive comments but the numbers are too small for us to read much into this. Given that farmers had been compensated for any shortfall in harvest for all the trial plot crops, it may be a sign of greater confidence on behalf of the male participants that they felt able to criticise the project at this point.

Comment

We should note at this stage only one reference to pest management. Rather, positive expectations are expressed in terms of increased harvest. This reflects farmers' preoccupation with food security and marketing requirements. Other project work, particularly monitoring exercises, suggests that desirable qualities such as disease and pest resistance are subsumed under yield. Pests are not equally a problem for all farmers but are a serious problem for some farmers. (This understanding led to the formation of specialist pest groups for FSIPMP trials in the 1998-99 season).

Question 5: Last year (1996-97) what did you understand to be the purpose of the trial?[12]

The aim of this question was to see what sort of spontaneous replies farmers would give rather than prompt them on the various aspects of the trial. This type of questioning means that we cannot read the results as indicating that where a farmer did not mention the part of a trial dealing with a particular pest, he or she definitely did not know about that aspect of the trial. However, if a farmer failed to mention what was, to the project, a central element of the trial, it is very likely that the farmer did not consider this a serious problem and quite likely that the farmer had not taken this aspect of the trial on board. There were 57 eligible respondents.

Farmers' answers were matched with the various trials (Table 15). Farmers could only be expected to know about the trials that were being conducted on their plots. The sample is restricted to those farmers for whom there was an activity related to pest management on their plots. The control plots, that is, where there were no activities, were excluded.

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[12] For a description of the 1996-97 trials, see Statistical Analysis Reports, 1996-97

Table 16. Question 5: Farmers' knowledge of particular trials

Crop	Pest	Technology	Location	No. in trial	No. citing pest
Maize	1.*Striga*	Fertiliser. green manure (tephrosia). trap crops scrupulous weeding	Upland	8	10* (125%)
Maize	2.Whitegrub	Maize seed dressing with Sevin	Dambo	18	19 (105%)
Maize	3.Termite	Banking/Not banking/Modified Kaselera	Upland	13	9 (69.2%)
Beans	4.Bean Stem Maggot	Seed dressing with Sevin. earthing up. mulching. high density planting. resistant variety (Kaulesi)	Everywhere except Chiradzulu Dambo	36	0 (Bean 'wilting' = 3)
Pigeon Pea	5.*Fusarium* wilt	Resistant variety (ICP 9145). side planting	Everywhere**	36	4 (11.1%)

*2 farmers in the main trial knew about the striga trial through friends

**excluding *Striga* farmers

All farmers with anti-whitegrub treatments on their plot were aware of this. Such knowledge was probably assisted by the fact that the treatment was a chemical seed dressing. The use of a chemical fits with the dominant paradigm of pest control through pesticides. Farmers were asked to soak their beans overnight before planting. In the field. just before the planting. the beans were mixed with the pesticide. The whole process of dressing the seeds was unusual for most farmers and was well observed. The team ostentatiously used unfamiliar safety equipment such as plastic gloves. Since almost all farmers participated in the first year planting. the application of seed dressing to counter whitegrubs clearly made an impression.

Termites as a focal point of the trials were mentioned by 69.2% of farmers. Termite damage to crops is well understood by farmers. The treatment of not banking to reduce termite damage is also common in the project areas. Where farmers did not recognise the treatment purpose. it may be due to the treatment. Modified kaselera. one of the first year treatments. is not practised locally and was widely confused with the practice of mbwera. the moving of the soil away from the ridges into the furrows to plant a second bean or a first field pea crop. Furthermore. modified kaselera did not prove to be a successful treatment against termites which makes it even more unlikely farmers would connect the treatment with the pest.

The importance of being able to observe a pest or a disease as a cause of harm to the plant is illustrated by the example of pigeon pea *Fusarium* wilt. Although it is a well known fact that pigeon peas are liable to *Fusarium* wilt, kunyala, wilting itself is not isolated as a discrete disease in its own right but as a part of a complex of factors that inhibit yield. [*Fusarium*] wilting is thought to be caused by too much rain or too much sun or by other adverse environmental factors. When asked by what criteria they judged pigeon peas, farmers did not mention resistance to wilt but saw this as an element in a variety's capacity to yield. The ability of the plant to resist wilt damage is reduced to one of the qualities of a high yielding variety. Side planting[13] is a common practice in Mombezi EPA. Some farmers may do this in the hope that it reduces wilting but others do it to save space on the ridge. It is likely that some participants did not realise that there was more to sideplanting than this. For whatever reason, despite the project's efforts to explain the pigeon pea trial, only 11.1% of farmers involved said that the variety (ICP 9145) was supposed to be wilt resistant or that the cultural practice (side-planting on the ridge) was being tested to see if it was wilt reducing.

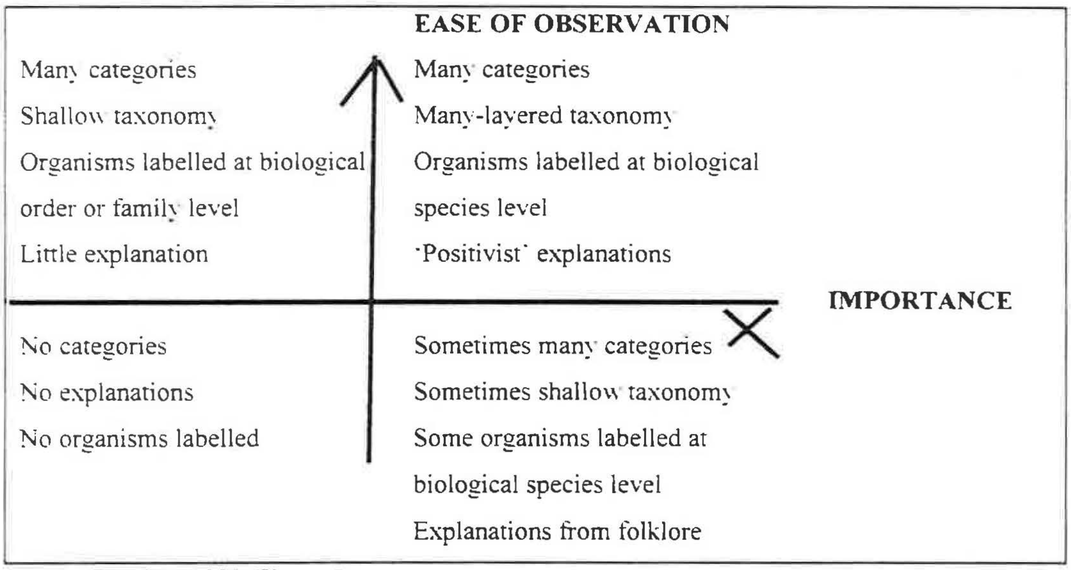
That visibility in the causal chain is important is further demonstrated by the fact that the bean stem maggot was not mentioned by any of the farmers included in this questionnaire despite our discussions during pre-implementation meetings. Three farmers mentioned bean wilting as a problem. The damage caused to the stem by the maggot has a wilt-like effect similar to that caused by too much sun or rain. Beans suffering in this way are said to be 'burned'. The bean stem maggot is not linked to the problem as a causal agent. Another reason that the bean stem maggot was not mentioned by respondents is that it was not a major cause of plant death or damage in either 1996-97 or 1997-98 seasons due to medium to high rainfall. The bean stem maggot becomes a major cause of harvest loss during drier seasons.

The apparent exception to this model is that all *Striga* trial farmers (and a couple of other farmers too) understood the target of the experiments being conducted on their land even though the parasitic nature of *Striga*'s attachment to maize is hard to detect with the naked eye. The reason for this derives precisely from project knowledge of farmer categories of knowledge. The team's awareness of the invisibility of the life cycle of *Striga* meant that the importance of farmer education on the topic was clear from the start. The *Striga* experiment group was small and had intensive and focused interaction with the FSIPMP team on *Striga* biology.

These findings fit a familiar model (see Figure 1). Farmers know most about those problems which are both important and easy to observe such as whitegrubs or termites but less about problems which, although important, are difficult to observe or which share symptoms with other pests, diseases or causes of damage.

[13] It is perhaps relevant that "less wilting" was only one of several reasons for side-planting given by farmers- only mentioned to us by a minority of farmers

Figure 1: Characteristics of four classes of farmer knowledge



(From Bentley, 1992, Figure 2)

When we examine responses to Question 5 not concerned with pests, some further insights arise. Farmers again show their prioritisation of the provision of inputs followed by yield and the opportunity to learn new agricultural practices. Twelve farmers thought that the purpose of the trial was to see how the maize would do without fertiliser. Farmers are continually worried about both yield and fertiliser. One farmer said that she had hoped that we were going to demonstrate hybrids that could give a high yield without fertiliser. Another thought that we were running the trials without fertiliser in order to show farmers how important it was to apply fertiliser (this might suggest that farmers do not overestimate researcher intelligence). One farmer suggested that the *Striga* trial was designed to encourage the emergence of *Striga*, (presumably so that we could then show farmers how to deal with the weed?).

Table 17, Question 5: Answers by category

Answer Type	**Total**
Pests/diseases	51
Fertiliser/Inputs	18
Yield	17
New practices	12
Cultural	2
Experimental	2
Other	2
Total	109

When results were compared between genders, there was little difference. (See Annex B. Table 9 and 10) When a comparison was made between villages, more people mentioned the whitegrub problem in Chiwinja than anywhere else. The explanation for this is most likely to be that the suggestion of a seed dressing originated here and Chitera dambo has a very specific and localised pest problem: the black maize beetle (matono) (Heteronychus lychas) damaging maize.

Question 6: How was contact with the team (1996-97)?

We asked this question to give farmers an opportunity to voice any problems that they might be having in their interaction with the members of the technical team who were visiting the plots regularly to collect data on pests and diseases.

Forty-five farmers (83.3%), out of an eligible sample of 54, said that contact with the team had been good in the 1996-7 season. Ten of these farmers stressed contact had been good because they were taken to the fields and shown what the team was doing. Only five farmers said that contact was not very good and another four said contact was only 'OK'. There was little difference between men and women in the way that they answered this question. Seventy- five percent of men and 83.9% of women said that their contact with the team was good. Men were more critical than women: 18.8% of men and only 6.5% of women said that their contact with the team was not good.

Table 18, Question 6. How was your contact with the team last year (1996-97)? Responses by total and gender

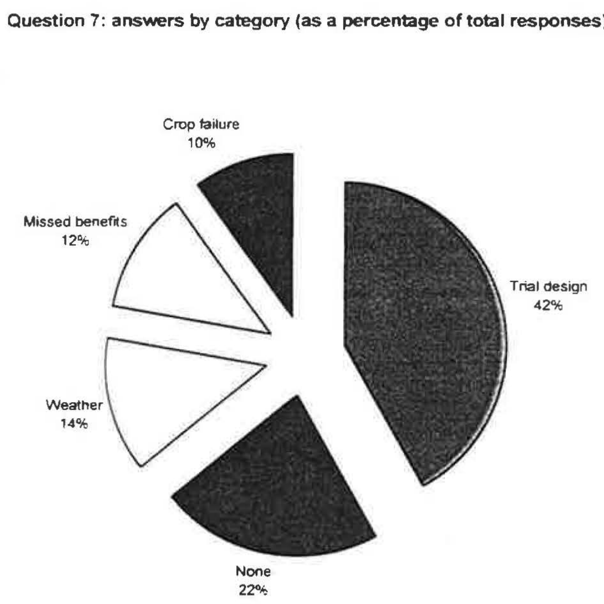
Response	Frequency (53)	Female Respondents (31)	Male Respondents (16)
Good	35 (64.8%)	20 (64.5%)	8 (50%)
Good because we are taken to fields & shown pests	10 (18.5%)	6 (19.4%)	4 (25%)
Not very good	4 (7.4%)	2 (6.5%)	2 (12.5%)
OK	4 (7.4%)	3 (9.7%)	1 (6.3%)
Not good because team did not include farmer	1 (1.9%)	0	1 (6.3%)
Total	53	31 (100%)	16(100%)

Similarly, when we compare the results between villages, there is little difference in reported experience (see Annex C. Table 12).

Question 7: What has been the most difficult aspect of taking part in the trials?

The aim of this question was to give farmers an opportunity to tell us about any aspect of the trial that they found difficult. Project members receive complaints from farmers in the ordinary course of their work but it is very hard to know how widespread feelings are on specific topics. This question and Question 11 below constitute a survey of farmer attitudes in this respect. Answers fell into five categories as Figure 2 shows (totals for respondents and responses for each category are given in Annex B. Table 13).

Figure 2. What has been the most difficult aspect of taking part in the trials?



This question clearly invites negative responses so it was pleasing to see that 18 respondents said that there were no difficult aspects to participating in the trial. Of the other responses. 34 were concerned with aspects of trial design. 17 with the performance of crops given the weather (see Annex C. Table 13) and 10 with side benefits of the project to which some farmers felt they were being denied access.

We look at the two categories of trial design and missed benefit to get an insight into the range of problems identified. We do not look at the categories 'none', weather or crop failure. The latter two catalogue problems about which the project could either do nothing or which it was trying to ameliorate through the trial treatments.

Table 19, Question 7: Complaints concerning trial design

Response	Total
Not using fertiliser so that there was a small harvest	18
Worried whether compensation would be paid	4
Fertiliser timing was wrong	2
Going to the field when tired because the team had come	1
Termite damage due to not banking	1
Other participating farmers are lazy, do not attend meetings	1
Mulching –what was the point?	1
Compensation too small	1
Team should have weeded	1
The maize seed used was hard to recycle	1
The beans were planted too densely	1
Maize stations too far apart	1
Feared crops would not be returned	1
Total	34

Most of the negative replies were concerned with practical aspects of trial design. Eighteen respondents objected most to small harvests as a result of not using fertiliser. (It is not clear if participants realised that they would not have received compensation if the crops had done better. Or would they have preferred, as farmers, to see a good crop in the field rather than receive compensation after the event?) Four farmers admitted that they had been anxious about whether compensation would really be paid. Individuals wondered about the purpose of mulching or queried the planting density and spacing of crops. One farmer complained that he had to weed his own plot. Either he had failed to understand the terms of the 'contract' or was seeking to renegotiate! Another did not like having to visit her plots when tired, also hinting at a preference for minimal engagement.

The second main category of response suggested that the main fault these participants found with the project is that the benefits were limited (see Table 19 below).

Table 20. Question 7: Missed benefits

Response	Total
Wanted to harvest green maize or beans for relish	3
Would like more or all fields used for plots	3
Others (i.e. not the on-farm trial farmer) employed as labourers	2
The team visited the fields without their knowledge so farmers could not learn from them.	2
Total	**10**

The answers demonstrate how concerned farmers were to benefit in material terms from the project through maximising yields. This seems a rational response to the opportunities that this rare contact with resource-rich outsiders should bring.

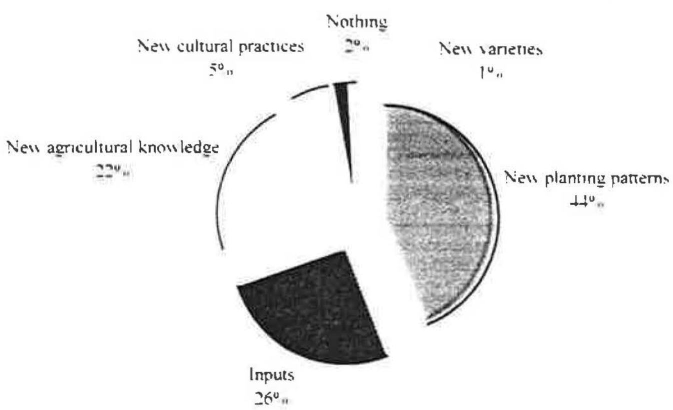
When the responses were compared between genders and across villages, there was no significant difference (see Annex B, Tables 14, 15 and 16).

Question 8: What was the best aspect of taking part in the trials?

Question 8 was designed to balance Question 7 where farmers were asked about the most difficult aspect of trial participation. There were 112 responses to this question from 54 people. The responses fell into six categories as illustrates.

Figure 3. What was the best aspect of taking part in the trials?

Question 8: Answers by categories and as a percentage of total



Four out of six categories cited the opportunity to learn about new techniques or technology as the best aspect of participating in the trial. A fifth response category concerned material inputs such as receiving inputs or getting a good harvest. Only two respondents felt that they had not learnt anything from the trials. The results are presented and discussed by category below

Table 21, Question 8: New planting patterns

Responses	Total (43)
Learning a new spacing pattern for maize	21
The bean planting pattern was new	12
The ridge spacing was new	4
The inter-cropping pattern was new	3
Finding that 3 maize plants per planting station is good	3

Respondents' emphasis on spacing and planting came as something of a surprise since the FSIPMP adopted extension recommendations assumed to be common in the areas concerned. As it turned out, the project spacing pattern of 90cm between maize stations was, on average, 10-30cm wider than farmers' normal distance. The intercrop combination of maize at 90cm distance with two planting stations of beans between them and one of pigeon peas (side and top planted in the first year) was also unusual. Pigeon peas were more normally planted at less frequent intervals, such as at every other maize station and beans were also planted less densely, partly because there was less space between maize stations. Some farmers also do not plant beans and pigeon peas in the same ridges.

Table 22. Question 8: New agricultural knowledge

Responses	Total (25)
Learning new agricultural techniques	15
Early fertiliser works well	5
Tephrosia seems good for maize	2
Consulting with team about problems	2
Importance of fertiliser proven	1

The results in this table include the vaguest response, 'learning new agricultural techniques' where respondents' resistance to probing suggests that they have not really learnt much of use. Five farmers told us that they approved of the early application of fertiliser and two farmers from the *Striga* trial were pleased with the results of using *Tephrosia* as a green manure. Two more farmers said that it was useful to be able to take problems to FSIPM Project members. One farmer thought that the first and second year trials were to prove the value of fertiliser, yet again reminding us of farmers' fixation on fertiliser.

Table 23. Question 8: New cultural practices

Responses	Total (7)
Learning pigeon pea top planting	3
Trying out planting all the crops on the same day	1
Saw that early weeding was beneficial	1
Learning that beans could grow in dambo land	1
Learning weeding without banking	1

As with responses about planting patterns. these comments concern cultural practices that had been thought to be prevalent in the target areas.

Table 24. Question 8: Inputs

Responses	Total (29)
All crops returned to farmer	10
Get inputs	10
Got good harvest /more maize for food	5
Compensation	3
Have less work to do	1

Twenty-nine responses concerned the material advantages gained from taking part in the project. Although the input package is not large. for a proportion of participants. it makes up a significant contribution to their annual requirements. The 13 responses mentioning the return of harvest or payment of compensation further indicate that doubts existed whether the project might take the harvest or fail to pay compensation whatever we had promised.

When we compared replies from men and women (Annex B. Tables 17 and 18) there were no noticeable differences between their content. When looking at villages. there was a marked enthusiasm in Chiwinja for the spacing pattern for maize and the planting pattern for beans.

Table 25. Question 8: Main responses compared between villages (with number of eligible respondents)

Responses	Chiwinja (15)	Kambuwa (12)	Lidala (17)	Magomero (10)
Learning a new spacing pattern for maize	11	3	6	1
Learning new agricultural techniques	3	4	4	4
The bean planting pattern was new	8		4	
All crops returned to farmer	1	5	2	2
Get inputs		6	2	2
Total	**23**	**18**	**18**	**9**

Discussion

Apart from new varieties and crops, most of the new agricultural knowledge farmers cited as a benefit gained from participation in the OFTs is not concerned with pest management. Only one reply, 'learnt weeding without banking' refers to a pest management strategy. The idea that there are varieties resistant to pests or diseases may not be well understood yet by farmers. Rather, what our respondents appear to have taken from the FSIPM Project trials are ideas about cultural practices, agricultural techniques and planting patterns that we had thought farmers already knew and practised.[14] Farmers' enthusiasm for learning relatively simple variations on their own practice proves the importance of running the trials on farmers' own land so that they can see for themselves what impact such variations may have.

Question 9a: What about this year? (a) Did you go to the village meeting? (b) What did you get out of it?

This question refers to the 1997 meetings held to explain the trials to participating farmers. The aim was to get a sense of how well attended the meetings had been and what sort of impact they had.

a) Did you go to the village meeting?

As the table below shows, attendance at the meeting was good.

[14] Naming such minor variations to existing techniques might indicate that farmers have not learnt very much from the trials. However, we must take respondents at face value here.

Table 26. Question 9a: attendance at 1997 meeting (analysis by gender)

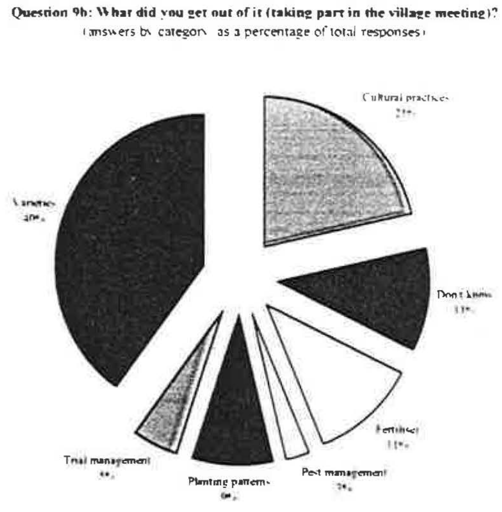
Response	Total (54)	Female respondents (30)	Male respondents (16)	Couples (8)
Yes	39 (72.2%)	22 (73.3%)	11 (68.8%)	6
No	12 (22.2%)	7 (23.3%)	3 (18.8%)	2

One man sent his wife on his behalf. one man said that he did not know about the meeting and one woman told us that she could not remember if she had been or not. However. at any one time. farmers have other calls on their time to prevent them attending meetings. The reasons that were given for non-attendance were that farmers had to attend funerals. were sick. caring for sick relatives or were away from the village. On average. only two to three trial participants per village missed the meeting. When it comes to gender differences. four women admitted that they could not remember anything about the meetings. The man who sent his wife to the meeting on his behalf complained that she had not told him anything about what took place there. There were no noticeable inter-village differences. (See Annex B. Table j)

b) What did you get out of it?

Yet again. while this appears an ambiguous question. we wanted to see what sort of responses farmers might give. As Figure 4 below demonstrates. the result was a wide variation (see Annex B. Tables 19-22)for individual answers in each category). Since Question 10 deals directly with the 1997-98 purpose of trials. it is not worth spending too much time analysing such diverse responses. Nonetheless. this question can serve as an illustration of those issues stuck in farmers' minds and thus act as a guide to interests or concerns.

Figure 4 What did you get out of the trial meeting for 1997-98?



Thirty two farmers mentioned new varieties. Participants are always keen to try new varieties to be compared for yield or speed of maturity. appears to be an element of the trial design that is welcomed and understood. Nine farmers mentioned the use of fertiliser. Farmers also commented on cultural practices. often contrasting what would be done in the current year with the previous year. for example. that there would be no mulching or that there would be beans in the dambo. Other participants noted that they should talk to the team about problems. Yet again. few highlighted the pest management aspect of the trials.

Discussion

The results in the figures above suggest that farmers were more interested in the material content of the trials than their purpose. Where the trials had been changed to meet popular demand. farmers also took note.

Question 10a: What does the project hope to learn from the different varieties of maize, pigeon peas, beans and from the cultural practices [in the trials]? [15]

This question aimed to elicit what farmers knew about the various trials without prompting an answer. The treatment structure for each trial is described briefly by crop after which we look at participants' responses.

Maize

Striga trial

Four of the farmers interviewed took part in a specialist *Striga* trial in the 1997-98 season. Only two of these were respondents to this questionnaire and answered Question 10a. Both knew that the trials on their land were concerned with the prevention of *Striga*.

Main trial

Farmers who were involved in the main trials were given a composite maize variety called Masika dressed (or not dressed) with the pesticide Gaucho against whitegrub attack. Whitegrub is more a problem of the wetter dambo areas but maize seeds in the upland areas were also dressed because some whitegrub attack occurs throughout the area and the pesticide has an anti-feedant effect on termites. Masika was chosen for the 1997-98 trials in response to farmers' requests for a recyclable variety. Question 10a aimed to capture farmers' ideas about the maize and the maize treatment. (The other element of the maize trial was to test weeding only as the second weeding practice to prevent termites causing maize plants to lodge (rather than banking up ridges) and is discussed in Question 10d which asked specifically about cultural practices).

[15] For a description of the trials, see 'Proposals for on-farm pest management field trials, 1997-98 season', (ed) J.Mark Ritchie, FSIPM Mimeo, 1997

Table 27, Question 10a: purpose of the maize trial

Response	Frequency	% of respondents (54)	% of responses (70)
Seed dressed and undressed –whitegrub attack	15	27.8%	21.4%
Varietal quality/recycling	9	16.7%	12.9%
If maize variety is suitable for this soil/high yielding	7	13.0%	10%
Has forgotten/doesn't know	7	13.0%	10%
Other	32	59.3%	45.7%
Total	70	n	100

The main results suggest that about a third of farmers remembered that the maize had been treated to prevent whitegrub damage. A third (16.7% + 13.0%) assumed that our interest lay in the variety itself, in particular, whether it would recycle well or whether it would prove high yielding in their area[16]. Just over a tenth of farmers were unsure as to the purpose of the trial.

The answers given by men and women were compared for differences.

Table 28, main answers given by women to Question 10a

Response	Frequency	% of respondents (32)	% of responses (39)
Seed dressed and undressed –whitegrub attack	11	34.4%	28.2%
Varietal quality/recycling	5	15.6%	12.8%
Has forgotten/doesn't know	4	12.5%	10.3%
Mankhwala to control termites	3	9.4%	7.7%
If maize variety is suitable for this soil/high yielding	3	9.4%	7.7%
Other	13	40.6%	33.3%
Total	39	N/A	100%

[16] There was no overlap in these answers.

Table 29. Question 10a: main answers by men

Response	Frequency	% of respondents (14)	% of responses (22)
Seed dressed and undressed –whitegrub attack	3	21.4%	13.6%
Has forgotten/doesn't know	3	21.4%	13.6%
Varietal quality/recycling	2	14.3%	9.1%
If maize variety is suitable for this soil/ is high yielding	2	14.3%	9.1%
No seed dressing	2	14.3%	9.1%
To introduce new variety	2	14.3%	9.1%
Other	8	57.1%	36.4%
Total	22	N/A	100%

More women (34.4%) than men (21.4%) mentioned seed dressing against whitegrubs and 14.3% of men said that there was no seed dressing in the trial. Three women told us that the seed dressing would also have an effect on termites. About a fifth (21.4%) of men said that they had forgotten or did not know what this aspect of the trial was about compared with only 12.3% of women . Both men and women thought that a feature of the trial was to assess the suitability and recyclability of a new variety.

We next compared the top four answers between villages.

Table 30: Comparison of top four answers to Question 10a between villages

Response	Chiwinja	Kambuwa	Lidala	Magomero
Seed dressed and undressed against whitegrub attack	7	4	3	1
Varietal quality/recycling	1	3	3	2
Has forgotten/doesn't know	3		3	1
If maize variety is suitable for this soil/high yielding		1	2	4
Total responses per village	**11**	**8**	**11**	**8**
Total respondents per village	**15**	**10**	**17**	**12**

It was striking that half the participants in Chiwinja (most of whom were women) were aware of the seed treatment of maize against whitegrubs while elsewhere the proportion was much lower. The reason for this is likely to be that the original idea for seed dressing against whitegrubs originated from a farmer in

Chiwinja. Mai Mpoya. although she and her relatives had used a different pesticide. Sevin. that the FSIPM Project tested in 1996-97 and found too toxic. Nonetheless. it appears that the idea of a seed dressing had been better understood in Chiwinja than elsewhere.

Discussion

From these results. it seems in the case of seed dressing against whitegrubs that. in contrast to the year before. their understanding of a straightforward treatment against a well known and easily visible pest was poor. This is perhaps due to the fact that the sample group is much larger and a high number of farmers were not involved in planting in 1997-98. This was not the case in 1996-97 or 1998-99. Another problem might have been that many upland farmers would not have connected seed dressing with whitegrubs or termites. If one takes the 29 dambo farmers as the sample. then 51.7% were aware that the purpose of the seed dressing was to reduce whitegrubs attack.

Pigeon Peas

Pigeon peas were intercropped with maize in the main trial and the *Striga* trial. In the 1997-98 season. the project continued to plant the wilt resistant variety. ICP 9145. and tested two long season cultivars new to farmers. ICEAP 00040 and ICEAP 00053. A local variety was grown as a control. ICEAP 00040 and 00053 are wilt-resistant Kenyan landraces that were being multiplied by ICRISAT for release to farmers.

Table 31. Question 10b: main answers

Response	Frequency	% of respondents (58)	% of responses (96)
To find highest yielding variety	19	32.8%	19.8%
To see if varieties are suitable to their soil /area	17	29.3%	17.7%
To find wilt resistant varieties	16	27.6%	15.8%
Four varieties	12	20.7%	11.9%
To find high yielding variety suitable to area	3	5.2%	3.1%
Other	29	50%	30.2%
Total	96	N/A	98.5

Just over a quarter of respondents spontaneously mentioned wilt resistance. Nineteen respondents said that they thought the purpose of the trial was to find a high yielding variety and 17 that it was to see how suitable the variety was for the area. Three people gave both answers, saying that the purpose was to find a high yielding variety suitable for the area. Clearly, all 39 respondents (67.2%) were saying much the same, that our interest lay with the possibilities for varieties with high yield qualities in the context of the particular area. A fifth of farmers said only that there were four varieties. Implicit in this statement is the suggestion that the project was interested in comparing the four varieties and if comparing, yield would be the most likely criterion.

Table 32, Question 10b: main answers from women

Response	*Frequency*	**% of respondents (33)**	**% of responses (61)**
To find highest yielding variety	14	42.4%	23%
To see if varieties are suitable to their soil /area	11	33.3%	18%
Four varieties	10	30.3%	16.4%
To find a wilt resistant variety	8	24.2%	13.1%
To find high yielding variety suitable to area	2	6.1%	3.3%
Other	16	48.5%	26.2%
Total	61	N/A	100

Table 33, Question 10b: main answers from men

Response	**Frequency**	**% of respondents (16)**	**% of responses (23)**
To find a wilt resistant variety	5	31.3%	21.7%
To see if varieties are suitable to their soil /area	4	25%	17.4%
To find highest yielding variety	2	12.5%	8.7%
Four varieties	2	12.5%	8.7%
Three varieties	2	12.5%	8.7%
Disease resistant	2	12.5%	8.7%
Other	6	37.5%	26%
Total	23	N/A	99.9%

When the answers given by men and women are compared, twenty seven out of thirty three[17] women replied in terms of yield and suitability of variety whereas only five out of sixteen men did so. A quarter of women and a third of men knew that the project was seeking to identify wilt resistant varieties. Four out of sixteen men were not sure how many varieties of pigeon pea had been planted.

Answers were similar across the villages except in Chiwinja where only one person mentioned wilt resistance (see Annex B, Table 23).

Discussion

At first sight, it may appear disappointing that less than a third of participants cited wilt resistance as the purpose of the pigeon pea varietal trial. However, as has been discussed above, in the experience of the FSIPM Project, farmers evaluate pigeon pea varieties in terms of yield whilst other qualities such as pest or disease resistance are subsumed under yield. This amalgamation of factors contributing to yield makes it likely that spontaneous responses would indicate interest in yield rather than wilt resistance.

Women seemed more convinced than men that a high yield in the context of their area was the reason for including pigeon peas in the trials. The explanation may be that pigeon peas are regarded as a woman's crop and consequently, women take a greater interest in new varieties. This might also explain why nearly a third of men questioned were not sure how many varieties were planted.

Beans

In the 1997-98 trials, all participants grew beans apart from those in the *Striga* trials. The varieties tested were chosen because they were believed to have some resistance or tolerance to the bean stem maggot (BSM). Kaulesi, an early maturing variety known to farmers and grown in the first year of the trials was used as a local control. The project tested two high yielding varieties from the Andean gene pool, provided by the CIAT bean programme, Napilira (CAL 143) Nagaga (A197), newly released in November 1995. The fourth variety, Kalima, also high yielding, was released by Bunda College in 1997 and was also thought to have some tolerance of BSM. The main responses are presented below

[17] Two women gave both answers.

Table 34. Question 10c: main answers

Responses	Frequency	% of respondents (55)	% of responses (107)
High yielding	21	38.2%	19.6%
Suitable for area/soil	13	23.6%	12.1%
High yielding and suitable for their area	10	18.2%	9.3%
There are 4 varieties	21	38.2%	19.6%
Early maturing	11	20.0%	10.3%
Other	31	56.4%	29%
Total	107	N/A	99.9%

Effectively, all farmers saw the bean trial as a test of varieties. By this stage, the FSIPM project had also accepted farmers' criteria in judging beans. Although technical causes of death continued to be assessed, the final arbiter of success must be yield. There was no significant difference between men and women in the way they answered this question nor between villages (see Annex B, Tables 24, 25, 26).

Discussion

It appears that farmers, regardless of gender or village, saw the trial as concerned with the amount of yield from the four varieties in the trial under the particular growing conditions of the area. Given that in both 1996-97 and 1997-8, beanfly attack was relatively light and that these varieties were bred to be high yielding, this seems a fair assessment of the trial. The early maturing quality of Kaulesi has also featured positively in farmers' evaluations of the trials. Farmers in Lidala appear to have taken particular note of high yielding qualities and of early maturing varieties.

Cultural practices

This question aimed to find out if farmers understood why, in the majority of plots, for the second weeding practice, the project had asked that two subplots be banked up and the other two merely weeded. The purpose of this with and without treatment was to observe whether termite attack is reduced when the ridges are not banked but weeded. The hypothesis is that the extra vegetative matter placed around the roots of the maize plants by banking attracts termites. It was also to see what other benefits or disadvantages might arise from either practice and to elicit farmers' views (for example, plants are more likely to lodge because of heavy rain or wind when the roots are not supported by banking up). Trial participants with plots in the dambo areas of Lidala and Chiwinja were asked to bank all their plots, however, because there was a reduced risk of termites and considerable danger of waterlogging. Dambo farmers in Chiradzulu and *Striga* farmers for whom it was not a part of their trial are therefore excluded from this section of the questionnaire.

Table 35. Question 10d: Main answers

Responses	Frequency	% by respondents (39)	% by responses (71)
Banking half plots and not banking other half to assess termite attack	19	48.7%	26.8%
Banking half plots and not banking other half	8	20.5%	11.3%
Termites	2	5.1%	2.8%
Yield	11	28.2%	15.5%
Banked all plots	6	15.4%	8.5%
Other	25	64.1	35.2
Total	71	N/A	100.1%

When we examine the first two responses ('banking half the plots and not banking the other half' and 'termites'), it emerges that 19 respondents out of 39 both described the practice and gave the reason for it. Two respondents told us that the treatment was against termites and eight described only the practice without explaining why it was done. This means that approximately half of our respondents volunteered the correct reason for this aspect of the trial. Six respondents told us that they had banked all plots which means that they either did not understand the instructions or the purpose of the trial or they considered banking up the ridges to be a better practice in terms of the ultimate yield.

A similar pattern is found when the figures are broken down for men and women (Annex B, Table 27.28). Seven women made it clear that the purpose of the weeding and banking experiment was to assess termite damage while four mentioned only banking and two mentioned termites alone. This means that just under half of the women understood the purpose of this aspect of the trial. Six men described the experiment and said that it was against termite attack while three mentioned the practice but not the purpose.

Table 36. Question 10d: Comparison of answers between villages

Responses	Chiwinja	Kambuwa	Lidala	Magomero
Banking half plots and not banking other half to assess termite attack	2	6	5	6
Banking half plots and not banking other half	0	2	4	1
Termites	1	1	0	0
Yield	0	3	5	3
Banked all plots	4	1	0	1
Total responses per village	**7**	**12**	**14**	**11**
Total respondents per village	**9**	**9**	**10**	**11**

When comparing those who both described the practice and gave the reason for it across villages, we find a similar pattern across the villages except perhaps in Chiwinja. Only three respondents in Chiwinja were clear that the trial was concerned with crop loss from termites and four respondents banked up all their plots.

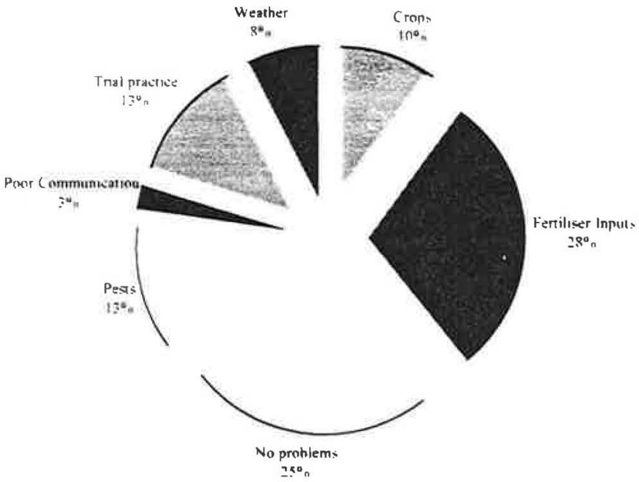
Discussion

The answers to this question show greater awareness of pest management practice than we found when looking at farmers' understanding of the purpose of the different varieties being used. Since weeding without banking to prevent termite damage was already known to some farmers in Chiradzulu, this practice may have been easier to understand than, for example, varietal resistance since it is possible that farmers may not be familiar with varieties that are resistant to pests or diseases.

Question 11: What problems, worries or expectations do you face with the plot?

The aim of the question was to give farmers an opportunity to voice any opinion or anxiety they might have concerning the plot and, by association, the trial and the project. There were 79 responses from 56 interviews. Many respondents ignored the part of the question concerning expectations and dealt with the issue of problems or worries. Rather than look at individual answers (see Annex B, Table 29), however, it is more interesting to consider the categories into which these fell (Figure 5).

Figure 5. What problems, worries or expectations do you face with the plot (1997-98)?



It is encouraging that a third of respondents stated that they had no problems with the plots. The other categories are discussed individually in the following sections.

Table 37. Question 11: Fertiliser/Inputs

Response	Frequency of responses
Fertiliser applied too early	11
No second application of fertiliser/not enough fertiliser	10
Thinks two types of fertiliser were applied early and that this was wrong	1
Project did not use pesticides	1
Total	**23**

Nearly a third of all responses were concerned with the project's use of fertiliser. For the majority of Malawian smallholder farmers, fertiliser is a crucial but expensive input. The extension recommendation is that there should be a basal fertiliser dressing at two weeks and a top dressing two to four weeks after this.

However, many cannot afford fertiliser or cannot afford fertiliser for all their fields or all their maize.[18] Similarly, few can follow extension recommendations and many of those who manage to buy fertiliser only have enough to apply it once. The preferred stage of plant growth for this application is just before the maize plant tassels, that is, prior to cob production.

In the second year of the FSIPM Project trials, fertiliser (at the rate of 50 kg/N/ha) was applied once as a basal dressing, dolloped either side of the plant, just after plant emergence. As farmers' comments reveal, our practice did not fit with local practice or understanding of best practice. When farmers had observed the post-emergence basal application of fertiliser on the plots, most assumed that this would be followed by a second application later on and were disappointed and worried to discover that this was not the case.

What underlies these complaints by trial participants is a local model of plant growth and health in contradiction to that of agricultural scientists. The local model works in the following way: fertiliser should be applied just before tasselling so the extra nutrients can be used to generate healthy and abundant cob production. In this way food production is maximised. If fertiliser is applied earlier than this, the goodness in the fertiliser is wasted on foliage and root production and does not result in extra food.

By contrast, agricultural research suggests that if fertiliser is applied at or soon after planting, faster root establishment and more rapid vegetative growth take place, producing a healthier plant and improved cob production. Cob production is determined by about 6-8 weeks after which the addition of nutrients offers no benefits. Late application of fertiliser is therefore less beneficial than earlier application. The one problem encountered with early application is that nutrients can be leached from the soil by heavy rainfall.

The other issue here is that farmers found it hard to understand why the project was not following best practice as they knew it. In the 1997-98 season, we had abandoned our policy of mounting trials without fertiliser to model the farming practice of the most resource poor (i.e. no fertiliser), a policy that had much confused farmers and led to many complaints. However, we seem to have continued to worry farmers by neither applying fertiliser twice nor applying once at the time they considered most beneficial.

Similarly, one farmer complained because we did not use pesticides to treat pest problems. This participant, a relatively well-off, retired schoolteacher, found it odd that the project did not do what it could to maximise yields. While it is disappointing that more of the project purpose and philosophy had not been absorbed by the farmer, his comments reveal more of the model of best practice discussed above. That is, a solution to the problem of pests exists in the form of pesticides. Since the FSIPM Project is clearly not

[18] The FSIPM 1996-97 Baseline Survey of 120 households in the target villages found that forty-five percent of the area planted to maize was unfertilised. Averaged across fertiliser users, fertiliser application on the area planted to maize was 53 kg N ha and 64 kg N ha on the area planted to maize which received fertiliser. (A.Orr et al. 1997:4)

short of resources. why does it not make use of the best technology available? Once again. it is clear that the notion that the trials were designed to emulate local conditions in order to produce appropriate and affordable technologies is in conflict with farmers' desire to have access to the best technology and the greatest yield this affords through the medium of the project.

Table 38. Question 11: Trial practice

Response	Frequency of responses
Plots are too small. should be extended to give more yield	5
Did not want to bank plots	1
Relay beans planted too early	1
Pigeon peas a waste of time because of wilt	1
Only need one variety of beans. should choose best	1
Mbwera beans fail when grown next to pigeon peas	1
Total	**10**

Identical concerns appear when we look at the comments under the category 'trial practice'. Five farmers would like to see a larger area used for the plots to have more inputs and a bigger harvest. Farmers' main agenda regarding the project is to improve their food security as much as they can in the immediate future. The comment about only needing the best variety of beans shows that this farmer had not taken the experimental and participatory approach on board since the project aim was that farmers should be telling us which bean was best from observing the trials. It is not clear whether the Matapwata farmer who suggested abandoning pigeon peas in the trial understood that wilt resistance was the trial purpose. The poor performance of pigeon peas in Matapwata as a whole means that varietal resistance has made little headway in improving yields.

Table 39, Question 11: Pests

Response	Frequency of responses
Whitegrubs	2
Termites	2
Pests on beans	2
Pests on pigeon peas	1
Chiwawu ('burning' of leaves/some sort of blight)	2
Cowpea pests	1
Total	**10**

Only four responses spontaneously mention two project target pests as a problem. This may appear unsatisfactory but should not be given too much weight, since, in the previous question, respondents had discussed the purpose of the trials at length.

Two respondents complained that they had not been kept informed of what was happening in the plots. The other categories of responses, a total of 14 comments, concerned problems with the crops caused mostly by the weather (see Annex B, Tables 31 and 32).

When we compared the answers given by men and women, little difference was evident (see Annex B.Tables 34 and 35). A greater proportion of men than women said that they had no anxieties concerning the plots. Two men felt that they were not being kept informed about what was happening on the plots this year.

Table 40, Question 11: main answers compared between villages

Response	Chiwinja	Kambuwa	Lidala	Magomero
None	3	6	7	2
Fertiliser too early	4	2	5	0
No second application of fertiliser/not enough fertiliser	2	3	5	0
Too much rain (later on affecting yield)	3	0	2	0
Plots small so yield results too small/want plot extended	0	0	2	3
Total no. of respondents	**15**	**12**	**17**	**12**

Table 11 shows that there were some differences between villages. No one in Magomero complained about the project's use of fertiliser. Was this because there was better project extension work in this village? Problems with too much rain late in the season only applied to the northern area.

Discussion

The results of Question 11 show us that farmers' concerns lie squarely with maximising the yield from the trial plots in the current season. To this end, farmers took issue with the project's reluctance to adopt best practice or at least local practice of fertiliser use, suggested that we should expand the plots or regretted damage caused to the plots by pests, diseases or adverse weather conditions. What is interesting, however, is what we learn about farmer models of plant growth and the optimum time for fertiliser application which led farmers to disagree widely with researcher practice. Fertiliser, the key input, is yet again the cause of most controversy.

Question 12: How has been your contact with the team (1997-98)?

The question aimed to give farmers a chance to voice their opinion of their contact with the technical team in the 1997-98 season who, through their weekly monitoring activities, have been the interface between farmers and the rest of the project staff. There had been individual complaints that participants were not meeting the team as often as they would like and we were anxious to see how widespread was this problem. Great care had been taken in the first year of the trials to make sure that farmers participated in planting the plots and in all major activities thereafter, there was some anxiety that this involvement had been allowed to slip in the second year.[19] Fifty-five respondents were eligible to answer this question and we received 106 comments.

Table 41. Question 12: responses by category

NEGATIVE	Frequency	POSITIVE	Frequency
Did not participate in fertiliser application	16	Still good /very good	36
Did not participate in planting	10	Participated in planting	13
Very little contact/ no feedback	7	Participated in fertilising	8
Contact not as good as last year	4	Better this year than last year	2
Has questions s/he has not been able to ask	3	Good because did not take much time	1
Did not get much information	3	Same as last year	1
Team always seems in a hurry	2		
Total	**45 (42.5%)**	**Total**	**61 (57.5%)**

[19] In the third year of the trial, farmer participation has been diligently pursued. Following discussions with farmers about which activities they wanted to take part in, their inclusion in key activities has been closely monitored.

It was reassuring that 36 (65.4%) farmers said that contact was either good or very good and that nearly sixty percent of comments were positive. Only 19 of the negative comments referred directly to day to day contact with the team. The figures on participation in planting and fertilising cannot be taken as indicative of trial wide experience, unfortunately, because this information was volunteered by a subset of respondents, twenty five in total. Out of the this group, however, thirteen had taken part in planting while ten had not and eight had taken part in applying fertiliser while sixteen had not. This experience suggests that anxieties about farmer participation in 1997-98 were not misplaced.

Table 42. Question 12: main answers by women

Responses	Frequency	% of respondents (31)	% of responses (60)
Still good /very good	20	64.5%	33.3%
Did not participate in fertiliser application	9	29.0%	15%
Participated in planting	7	22.6%	11.7%
Did not participate in planting	6	19.4%	10%
Other	18	58%	30%
Total	60	N/A	100

Table 43. Question 12: main answers by men

Responses	Frequency	% of respondents (16)	% of responses (37)
Still good /very good	9	56.3%	24.3%
Did not participate in fertiliser application	7	43.8%	18.9%
Participated in planting	6	37.5%	16.2%
Did not participate in planting	4	25.0%	10.8%
Participated in fertilising	4	25.0%	10.8%
Other	7	43.4%	18.9%
Total	37	N/A	99.9

The main difference between men and women appears to be that a higher proportion of women than men stated that they had taken part in planting and a greater percentage of men than women complained that they had not been included in the fertiliser application.

Table 44. Question 12: inter-village comparison

Responses	Chiwinja	*Kambuwa*	Lidala	Magomero
Still good /very good	11	8	9	8
Did not participate in fertiliser application	8	1	5	2
Participated in planting	5	3	4	1
Did not participate in planting	4	1	4	1
Participated in fertilising	1	3	4	0
Very little contact/ no feedback	2	2	1	2
Total no. of responses	**31**	**18**	**27**	**14**
Total no. of respondents	**15**	**12**	**17**	**11**

When inter-village experience is compared, it appears that there were more complaints from Mombezi EPA about being not taking part in planting and fertilising than from Matapwata EPA. Otherwise, approval is fairly distributed across the villages.

Discussion

Farmers were, on the whole, positive about their interaction with the project technical team. One of the most interesting comments came from an older woman farmer, sole head of a household, who told us that interaction was good because 'it did not take up much time'. This indicates that one criterion for her involvement in the project is that it should not encroach too much on her other activities. Presumably every farmer makes a rough cost-benefit calculation along similar lines.

4.0 Conclusions

The objectives of this research were

1. To understand better the context regarding attitudes to development interventions into which the project had been introduced.
2. To identify barriers to farmer understanding.

It became clear from these interviews that the FSIPM Project was very novel in purpose and style for all villages. Farmers had much less context in which to place the project and its objectives than we had imagined. There had been little history of success with agricultural interventions: about 65% had failed. (only two farmers mentioned demonstration plots). Villagers had never been asked to take part in technology testing or evaluation. There may have been some research but if so it was extractive. Finally, the notion that experimentation aimed at fitting in with existing farming systems was quite new.

Suspicions about the intentions of the project were also more widespread and serious than we had realised. Although farmers told us that their own expectations were broadly positive from the start, they recounted their fellow villagers' opinions in much more negative terms. Members of the FSIPM Project found some of the rumours about our intentions quite shocking, for example, that we would steal land and the owners would be resettled, that there might be a return of forced labour (thangata) or that chiefs were collaborating to sell their people to the Chinese.[20] Perhaps it is a reflection of the newness of the current political dispensation that some villagers might think such things possible? Certainly it suggests that memories of the colonial period are still strong.

How well did farmers understand our project? Farmers showed that they best understood the whitegrub, termite and *Striga* trials. This fits experience elsewhere in pest management research. Participants understood the purpose of the trials where the pest was visible, was considered a serious problem and the treatment was either easy to understand or where training was provided on pest or disease biology. Where the pest or disease was much less visible, possibly less serious and the treatment less intuitively obvious, as with pigeon pea wilt or BSM, the purpose appears to have been grasped only by a minority. We should also stress that where most farmers had little or no knowledge of the pest or disease or their effects, they will not have been looking for treatments for the pest or disease. These findings suggest that it is hard to overestimate how much training or education about pest or disease biology is required where a treatment or pest is not visible but important.

The responses to these questions have been exhaustively analysed to see if there is any variation in the nature of responses from men and women. It appears that the project can congratulate itself on a lack of gender bias. While there is some evidence (Questions 1 and 2a) that men found the project easier to understand at the start due to previous experience, overall there is little difference. Women seemed more aware of the content of trials involving legumes which would fit with their greater interest in legumes.

Allowing for differences in resources, there is, of course, variation between farmers in enthusiasm, interest or capacity to understand which researchers should not underestimate as a factor when setting up on-farm trials. This is particularly true where a sample is selected rather than volunteers. Where farming is an everyday activity, enforced rather than chosen, similar to housework or cooking in developed countries, some farmers will be diligent experts, some competent and some neither very good nor very interested. We do not expect everyone to be a cordon bleu cook or a superb housekeeper, why should developing country farmers all be keen or expert? Similarly, agriculture contributes different proportions of overall income according to a household's overall package of livelihood strategies.[21] Some so-called 'farmers' may earn a greater part of their income from marketing or off-farm labour. A project such as the FSIPMP must, therefore, expect to find gradations of engagement among trial participants. This must be a part if not the whole explanation of why some farmers have participated as fully as they could (and been labelled 'good' farmers). At the other end of the spectrum, others have been harder to involve in monitoring, evaluation or even plot management once the inputs are distributed (and have been labelled 'bad' participants). A third group lies in between these extremes.

A further problem identified by this research concerns the quality of the feedback we receive as a project. During interviews with farmers for this research, project staff sometimes felt that the responses they were getting were bland and that some farmers did not say what they really thought. We had assured farmers that their comments would not be individually attributed and explained that we were asking a large number of participating farmers their opinions so that we might put all the answers together to understand the larger picture. Did farmers believe us? Should they have believed us? Questionnaires to garner opinion are a new phenomenon and not well understood. Criticism of high status outsiders and government officials – to their faces – runs counter to cultural norms of respect, humility and the obligation to avoid open confrontation. In general, Malawian society is characterised by low levels of trust and, historically, open feedback of problems to the authorities has not been encouraged.[22]

We might also ask why many respondents should take the risk of finding fault with a project providing free inputs, when little in their experience encourages them to feel a sense of ownership towards the trials. It is noticeable, that resistance to the project has come over key resources or where local frameworks of understanding differ from project models. The principal example is fertiliser. Not only whether or not it should be applied but also when it is most efficacious. Apart from this example, the most open criticisms came from the case study households in Magomero village who had become familiar with social anthropology team members and used to exchanging information on a variety of topics. Even with these households, negative comments tended to be teased out of the respondent by other members of the

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[20] This rumour is worse than it appears since there is a folk belief that the Chinese and Japanese may be cannibals.

[21] We know of households where a wife or mother spends most of her time on marketing and leaves most agricultural work to teenage children or hired labour because marketing is a more successful and reliable form of income.

[22] A low trust society is characterised by an absence of trust between individuals who are not related to one another so that there is a weak basis for the construction of new social or economic groups outside of kin groups or the state. (Fukuyama, 1995:57) Reasons for the absence of trust vary according to the specific historical, social and cultural context. In Malawi's case, one might point to a history of social disruption and migration, the colonial experience, the MCP regime, widespread poverty, the prevalence of witchcraft beliefs and even tensions between particular family structures (matrilineal or patrilineal) and changing systems of gender relations.

household such as a son or a sister who would challenge the respondent to say what they had really said or thought.

Distrust of outsiders and a history of bad experiences with development project make the task of a project aiming at a participatory relationship difficult even before one considers to what extent the agenda of villagers and of the project coincide. One aspect of the context regarding attitudes to development interventions that has emerged is that barriers to communication exist because farmers and researchers have different agendas. This may mean that participants pursue different ends through the same activities but do not wish to talk openly about their different ends.[23] The results of this questionnaire strongly suggest that if the project had been able to carry out a needs assessment, few farmers would have asked for a pest management project. Throughout the life of the project, farmers have shown more active interest in gaining access to inputs, particularly fertiliser, than to any of the pest management technologies (see Questions 4, 5, 7 and 11 in particular). The realisation that not all farmers suffered equally from pest damage led the project in the final year of trials to work with specialist problem groups. Encouragingly, however, many farmers said that the best aspect of the trial was the opportunity to learn about new methods or technologies in agriculture (see Questions 5, 6, 7 and 8) even though, to the project, these were not much different to existing practices. There is no doubt that participants enjoyed the chance to try out new varieties.

The project's agenda, by contrast, was to identify pest management strategies for resource poor households that fitted into local farming systems. This mitigated against a large package of inputs and meant that we had to take local conditions and evaluation on board at all times. However, for many farmers, contact with the project should have provided access to the best model of farming practice, to fertiliser, pesticides and the latest knowledge imported from centres of excellence. This is another reason for variation in interest and cooperation. Some farmers have taken the project goals on board in so far as they can and enjoy working with the team. For others, it is a useful if minor contribution to income, but not one for which they can spare much time or energy. For others, it is a frustration that the needs they identify as important cannot be met more easily through their contact with a resource-rich project. This variation in engagement with project objectives must be set in the context of declining food security and farmers' knowledge that the project has a limited life span.

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[23] It is a truism of late 20th century social science that knowledge 'emerges out of a complex process involving social, situational, cultural and institutional factors' (Long and Long, 1992, p211). This insight has certainly proved true in research activities carried out by the FSIPMP team. The social anthropology team has encountered a number of situations where it has been clear that individual opinions given in a 'safe' environment can be very different from those expressed by individuals in more formal contexts or in groups. Work done by the socio-economic team on local management techniques for termites and whitegrubs also demonstrates that investigations in groups can suppress information about individual strategies.

It is important that any project acknowledges that participants are operating in their own 'life worlds' and that they will not necessarily share our view of agricultural or project priorities unless these are verified in advance (and even then there will be different levels of engagement). Throughout these interviews we listened to participants reiterate their concerns and priorities (fertiliser, inputs, more land, less labour, less time) but taking care not to appear ungrateful or, for the most part, to take issue with the main project purpose. Rather, participants, where they can, negotiate at the margins for what they want from us. This may not be the same as what we want from them. For us, the objectives of the project dominate the landscape, for farmers, the trial plots are a small part of their lives and livelihoods. Each individual has a set of problems they prioritise and seek to solve through whatever means become available. Trial participants must be viewed as actors, with their own agendas, who have negotiated for the best deal they can from the project and from the trials whether in terms of pest management technology, new varieties, or as little bother as possible.

However, the project, through constant interaction with farmers during implementation, monitoring and evaluation activities has listened to farmers' concerns and done its best to respond to them. Participation has improved (if unevenly over the three years).[24] The project has acknowledged that the criteria of yield or time of yield prevail where the need for food security is paramount. Trials have been simplified, disliked technologies dropped and there has been consultation about when and why we should meet. Where farmers and researchers have very different views about practice, as with fertiliser timing, further research has been carried out or trials have been set up so that we can learn together about what works best. Perhaps the most important lesson is that the FSIPM Project has had to prove itself to trial participants in order to achieve the level of cooperation and mutual understanding that now exists.

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[24] What further research is suggested by these findings? A pivotal group in the implementation of the project have been junior technical staff. Interaction between frontline workers and farmers is a crucial 'interface' in an on-farm research project. Their role has been hinted at when we asked participants about their contact with team members but has not yet been explored in any detail. How do such frontline workers perceive the aims of the project and what, for them, are the main barriers to fulfilment? How well are participatory intentions at the main office translated into action?

References

BENTLEY. J.W. (1991) The Epistemology of plant protection: Honduran campesino knowledge of pests and natural enemies. In: Proceedings of a seminar on Crop Protection for Resource-Poor Farmers. 4-8 November. 1991. CTA/NRI. Isle of Thorns Conference Centre. Sussex. United Kingdom.

FUKUYAMA. F. (1995) TRUST: *The Social Virtues and the Creation of Prosperity*. Penguin Books.

LAWSON-MCDOWALL. J and JERE. P. (1996) Selection of farmers for participation in on-farm trials. FSIPM Project. October 1996. Mimeo.

LONG. N and A. (Eds.) (1992) *Battlefields of Knowledge: the interlocking of theory and practice in social research and development*. Routledge.

ODA/MALAWI GOVERNMENT (1995) Project Memorandum for the Farming Systems Integrated Pest Management Project. Mimeo

ORR. A & KOLOKO. A. (1998) "Why don't they weed?" Researcher recommendations and farmers' weeding decisions in southern Malawi. FSIPM Project. August 1998. Mimeo.

JERE. P (1997) Integrating farmer evaluations in IPM research: concepts. experiences and lessons. FSIPM Project. August 1997. Mimeo.

QUIROS. C.A. GRACIA. T and ASHBY. J.A. (1991) Farmer Evaluations of Technology: Methodology for Open-ended Evaluation. Instructional Unit No.1. CIAT (Centro Internacional de Agricultura Tropical) Publication No.192. Colombia.

RITCHIE. J.M (Ed) (1997) Proposals for On-Farm Pest Management Field Trials. 1997-98 Season. FSIPM Project. November 1997. Mimeo.

ANNEX A: QUESTION CHECKLIST

CHECKLIST: FARMERS EXPERIENCES. EXPECTATIONS. ANXIETIES AND SUSPICIONS OF THE FSIPM PROJECT AND OTHER INTERVENTIONS

Farmer Name:		OFT/Non OFT	
Cluster:		Interviewers:	
Date:			

1.Have you had any previous experience here or elsewhere with outsiders and projects [agricultural. health. education or otherwise]? Have any projects failed to start that were promised?

- 'outsiders' can be anyone Research Station. Extension Officers. Projects. MP's. Parties. Religious Organisations
- who what. when. how it was perceived - success. failure

2. Expectations and suspicions

(a) What did you think or expect last year when the FSIPM project came to the village?

(b) What were other people saying?

(c) Did you go to any introductory meetings?

(d) How was the text that was handed out - were you or someone in your family able to read it?

3. Did you wonder why you had been chosen?

4. What did you hope to see on the plots?

5. Last year. what did you understand to be the purpose of the trials?

6. How was contact with the team?

7. What has been the most difficult aspect of taking part in the trials? Did you have anxieties or disappointments?

e.g. using your land, strangers coming and going, compensation, lack of fertiliser, not knowing what to do on your plot, wanting to do something but not being able to e.g. harvest when hungry

8. What was the best aspect of taking part in the trials?

9. What about this year (1997-98)? Did you go to the village meeting? What did you get out of it?

10. What does the project hope to learn from the

a) Maize	
b) Pigeon pea varieties	
c) Bean varieties	
c) Banking/not banking	
d) Seed dressing	

11. What problems, worries or expectations do you face with the plot?

12. How has been your contact with the team?

ANNEX B: TABLES REFERRED TO IN TEXT

Table 1. Question 2a: What did you think or expect last year when the FSIPM Project came to the village? Comparison of main responses between villages

Responses	**Chiwinja (15)**	**Kambuwa (13)**	**Lidala (17)**	**Magomero (18)**
To learn good/modern farming methods	5	5	5	3
Don't know/nothing	2	1	3	3
Land stealing	1	0	6	2
Bumper harvest	1	2	2	3
Free inputs	1	1	1	2
Other				
Total respondents per village	10	9	17	13

Table 2. Question 2b: What were other people saying (when the FSIPM Project first came)? Main answers by women

Responses	**Frequency**	**% of respondents (33)**	**% of responses(38)**
Land stealing	29	87.9	76.3
Harvest stealing	2	6.1	5.3
Other	2	6.1	18.4
Total	33	100	100

Table 3. Question 2b: What were other people saying (when the FSIPM Project first came)? Main answers by men

Responses	Frequency	% of respondents (14)	% of responses(16)
Land stealing	11	78.6	68.8
Relocation	1	7.1	6.3
Forced labour	1	7.1	6.3
Research	1	7.1	6.3
Other	2	14.3	12.5
Total	16	100	100

Table 4.Question 2b: What were other people saying (when the FSIPM Project first came)? Comparison of main responses between villages

Responses	**Chiwinja**	**Kambuwa**	**Lidala**	**Magomero**
Land stealing	9	9	10	15
People stealing and selling	0	2	1	0
Relocation	1	1	0	0
Forced labour	1	0	0	1
Research	0	0	2	0
Total respondents per village	**11**	**12**	**13**	**16**

Table 5. Question 2c: Did you go to any introductory meetings? (When the FSIPM Project first came to the village)? Comparison of main answers between villages

Responses	**Chiwinja**	**Kambuwa**	**Lidala**	**Magomero**
Yes	2	1	8	10
All	10	10	1	0
One	2	0	0	0
None/no	0	2	2	4
Total number of respondents per village	14	13	11	14

Table 6. Question 2d: How was the text that was handed out? Were you or someone in your family able to read it?? Comparison of main responses between villages

Responses	Chiwinja	Kambuwa	Lidala	Magomero
Read and understood	4	6	5	2
Not mentioned	2	2	4	4
Read but has forgotten	5	1	4	0
Did not get	1	2	1	1
Total number of respondents per village	12	11	14	7

Table 7. Question 3: Did you wonder why you had been chosen? Total responses (includes couples)

Responses	**Frequency**	**% of respondents (58)**	**% of responses (59)**
No because it was for agriculture/ research	15	25.9	25.4
No because volunteer/keen	9	15.5	15.3
Lineage-Yes	8	13.8	13.6
No	5	8.6	8.5
Yes and was worried	5	8.6	8.5
Other	17	29.3	28.8
Total	59	N/A*	100.1

*There are more responses than respondents

Table 8. Question 4: What did you hope to see on the plots? Gender analysis of farmers' expectations by category

Type of Comment	**Comments by women**	**% of female respondents (34)**	**% of responses (43)**	**Comments by men**	**% of male respondents (16)**	**% of responses (18)**
Positive	22	64.7	51.2	9	56.3	50.0
Sceptical	12	35.3	27.9	5	31.3	27.8
Negative	5	14.7	11.6	4	25.0	22.2
Other	4	11.8	9.3	0	0	0
Total	39	N/A	100	18	N/A	100

Table 9. Question 5: Last year (1996-97), what did you understand to be the purpose of the trials? Main responses by women

Responses	FREQUENCY	% OF RESPONDENTS (34)	% OF RESPONSES (61)
Whitegrubs	13	38.2	21.3
To see which crops are suitable for area/soil	7	20.6	11.5
To see how maize would do without fertiliser	7	20.6	11.5
Termites	6	17.6	9.8
New agricultural practices	4	11.8	6.6
Find high yielding crops	3	8.8	4.9
Wilt	3	8.8	4.9
Wasn't sure	3	8.8	4.9
Other	15	44.1	24.6
Total	61	N/A	100

Table 10. Question 5: Last year (1996-97), what did you understand to be the purpose of the trials? Main responses by men

Responses	Frequency	% of respondents (16)	% of responses(29)
Whitegrubs	6	37.5	20.7
New agricultural practices	4	25.0	13.8
To see which crops are suitable for area/soil	2	12.5	6.9
Termites	2	12.5	6.9
Find high yielding crops	2	12.5	6.9
To give farmers inputs and harvest	2	12.5	6.9
Other	11	68.8	37.9
Total	29	N/A	100

Table 11. Question 6. How was contact with the team (1996-97)? Gender analysis of questions

Responses	Frequency (53)	Female Respondents (31)	Male Respondents (16)
Good	35 (64.8 %)	20 (64.5 %)	8(50.0 %)
Good because we are taken to fields & shown pests	10 (18.5 %)	6 (19.4 %)	4(25.0 %)
Ok	4 (7.4 %)	3 (9.7 %)	1(6.3 %)
Not very good	4 (7.4 %)	2 (6.5 %)	2(12.5 %)
Not good because team did not include farmer	1 (1.9 %)	0	1(6.3 %)
Total	53	31	16

Table 12. Question 6: How was contact with the team (1996-97)? Comparison of the main responses between villages

Responses	Chiwinja	Kambuwa	Lidala	Magomero
Good	8	9	9	8
Good because we are taken to fields & shown pests	6	1	3	
Ok			3	1
Not very good	1	1	2	
Not good because team did not include farmer		1		
Total number of respondents per village	15	12	17	9

Table 13. Question 7. What has been the most difficult aspect of taking part in the trials? Did you have anxieties or disappointments? Categories of reply

Categories of reply	Total	% of respondents (60)	% of response (81)
Trial design	34	56.7	42.0
None	18	30.0	22.2
Weather	11	18.3	13.6
Missed benefits	10	16.7	12.3
Crop failure	8	13.3	9.9
Total	81	N/A	100.0

Table 14. Question 7: What has been the most difficult aspect of taking part in the trials? Did you have anxieties or disappointments? Main responses by men

Responses	**Frequency**	**% of respondents (16)**	**% of responses (28)**
Not using (fertiliser small harvest)	7	43.8	25.0
Disappointment because heavy rains caused crops to fail	6	37.5	21.4
None	5	31.3	17.9
Would like more or all fields used for plots	2	12.5	7.1
Other	8	50	28.6
Total	28	N/A	100

Table 15. Question 7: What has been the most difficult aspect of taking part in the trials? Did you have anxieties or disappointments? Main responses by women

Responses	**Frequency**	**% of respondents (35)**	**% of responses (41)**
Not using (fertiliser small harvest)	11	31.4	26.8
None	6	17.1	14.6
Disappointment because heavy rains caused crops to fail	5	14.3	12.2
Worried whether compensation would be paid	3	8.6	7.3
Beans failed to thrive	2	5.7	4.9
Wanting to harvest beans for relish/green maize	2	5.7	4.9
Other	12	34.3	29.2
Total	41	N/A	100

Table 16. Question 7: What has been the most difficult aspect of taking part in the trials? Did you have anxieties or disappointments? Comparison of the main responses between villages

Responses	Chiwinja	Kambuwa	Lidala	Magomero
Not using (fertilizer small harvest)	5	5	3	5
None	2	3	6	4
Disappointment because heavy rains caused crops to fail	7	1	2	1
Worried whether compensation would be paid			1	3
Beans failed to thrive		2	1	1
Total number of respondents per village	14	11	13	14

Table 17. Question 8: What was the best aspect of taking part in the trials? Main responses given by men

Responses	**Frequency**	**% of respondents (16)**	**% of responses (39)**
Learning a new spacing pattern for maize	7	43.8	17.9
The bean planting pattern was new	5	31.3	12.8
Learning new agricultural techniques	5	31.3	12.8
Pigeon pea planting pattern	3	18.8	7.7
Early fertiliser = good system	3	18.8	7.7
The intercropping pattern was new	3	18.8	7.7
Other	13	81.3	33.3
Total	39	N/A	100

Table 18. Question 8: What was the best aspect of taking part in the trials? Main responses given by females

Responses	Frequency	% of respondents (30)	% of responses (58)
Learning a new spacing pattern for maize	12	40.0	20.7
The bean planting pattern was new	7	23.3	12.1
Learning new agricultural techniques	6	20.0	10.3
All crops returned to farmer	6	20.0	10.3
Get inputs	4	13.3	6.9
Pigeon pea planting pattern	4	13.3	6.9
Trying 3 maize seeds per planting station	3	10.0	5.2
Other	16	53.3	27.6
Total	58	N/A	100

Table 19. Question 9a: What about this year (1997-98)? What did you get out of [the village meeting]?

Varieties	
A new maize variety, Masika	9
Four different varieties of beans	9
Four pigeon pea varieties	7
New varieties	7
Total	32

Table 20. Question 9a: What about this year (1997-98)? What did you get out of [the village meeting]?

Cultural practices	
Must not harvest early on plots	4
There will be four plots	4
Beans to be planted in dambo	3
Ridge spacing	3
Some plots to be banked some not	2
No mulching this year	1
Total	17

Table 21. Question 9a: What about this year (1997-98)? What did you get out of [the village meeting]?

Trial management	
Must discuss any problems with team	2
Team supervision and reporting	1
No farmer plot	1
Total	4

Table 22. Question 9a: What about this year (1997-98)? What did you get out of [the village meeting]?

Pest management	
Some beans will be seed dressed and some not dressed	1
No bean dressing	1
Total	2

Table 23. Question 10b: What was the purpose of the pigeon pea trial? Comparison of main answers between villages

Response by village	**Chiwinja**	**Kambuwa**	**Lidala**	**Magomero**
To find highest yielding variety	5	4	6	4
To see if varieties are suitable to their soil /area	6	3	5	3
To find high yielding variety suitable to area	0	1	1	1
To find a wilt resistant variety	1	7	5	3
Four varieties	3	1	6	2
Total respondents per village	15	13	17	13

Table 24. Question 10c: What was the purpose of the bean trial? Main answers given by women

Responses	**Frequency**	**% of respondents (32)**	**% of responses (67)**
High yielding	13	40.6	19.4
There are 4 varieties	16	50.0	23.9
Suitable for area/soil	8	25	11.9
High yielding and suitable for their area	5	15.6	7.5
Early maturing	7	21.9	9.6
Other	18	56.3	26.9
Total	67	N/A	99.2

Table 25. Question 10c: What was the purpose of the bean trial? Main answers given by men

Responses	**Frequency**	**% of respondents (15)**	**% of responses (29)**
High yielding	5	33.3	17.2
Suitable for area/soil	4	26.7	13.8
High yielding and suitable for their area	3	20	10.6
There are 4 varieties	5	33.3	17.2
Other	12	80	41.4
Total	29	N/A	100.2

Table 26. Question 10c: What was the purpose of the bean trial? Main answers compared between villages

Response by village	**Chiwinja**	**Kambuwa**	**Lidala**	**Magomero**
High yielding	4	2	8	7
Suitable for area/soil	5	3	3	2
High yielding and suitable for their area	1	3	5	1
There are 4 varieties	7	3	9	2
Early maturing	1	1	6	3
Total respondents per village	15	11	17	12

Table 27. Question 10d: What was the purpose of the cultural practices in the trial? Main responses given by women

Responses	Frequency	% of respondents (21)	% of responses (34)
Banking half plots and not banking other half to assess termite attack	7	33.3	20.6
Banking half plots and not banking other half	4	19.0	11.8
Termites	2	9.5	5.9
Yield	4	19.0	11.8
Banked all plots	4	19.0	11.8
Other	13	61.9	38.2
Total	34	N/A	100.1

Table 28. Question 10d: What was the purpose of the cultural practices in the trial? Main responses given by men

Responses	Frequency	% of respondents (11)[25]	% of responses (22)
Banking half plots and not banking other half to assess termite attack	6	54.5	27.3
Banking half plots and not banking other half	3	27.3	13.6
Termites	0	0.0	0.0
Yield	5	45.5	22.7
Banked all plots	2	18.2	9.1
Other	6	54.5	27.2
Total	22	N/A	99.9

[25] The numbers considered in this column are too small for percentages to be meaningful but they are given in order that the same information is present in each table

Table 30. Question 11: What problems, worries or expectations do you face with the plot? Main answers

Responses	Frequency	% of respondents (56)	% of responses (79)
None/happy with trial	20	35.7	25.3
Fertiliser applied too early and no second application	6	10.7	7.6
Fertiliser applied too early	5	19.6	6.3
Too much rain	5	8.9	6.3
Plots are too small, should be extended to give more yield	5	8.9	6.3
No second application of fertiliser/not enough fertiliser	4	17.9	5
Other	34	60.7	43
Total	79	N/A	99.8

Table 31. Question 11: What problems, worries or expectations do you face with the plot? Categories of farmer responses

Category	Total	% of responses (79)
Fertiliser/Inputs	23	29.1
No problems/happy with trials	20	25.3
Pests	10	12.7
Trial practice	10	12.7
Crops	8	10.1
Weather	6	7.6
Poor communication with project	2	2.5
Total	79	100

Table 32. Question 11: What problems, worries or expectations do you face with the plot? Crops

Responses	Frequency of responses
Maize plants have turned yellow	3
Beans failed to do well	3
Nagaga too slow in maturing in the dambo	1
Thieves	1
Total	8

Table 33. Question 11: What problems, worries or expectations do you face with the plot? Weather

Responses	Frequency of responses
Too much rain	5
Relay beans failing due to lack of moisture	1
Total	6

Table 34. Question 11: What problems, worries or expectations do you face with the plot? Main answers by women

Responses	Frequency	% of respondents (32)	% of responses (43)
None	9	28.1	20.9
Fertiliser too early	6	18.8	14
No second application of fertiliser/not enough fertiliser	6	18.8	14
Too much rain (later on affecting yield)	5	15.6	11.6
Other	17	53.1	39.5
Total	43	N/A	100

Table 35. Question 11: What problems, worries or expectations do you face with the plot? Main responses given by men

Responses	Frequency	% of respondents (16)	% of responses (23)
None	6	37.5	26
Fertiliser too early	3	18.8	13
No second application of fertiliser/not enough fertiliser	2	12.5	8.6
Plots small so yield results too small/want plot extended	2	12.5	8.6
Not informed of procedures this year	2	12.5	8.6
Chiwawu	2	12.5	8.6
Other	6	37.5	26
Total	23	N/A	99.4

ANNEX C: ALL RESPONSES

Table 1. Question 1: Have you had any experience here or elsewhere with outsider and projects?

Replies by gender

Responses	Frequency	Female	Male	Couple
Hygiene advice (govt)	31	20	10	1
Needlecraft and cookery classes	19	11	2	6
Tobacco Club	17	10	6	1
Pre-Democracy maize clubs	16	9	4	3
Boreholes and wells	15	8	3	4
Contour Ridging (1960-90)	12	7	2	3
Maize clubs 1992-98	6	5		1
Agricultural Demonstration Plot	5	2	2	1
Private Fertiliser Co /(AGOLA)	5	4	1	
Adult literacy	3	2	1	
Scales for children	3	1	2	
Family Planning	2	2		
Bricks for school (MASAF?)	2	1		1
Soil Fertility (CSM)	2	2		
Livestock credit (chickens)	2	2		
Child Survival researchers	2	2		
Bahai development organisation	2	2		
Orphan registration	2	1	1	
Livestock credit (cattle)	2		2	
Livestock (Church)	1		1	
Whitegrub Chemical Control	1		1	
Govt assistance rebuilding flood damaged houses	1		1	
Free maize (MP)	1		1	
Food for work (MP)	1	1		
Well (Mosque leaders)	1	1		
Traditional Medicine Hospital	1	1		
Girls Club subsistence crops	1	1		
Health visitors	1	1		

(Table 1 cont'd)

Responses	Frequency	Female	Male	Couple
Road maintenance	1	1		
Government bus	1	1		
Vegetable extension workers	1			1
Malawi Union of Credit and Savings	1			1
Total	**161**	**98**	**40**	**23**

Table 2. Question 2a: What did you think or expect last year when the FSIPM Project came to the village: Replies by gender

Responses	Frequency	Female	Male	Couple
To learn good/modern farming methods	18	8	6	4
Don't know/nothing	9	8	1	
Land stealing	9	7	2	
Bumper harvest	8	5	1	2
Free inputs	5	3	2	
A maize/fertiliser club	4	2	1	1
Pest control	4	1	2	1
To find out about the suitability of the soil for specific crops	3	1	2	
To lose harvest	3	2	1	
Soil fertility interventions/conservation	3	2	1	
Thangata/forced labour	2	2		
Research	2	1	1	
Not land stealing because land is too small/poor	1	1		
Targeting old people	1	1		
Tree planting	1		1	
Trouble because whites are involved	1	1		
Assistance	1	1		
Total	75	46	21	8
No answer	5	3	0	2

Table 3. Question 2b: What were other people saying (when the FSIPM Project first came): Replies by gender

Responses	Frequency	Female	Male	Couple
Land stealing	44	29	11	4
People stealing and selling	3	1		2
Relocation	2		1	1
Forced labour	2	1	1	
Research	2	1	1	
Harvest stealing	2	2		
Chief to sell land. resettle villagers/possibly sell pple	2			2
Village agri. problems not soluble but long standing	1		1	
Modern farming	1	1		
Manure as free input for soil conservation	1	1		
Nothing	1	1		
Inputs	1		1	
Women were prostitutes if took part	1	1		
Total	63	38	16	9
No comment	8	5	2	1

Table 4. Question 2c: Did you go to any introductory meetings? (When the FSIPM Project first came to the village): Replies by gender

Responses	Frequency	Female	Male	Couple
yes	30	12	10	8
all	12	10	2	
None/no	8	7		1
one	2	2		
Total	52	31	12	9
no answer recorded	11	7	4	0

Table 5, Question 3: Did you wonder why you had been chosen? Replies by gender

Responses	Frequency	Female	Male	Couple
No because it was for agriculture research	15	6	7	2
No because volunteer/keen	9	7		2
Lineage-Yes	8	5	1	2
No	5	3	2	
Yes and was worried	5	5		
No – known as good farmer	4	1	2	1
No - known as a leader	3		3	
Yes	2	2		
No- because poor	2	2		
No- registration	2	1		1
No- because young	1		1	
No – because not mobile	1	1		
Yes, so asked the team (research)	1		1	
No- because old	1	1		
Total	59	34	17	8
Not applicable	5	4	0	1

Table 6. Question 4: What did you hope to see on the plots: Replies by gender

Response	Frequency	Men	Women	Couples
Good crops/big harvest because research people are experts	30	6	20	4
Nothing much because no fertiliser	11	2	6	3
New farming methods	6	2	1	3
Don't know	5	1	4	
Poor crops because no fertiliser	5	3	2	
Nothing special	4	2	2	
Poor bean crop because they were too close together	2		2	
To learn about soil sample & soil fertility	2	1		1
Poor crops because boxed ridges in dambo	1	1		
Poor crops	1		1	
Reduced pest attack	1		1	
Total	68	18	39	11
Not applicable	5	0	4	1

Table 7, Question 5: Last year (1996-97), what did you understand to be the purpose of the trials? Replies by gender

Response	Frequency	Men	Women	Couples
Whitegrubs	19	6	13	
New agricultural practices	12	4	4	4
To see which crops are suitable for area/soil	10	2	7	1
Striga	10	4	5	1
To see how maize would do without fertilizer	9	1	7	1
Termites	9	2	6	1
Research on control of pests	5	1	2	2
Find high yielding crops	5	2	3	
To give farmers inputs and harvest	5	2		3
Wilt	4	1	3	
Wasn't sure	3		3	
New varieties	3		2	1
Bean wilting	3	1	2	
Different plant spacing high density planting	2		2	
To differentiate farmers research plots & crop perform.	2	1	1	
Fertility	2	1	1	
Multiplying seed varieties	1	1		
Encourage striga emergence	1			1
Total	105	29	61	15
Not applicable	4	0	4	0

Table 8. Question 6: How was contact with the team (1996-97)? Replies by gender

Responses	Frequency	Female	Male	Couple
Good	35	20	8	7
Good because we are taken to fields & shown pests	10	6	4	
Ok	4	3	1	
Not very good	4	2	2	
Not good because team did not include farmer	1		1	
Total	56	31	16	7
Not applicable/missing	9	7	0	2

Table 9. Question 7: What has been the most difficult aspect of taking part in the trials? Did you have anxieties or disappointments? Replies by gender

Responses	Frequencies	Female	Male	Couple
Not using (fertiliser small harvest)	18	11	7	
None	16	6	5	5
Disappointment because heavy rains caused crops to fail	11	5	6	
Worried whether compensation would be paid	4	3		1
Beans failed to thrive	4	2	1	1
Wanting to harvest beans for relish/green maize	3	2	1	
Would like more or all fields used for plots	3		2	1
Pigeon peas gave a poor harvest	3	1	1	1
Others (i.e. not the on farm trial farmer) employed as labourers	2	1	1	
The team visited the fields without their knowledge so farmers could not learn from them.	2	1		1
It was good that she was not bothered too much by team members	2		1	1

Responses (Qn 9 cont'd)	**Frequencies**	**Female**	**Male**	**Couple**
Going to the field when tired because the team had come	1	1		
Termite damage due to not banking	1	1		
Other participating farmers are lazy, do not attend meetings	1	1		
Mulching –what was the point	1	1		
Compensation too small	1		1	
Mbwera beans failed	1			1
Team should have weeded	1		1	
The maize seed used was hard to recycle	1		1	
The beans were planted too densely	1	1		
Fertiliser timing all wrong	1	1		
Maize too far apart	1	1		
Feared non return of crops	1	1		
Timing of fertiliser	1	1		
Total	81	41	28	12
Not applicable	3	3	0	0

Table 10, Question 8: What was the best aspect of taking part in the trials? Replies by gender

Response	**Frequency**	**Men**	**Women**	**Couples**
Learning a new spacing pattern for maize	21	7	12	2
Learning new agricultural techniques	15	5	6	4
The bean planting pattern was new	12	5	7	
All crops returned to farmer	10	2	6	2
Get inputs	10	2	4	4
Pigeon pea planting pattern	7	3	4	
Good harvest	5	2	1	2
Early fertiliser = good system	5	3	1	1
The ridge spacing was new	4	2	1	1
Compensation	3	2	1	
Learning pigeon pea top planting	3	1	2	
The intercropping pattern was new	3	3		

Response (Qn 10 cont'd)	**Frequency**	**Men**	**Women**	**Couples**
Trying 3 maize seeds per planting station	3		3	
Don't know/nothing	2		2	
Can tell team about problems	2	1	1	
Tephrosia seems good for maize	2		2	
Trying out new seeds	1		1	
Trying out planting all the crops on the same day	1		1	
Saw benefits of early weeding	1		1	
Observing beans could grow in dambo	1		1	
Weeding without banking	1		1	
Importance of fertiliser proven	1	1		
Have less work to do	1			1
Total	116	39	58	17
Not applicable	9	0	8	1

Table 11. Question 9: What about this year (1997-98)? Did you go to the village meeting? : Replies by gender

Responses	**Frequency**	**Men**	**Women**	**Couples**
Yes	39	11	22	6
No	12	3	7	2
Spouse went	1	1		
Can't remember	1		1	
Didn't know about it	1	1		
Total	54	16	30	8
Not applicable	9	0	8	1

Table 12. Question 9: What about this year (1997-98)? What did you get out of [the village meeting]? Replies by gender

Responses	**Frequency**	**Men**	**Women**	**Couples**
A new maize variety, masika	9	2	5	2
Four different varieties of beans	9	3	4	2
Fertiliser will be applied	9	5	4	
Four pigeon pea varieties	7	3	1	3
Planting pattern maize/beans/pigeon peas	7	1	2	4

Responses (Qn 12 cont'd)	Frequency	Men	Women	Couples
New varieties	7	2	2	3
Has now forgotten	5		5	
Must not harvest early on plots	4	1	3	
There will be four plots	4		2	2
Beans to be planted in dambo	3	2		1
No answer	3		3	
Ridge spacing	3	1		2
Some plots to be banked some not	2	1	1	
Must discuss any problems with team	2	1	1	
Relative did not tell him what was said	1	1		
No mulching this year	1		1	
Some beans will be dressed with pesticide	1		1	
No bean dressing	1		1	
Team supervision and reporting	1	1		
No farmer's plot this year	1	1		
Total	80	25	36	19
Not applicable	23	4	16	3

Table 13. Question 9c: Replies by gender

Responses	Frequency	Men	Women	Couples
Read and understood	17	5	8	4
Not mentioned	12	6	4	2
Read but has forgotten	10		10	
Did not get	5	2	1	2
Relative read out, now has forgotten	3	1	2	
Have not read or have read	3		3	
Read did not give to anyone else	2		2	
Read did not understand	1	1		
Relative read for farmer	1	1		
Total	54	16	30	8
Not applicable	9	0	8	1

Table 14. Question 10a: What was the purpose of the maize trial? Replies by gender

Responses	Frequency	Female	Male	Couple
Seed dressed and undressed -whitegrub attack	15	11	3	1
Varietal quality/recycling	9	5	2	2
If maize variety is suitable for this soil/high yielding	8	3	2	3
Has forgotten/doesn't know	7	4	3	
Fertiliser-see how high yield will be	3	2	1	
Prevent striga	3	1	2	
Mankhwala to control termites	3	3		
No seed dressing	3	1	2	
Single fertiliser application	3	2	1	
Early fertiliser application efficacy	2	1	1	
To compare MH18 and Masika for productivity	2			2
To introduce new variety	2		2	
Stalkborer	1		1	
Nothing	1	1		
Resistance of masika to storage pests	1		1	
Look at two applications of fertiliser	1	1		
4 maize varieties	1	1		
Early weeding	1		1	
2 varieties of maize	1		1	
Poundablity of masika	1			1
Disease resistance	1			1
Fast maturing so helping farmers	1	1		
Total	70	37	23	10
Not applicable	9	8	0	1

Table 15. Question 10b: What was the purpose of the pigeon pea trial? Replies by gender

Responses	Frequency	Female	Male	Couple
To find highest yielding variety	22	16	2	4
To find if they are suitable to their soil /area	20	13	4	3
Wilt resistant	16	8	5	3
Four varieties	12	10	2	
Disease resistant	4	1	2	1
Two varieties	4	3	1	
Early maturing	3	3		
Three varieties	3	1	2	
Has forgotten/does not know	2	2		
Test effect of growing on ridge	2	1	1	
Pest resistant	2	1	1	
Don't know how many varieties	2	2		
To compare with previous years' performance	1		1	
To see if dambo is suitable for pigeon peas	1		1	
Discover causes of wilting	1		1	
To encourage emergence of striga	1			1
Total	96	61	23	12
Not applicable	5	5	0	0

Table 16. Question 10c: What was the purpose of the bean trial? Replies by gender

Responses	Frequency	Female	Male	Couple
High yielding	31	18	8	5
Suitable for area/soil	23	13	7	3
There are 4 varieties	21	16	5	
Early maturing	11	7	2	2
Disease resistant	5	2	2	1
Wilt resistant	4	2	2	
Don't know	3	3		
Pest resistant	3	2	1	
3 varieties	2	2		
2 varieties	2	1	1	
See if dambo is suitable	1		1	
Being shown that maize and beans go together	1	1		
Total	107	67	29	11
Not applicable	8	6	1	1

Table 17. Question 10d: What was the purpose of the cultural practices in the trial? Replies by gender

Responses	Frequency	Female	Male	Couple
Banking/not banking	34	16	10	8
Termites	24	11	6	7
Yield	16	8	6	2
Banked all plots	12	8	4	
Banking/unbanking but does not know the reason	3	3		
Planting pattern only	2	2		
Don't know	2	1	1	
Cowpeas (for food or don't know)	2	1	1	
4 plots	1	1		
Total	96	51	28	17
Not applicable	8	7	0	1

Table 18. Question 11: What problems, worries or expectations do you face with the plot? Replies by gender

Response	Frequency	Men	Women	Couples
None	18	6	9	3
Fertiliser too early	11	3	6	2
No second application of fertiliser/not enough fertiliser	10	2	6	2
Too much rain (later on affecting yield)	5		5	
Plots small so yield results too small/want plot extended	5	2	2	1
Maize plants yellow/maize poor	3	1	2	
Beans failed to do well	3		2	1
Not informed of procedures this year	2	2		
Whitegrubs	2		2	
Termites	2		2	
Pests on beans	2	1		1
Chiwawu	2	2		
Did not want to bank plots	1		1	
Thinks two types of fertiliser applied early and this was wrong	1	1		
Nagaga too slow in maturing in the dambo	1		1	
Relay beans planted too early	1		1	
Pigeon peas a waste of time because of wilt	1	1		
Only need 1 variety of beans, should choose the best	1	1		
Thieves	1			1
Relay beans failed due to lack of moisture	1		1	
Mbwera beans fail next to pigeon peas	1			1
Pests on pigeon peas	1		1	
No pesticides	1			1
Happy about new bean varieties	1	1		
Don't know	1		1	
Cowpeas pests	1		1	
Total	79	23	43	13
Not applicable	7	0	6	1

Table 19, Question 12: How has been your contact with the team (1997-98)? Replies by gender

Response	Frequency	Men	Women	Couples
Still good /very good	36	9	20	7
Did not participate in fertiliser application	16	7	9	
Participated in planting	13	6	7	
Did not participate in planting	10	4	6	
Participated in fertilising	8	4	4	
Very little contact/ no feedback	7	3	3	1
Contact not as good as last year	4		4	
Has questions s/he has not been able to ask	3	2	1	
Did not get much information	3		2	1
Better this year than last year	2	1	1	
Team always seems in a hurry	2	1	1	
Good because did not take much time	1		1	
Same as last year	1		1	
Total	106	37	60	9
Not applicable	8	0	7	1

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

INTEGRATING FARMER EVALUATIONS IN IPM RESEARCH: CONCEPTS, EXPERIENCES AND LESSONS

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INTEGRATING FARMER EVALUATIONS IN IPM RESEARCH: concepts, experiences and lessons.

INTRODUCTION

The FSIPM project is testing various pest management strategies on-farm for the major crops of maize, beans and pigeon peas. These strategies encompass host plant resistance, cultural practices (e.g. tillage practices) and some chemical pesticides. The pests or problems targeted include *Striga asiatica*, white grubs and termites in maize, fusarium wilt in pigeon peas and bean fly in Phaseolus beans. Considering that the ultimate goal of this research work is provide small-scale, resource poor farmers with acceptable and practical Integrated Pest Management (IPM) strategies which will reduce crop losses by pests, it is important that the assessment of these strategies involves both technical, economic and social dimensions.

In most of the past IPM research work, farmers have not actively taken part in the assessment so that their knowledge, practices and experiences are often unknown as well as undervalued by researchers (Ashby, 1990). The FSIPM project, however, realises that farmers knowledge and practices as regards pests and crop protection are very rich and diverse because they have been practising a lot of Pest management strategies (PMS) for a long time on their own. In all cases the farmer is the one who finally decides whether or not a new strategy is useful based on their knowledge and past as well as present experiences (Ssennyonga et al 1994). The FSIPM project therefore considers farmer evaluations as a very important aspect of its research and has been continuously assessing with the farmers the various PMS so that acceptable solutions to the pest problems can be developed and promoted. There are numerous benefits from involving farmers as active participants in the evaluation of the various PMS. Researchers can learn from the practical experience and indigenous technical knowledge (acquired with time) farmers bring to assessing usefulness of a new PMS. Involving farmers in evaluation can provide researchers with direct insight into farmers' priorities and criteria. The criteria used by farmers to evaluate these strategies may be different from those that scientists use and may even vary from farmer to farmer. These criteria are often not very evident to the observer or to the farmer so it takes some time to understand why certain decisions are made. It is thus very important that researchers and farmers collaborate in the evaluation of pest management strategies so that the farmers interests are taken into consideration and adoption can be enhanced. Farmers evaluation is one way of involving future users of the IPM strategies and can be a positive catalyst to adoption (Martin et al 1997). During farmer evaluation you detect criteria unknown to researchers and important changes that need to be made to match the PMS with farmers priorities.

This report gives the results of the farmer evaluation exercise conducted in the first season (1996/97) of the On-farm trials. The report is set out into the following parts:

- Methodology
- Evaluation results comprising of :
    1. Striga trial
    2. Seed dressing trial in Maize against white grubs
    3. Termite trial in maize
    4. Fusarium wilt trial in pigeon peas
    5. Bean fly trial in beans
    6. Comments on general management of the trials and production
- Conclusion

METHODOLOGY

(a) Techniques for evaluation

The techniques which have been used in the farmer evaluation process included 'Open-ended (absolute) evaluation (with individual farmers as well as local extension officials) and Group evaluations. Quiros et al (1991) gives more insight on the various techniques used in farmer evaluation.

Open- ended evaluation (absolute evaluation) was used to solicit qualitative explanations about farmers knowledge of pests, experiences and perceptions of the effects of the various PMS. It is a technique for stimulating and recording the spontaneous and free expressions of farmers' opinions of the PMS without using formal questions. This technique helped to foster a friendly and effective communication between the farmers and researchers because it involved discussions and probing with individual farmers on the various aspects of the farming system. In this approach each PMS was assessed in its own right in terms of its impacts, and constraints or shortfalls. This technique was also applied to the Development Officer (DO) and the Field Assistant (FA) who were involved in this work. The discussions were conducted with each extension worker separately.

Group evaluation is often appropriate when researchers want to form an impression in a short time of farmers reactions to new PMS. This technique was used to find out the collective views of the participating farmers on the various PMS tried in their fields. This also considered issues of trial management, farmer and extension involvement, farmer-researcher interactions, farmer expectations and production issues. Group interaction helped to stimulate discussion , especially when there are conflicting opinions on identification of a pest and impact of a PMS. This technique was used to supplement the individual evaluations because there are some problems associated with using the technique on its own. One problem is that groups can be dominated or inhibited thereby leading to false consensus and misleading evaluations because of peer pressure. The other problem is that members may withhold opinions to avoid offending the researchers or other farmers who seem to benefit from the research work.

(b) Mode of evaluation

The participating farmers were divided into two sets. One group comprising of ten farmers (5 from each EPA) was involved in the *striga* trial and all these farmers participated in the evaluation process. These farmers had indicated that they had *striga* problems in their fields and the trial plots were marked where the farmers supposedly had more *striga*. The other group consisting of 64 farmers (32 from each EPA) formed what was termed the main intercropping IPM trial. In this trial each farmer was growing all the three crops and a specified combination of the PMS on each crop was prescribed. Different farmers tried different combinations of the PMS on the three crops. Before the trials started, the trials were explained individually to each farmer and a hand out in Chichewa was issued to each to improve understanding. In some cases a farmer would try more than two treatments on one pest (due to the specifications of the statistical design) thereby causing interactions which would pose problems for farmers to notice specific effects of a PMS. In choosing farmers to participate in the evaluation, an effort was made to use farmers who had fewer interactions. This resulted in only 32 farmers (16 from each EPA) participating in the individual evaluations. However all the participating farmers were involved in the group evaluation.

The process of farmer evaluation considered the following aspects :

- Farmers' understanding of the trials and its various treatments. This looked at whether the farmers understood the aims of the different strategies following the initial explanations and the experience in the running of the trial.
- Farmers' experiences, comments or responses on the specific treatments. This was aimed at soliciting farmers positive and negative views of the various strategies as regards all aspects of the farming system.
- Farmers' perceptions of incidence of the pests this year and the effects of the various strategies. This was aimed at finding out whether the farmers would relate the incidences of the pests to the various strategies being tested in the trials.

- Farmers general comments on the experiences and problems associated with the trial and agricultural production in general this year. This was also aimed at how the farmers thought these would have affected the trial results in general.

The individual evaluations were done with the participating farmers in their trial plots. These evaluations were done twice for each farmer; soon after germination of plants and when crops had reached physiological maturity but before harvesting. The first discussion was aimed at capturing farmers' comments on the issues of planting, labour requirement, applicability, germination, and weeding. The second discussions captured information on weeds , banking, pests, diseases and performance of the crops as well as consolidating information from the first discussions. The group evaluation was conducted after harvesting in each of the four villages and involved all the farmers who had participated in the trials.

The results of the individual discussions with farmers have been summarised in tables comprising of farmers comments on various evaluation variables. The number of farmers who gave each comment is attached. A plus sign represent a positive factor associated with a particular PMS while a minus means a negative effect of a particular PMS. Due to the small number of farmers and the similarity of their comments, the results from the two EPAs have been combined. The analysis of these results is qualitative where each comment is given equal value. The results from the discussion with extension officials follow the farmers comments on specific trial components. Other general aspects which were covered in the discussions with extension officials and in group discussions are brought after the specific trial discussions. Lastly some general lessons for debate and further consideration are given in the conclusion.

RESULTS OF THE EVALUATIONS OF THE TRIALS

1. MAIZE - STRIGA TRIAL

(a). Farmers' Understanding

Despite the initial explanations and the handouts, not all farmers fully understood the aims of the trial. Only four farmers indicated that the trial was aimed at finding ways of reducing incidence of *striga* while others felt that the trial was aimed at comparing the researchers' ways of farming i.e. planting (spacing, varieties and planting position) weeding, harvesting, etc. with the farmers' in terms of yield of various crops.

Considering specific treatments, Table 1 shows that some farmers could not fully understand or ralate the aims of growing soya on the control of *striga*. Farmers also had problems relating the soil improvement strategies (fertiliser and tephrosia) to the control of *striga*.

TABLE 1. Farmers understanding on the aims of the treatments

SOYA	TEPHROSIA	FERTILISER
- To improve soil fertility (3) - To induce *striga* germination (2) - Do not understand (5)	- To improve fertility of soil (5) - Do not understand (5)	- To improve soil fertility (3) - To induce *striga* germination (1) - To reduce *striga* incidence (1) - not understanding why two modes of application

*the number in brackets is the number of farmers giving that comment

These results indicate that farmers found it difficult to understand the strategies which have indirect effects on *striga* as such there is need to continuously involve and communicate with farmers in all aspects of the research so that farmers can understand the aims of the trial. Farmers may take time to study and understand the trials and they can only make sensible evaluation of the trial if they are following what is going on.

(b). Farmers' experiences and perceptions of the various strategies

Table 2 shows that that farmers used various criteria to assess different strategies in the trial. The farmers criteria included labour, economic aspects, technical application and yield. The use of multiple criteria resulted in multiple responses on each strategy which could be indicators of how the farmers would welcome the strategies.

Table 2. Farmers' experiences and perceptions on the striga trial

TREATMENT	COMMENTS	CRITERIA USED*
Planting Soya beans at 5cm spacing on one side of ridge as trap crop for *striga*. The Soya could also help improve soil fertility.	• spacing too narrow resulting in : - more labour required for planting (-6) - difficulty in weeding (-5) - competition for nutrients ; low yield (-2) • never planted soya before (-3) • low prices; low returns for soya (-1) • low yields due to too much rain (-1) • side planting good ; increases number of intercrops (+2)	- labour - weeding - yield - return - intercropping
Planting tephrosia -to be incorporated as green manure to improve fertility in the next growing season	• poor germination and slow growth in furrow due to: - water logging (-6) - hard surface (-5) • planting in furrow causing difficulties in weeding (-2) • demands additional labour (-2) • good strategy as green manure; fertiliser expensive (+2)	- weeding - labour - fertility
Fertiliser use -to improve soil fertility and reduce germination and incidence of *striga*. -applied as basal dressing in two modes:	• time of application not appropriate: - increases labour at planting (-4) - promotes weed growth (-2) - fertiliser washed away easily (-5) • fertiliser expensive (-2) • good to use fertiliser ; most soils are infertile (+2)	- labour - weeds - weeds - fertility
(a) Dollop - ~~both~~ one side~~s~~ of maize planting stations	• better yield; fertiliser is targeted (+5) • more economic; less wasteful (+9) • easier to apply (+1) • more labour demanding (-1)	- yield - cost - labour
(b) Spread along the ridge	• not economic; more wasteful (-7) • easily washed away with rains (-3) • more labour to apply (-2) • increased weed growth and crops (-/+2) • beneficial also to other intercrops (+3)	- labour - weeds - intercropping

* plus sign against the number of respondents means the effect is positive or beneficial while minus sign means the effect is negative or disadvantageous

On the use of soya, farmers' comments mainly centred on the spacing between plants. This could be because most farmers have not been growing this crop so that this is a new experience. Farmers felt that the spacing was too narrow and posed difficulties in planting, weeding and could result in competition between plants for nutrients, light and air. The end use of the product also needs to be considered since most farmers saw soya as a cash crop and low prices could be a disincentive. However some farmers welcomed planting on the side of the ridge because it increased the number of intercrops in the field thereby maximising use of space.

Tephrosia as a green manure to improve soil fertility was welcomed by the farmers because fertiliser has become too expensive. However, the problem was with planting position. Planting in the furrow resulted in poor germination, slow growth and difficulty in weeding because of water logging and hard sub soils because most of the top soil is pulled to the ridge. The farmers, therefore, felt that planting on the sides of the ridge could be better. Considering labour shortage as a problem for most farmers, some farmers felt that planting the *tephrosia* was additional work demanding more labour during times when the farmers were planting and weeding other crops.

Although fertiliser brings good yields for most crops, too much rains this year caused leaching and washing away so that the fertiliser had reduced effect (less than expected) on yield. However, the major problem with the fertiliser used in the trial was the time of application. The farmers felt that applying the fertiliser at time of planting was not good because it increased labour demand at this peak period and the fertiliser could easily be washed away by the early heavy rains on loose soils resulting in less effect. The early application (especially for spread fertiliser) could promote weed growth necessitating early weeding and demanding more labour. For the two methods of application, most farmers preferred dollop method because they felt it was more economic (less waste of fertiliser) and could result in better yields since the fertiliser is targeted to the planting stations. Although some noted that dolloping might be difficult and demanding more labour, most farmers felt that spreading the fertiliser involved a lot of wasting of fertiliser and uses more fertiliser because you apply to the whole ridge. The only benefit from spreading was that the other crops (intercrops) on the ridge (e.g. beans) could have access to the fertiliser but it could also promote weed growth on the ridge as well as some of the fertiliser getting washed away by rains. Nevertheless, some farmers saw no difference in performance of the crops where fertiliser was dolloped and where it was spread along the ridge. This was attributed to heavy rain this year causing excessive leaching.

(C). Comments from extension officials

1. Mombezi EPA
The DO indicated that *striga* is becoming a problem in the area because of repeated cropping (no rotation) and declining soil fertility. However, considering farmers income problems, the use of fertiliser to control *striga* may be difficult to adopt but if soya and *tephrosia* effects can be established, they could be good candidates for *striga* control and further research.

On his part the FA also felt that the use of fertiliser is not appropriate because most farmers in the area can not afford fertiliser and they do not belong to credit clubs (they feel that credit is risky). Hence, he felt that it may be important to try manure (e.g. compost and green manure) to replace fertiliser.

2. Matapwata EPA
The DO also indicated that *striga* is also a big problem in many fields in the area but he was not sure of the extent of the problem. He welcomed the use of soya in the trial especially on the aspect of narrow spacing (thereby improving yield) and striga control. He also indicated that they are promoting the growing of Soya in the area but they are not yet sure of the performance of different varieties. On the use of fertiliser, he indicated that spreading of fertiliser on the ridge is good for crop growth but promotes weeds so that one needs more labour to keep the field weed free. The DO also said that the use of MH18 maize variety in all the trials was good because it is high yielding but he said he was sceptical about head smut attack on this variety. He however indicated that he has observed less *striga* on NSCM41 variety than on local varieties and he speculated that this may be due early maturity of the NSCM41 variety.

The FA felt that using fertiliser is not sustainable on its own in most smallholder farms because most farmers can not afford fertiliser but suggested that the project should consider other soil fertility interventions such as compost and green manures to replace fertiliser. He also felt that these should be complemented by soil conservation measures such as marker ridges and contour bunds.

(d) General comments on striga trial

Most of the striga farmers felt that the work was interesting and beneficial because they recieved free seed for the crops used in the trial. However, most of the farmers had little or no *striga* on the trial plots so that it was difficult to assess the effect of the various strategies. Some farmers felt that this was due to too much rain this year which inhibited *striga* germination and growth. A more reasonable explanation could be that the sites where the plots were laid had little *striga* in the previous year because the researchers could not verify it.

There was mixed reactions on the use of fertiliser in the trial with some feeling the use of fertiliser was not appropriate for most farmers while others felt it was good (may be because it was free?) since the soils are otherwise too infertile to produce a good crop.

In general production of most crops e.g. maize was low this year because of heavy much rains and lack of fertiliser. Apart from maize, the pulses (beans, cowpeas, and soya?) were heavily attacked by beetles and caterpillars causing low yields. Due to these factors some farmers felt they did not benefit from the research this year.

2. MAIZE SEED DRESSING WITH SEVIN AGAINST WHITE GRUBS

(a) Farmers evaluation of seed dressing trial

Whitegrubs are a serious pest on maize especially in the dambo areas. This trial was thus aimed at determining the effect of the seed dressing with a chemical, Sevin on whitegrubs. There were 20 farmers who participated in the trial and 10 farmers were involved in the evaluation exercise. The evaluation included aspects of application, effect and constraints associated with the use of the chemical. The results are given in the table 3 below:

Table 3. Farmers comments on seed dressing with sevin (n=10)

VARIABLE	COMMENTS/REACTIONS	n
Mode of application	• easy/no problem • chemical easily washed away with rains	8 2
Perception/experience of effect	• positive • no difference • don't know/can't tell	6 3 1
constraints associated with the strategy	• cost of chemical • availability of chemical	5 2
Other observations/problems	• too much rainfall this year causing : - water logging and crop failure - abandoning of fields • lack of fertiliser causing low yield • no serious whitegrub attack this year • already used to seed dressing • burying crop residues promotes breeding of white grubs	 6 2 3 3 2 1

The application of the chemical to the seed was considered easy by most of the farmers and this group included some farmers who were already using the chemical against white grubs in their fields. These farmers also felt that Sevin really helped to control whitegrubs in maize although some (3) saw no difference due to Sevin. The effect of the chemical might have been reduced because of too much rains which might have caused washing away of the chemical. The heavy and continuous rains this year also caused water logging and general crop failure in the dambos so that some farmers abandoned their fields without weeding. Some farmers however indicated that the chemical is expensive and could be unaffordable to most small holder farmers to apply in all their fields. The effect of the chemical on whitegrubs therefore has to justify the cost of the chemical otherwise it might be difficult to entice farmers to use it. The use and effect of the chemical also depends on the extent of the pest problem in the farmers field. It would be difficult for those who had little or no whitegrub attack to assess and appreciate the effect of the chemical.

(b) **Comments from extension officials**

1. Mombezi EPA

The DO indicated that whitegrubs are a big problem in Chitera dambo so the trial is welcome. However, availability and affordability of Sevin may be a problem for smallholder farmers. He also wondered whether the project was assessing the possibility of residual effects of sevin (e.g. health hazard) even though farmers want to use it. He also urged the project to consider alternative ways of controlling whitegrubs other than just using Sevin.

The FA felt that the effectiveness of Sevin on whitegrubs depended on the concentration being used so it is necessary to establish the right concentration to use. He also expressed fears of residual toxic effect of the chemical after using for some years especially in drinking water.

2. Matapwata EPA

The DO indicated that chemicals (e.g. for seed dressing) may be costly for smallholder farmers so they are often not appropriate. The FA also had the same view on the Sevin but he also expressed fears of potential danger to the other crops (e.g. beans) in the intercropping systems

From the above discussion, it might be important to do more assessments on the effect of the chemical on areas where there is a serious whitegrub problem. It might also be important to consider other less expensive methods of controlling whitegrubs in maize.

3. TERMITES TRIAL ON MAIZE

(a) **Farmers evaluation of the termites trial**

This trial consisted of two strategies to reduce the attack of termite on maize. The strategies were weeding without banking at second weeding and modified kaselera (making new ridges for a relay crop leaving the maize on isolated stands). The evaluation of this trial considered aspects of farmers knowledge or understanding on the strategies, their experience in using the strategy and their perception of the effect of the strategies on termites.

Table 4. Farmers comments on strategies to control termites

CRITERIA FOR EVALUATION	TREATMENTS WEEDING WITHOUT BANKING n=5	MODIFIED KASELERA n=5
Farmers' knowledge/ understanding of strategy	• to reduce termite attack (5) • common practice in the area (2)	• to compare performance of relay beans on ridges and on flat beds (5) • new practice (5)
Farmers experience in using the strategy	• less termite attack this year due to heavy rains (4) • poor crop & yield for maize due to heavy rains (5) • promotes lodging (1)	• making ridges & planting requires more labour (-3) • less moisture retention on ridges (-2) • less plant population (-1) • total crop failure due to dry spell (-5) • easier to weed on ridges (+2) • relay beans growing more vigorously due greater soil depth on ridge (+2)
Farmers' perception of effect on termites	• less termite attack noted (+2) • can't tell : termite attack less on poor crop of maize (3) • unbanked maize equally attacked in a dry year (1)	• can' tell - less termite attack this year (5)

* plus sign against the number of respondents means the effect is positive or beneficial while minus sign means the effect is negative or disadvantageous

The farmers involved in the evaluation were able to appreciate weeding without banking as a strategy to reduce termite attack on maize. For some of these farmers this was a common practice which they have been using for some time.

However, modified kaselera was a new strategy for the farmers as they were used to planting their relay crops on flat beds rather than on ridges. The farmers felt that the strategy was mainly to assess the performance of relay beans planted on the ridges as compared to their normal way of planting on flat beds and not to control termites.

It has also been shown that there was less termite attack this year as such it was difficult for the farmers to appreciate the effect of the two strategies. The low incidence is attributed to the heavy and continuous rains which were experienced this year which also resulted in a poor crop of maize.

Apart from controlling termites, there were other aspects of the strategies which the farmers commented on. One was that weeding without banking promotes lodging because the maize plants do not have enough soil anchorage. The modified kaselera strategy was associated with more labour to make the ridges and reduced plant population due to restricting planting to ridges. Some farmers also felt that there was less moisture retention on ridges than on flat beds which could reduce performance of relay beans. It was also interesting that some farmers were able to notice the advantages of the mdified kaselera strategy. It was seen to be easier to weed on ridges than on flat bed and the beans were seen by two farmers to be growing more vigorously on ridges because of more soil.

(b) **Comments from extension officials**

1. Mombezi EPA
The DO indicated that weeding without banking is a common practice for the farmers in the area unless the aim is to findout the extent of controlling termite attack. The only problem is that it results in lodging of maize especially when there are winds. The FA however indicated that the practice mostly works in years of high rainfall rains but in yearys of low rainfall there could still be considerable damage by termites because termite populations increase with those conditions.

2. Matapwata EPA
Weeding without banking was also indicated to be a common practice in the EPA for the farmers who have termite problems in the area. The FA commented on the modified kaselera practice and he indicated that the practice is different from the way the farmers in the area plant their relay beans so the farmers may not practice it. He also felt that the problem with Kaselera is that it can result in lodging of maize especially when there are winds because you build new ridges leaving the maize plants with little soil.

4. PIGEON PEAS - FUSARIUM WILT TRIAL

(a) **Farmers evaluation of the fusarium wilt trial**

The most common problem in pigeon peas is *Fusarium* wilt which leads to total wilting of the plants. Two strategies were tested to determine their effect on this disease. The strategies included using a variety known to be resistant, (ICP9145) in comparison with local varieties and planting the pigeon peas on the side and not on top of the ridge (a strategy already used by some farmers).

Table 5. Farmers comments on the strategies for fusarium wilt

	TREATMENTS	
CRITERIA FOR EVALUATION	ICP9145 VARIETY n=11	PLANTING ON THE SIDE OF RIDGE n=10
Farmers' knowledge/ understanding	• early maturing (+5) • wilt resistant (+3) • high yielding (+2) • slow cooking (-3) • not tasty (-2) • don't know much (3)	• to allow for more intercrops (+5) • to reduce wilting (+3) - plants accessing more moisture - plants growing away from buried crop residues • to avoid lodging of plants when preparing for relay crops (+2)
Farmers' experiences on planting, management and performance	• no problem - used to growing the variety (4) • poor germination due to water logging (4) • stunted growth due water logging(4) • growing faster than local varieties (+3) • higher yield expected (+2)	• farmer already planting on the sides (6) • strategy not appropriate for dambo areas due to water logged conditions leading to : - dying of plants (-5) - stunted growth (-2) • plants not getting enough nutrients on the sides (-1) • plants growing faster due to less competition from maize (2)
Farmers' perception of effect on wilting	• variety less susceptible (+4) • can't tell -wilting not fully started (5) • no differences with local (2)	• can't tell -wilting on fully started (7) • no differences with local (3)

* plus sign against the number of respondents means the effect is positive or beneficial while minus sign means the effect is negative or disadvantageous

Table 5 shows that most of the farmers involved in this trial know the variety ICP9145 as an early maturing variety while others characterised it as a high yielding and wilt resistant variety. Some farmers (3) had never grown this variety before but some who had grown it before indicated that they did not like the it because it took longer to cook and was not tasty.

Some farmers indicated that they had seen no wilting on this variety while wilting was noticed on their local varieties. But some of the farmers could not say much because wilting had not yet started in their fields at the time of the evaluation. The pigeon peas also faced problems of poor germination and stunted growth due to water logged conditions arising from the heavy rains this year. However, this variety was noticed by some farmers to be growing faster and more vigorously than the local varieties so that higher yield was expected.

In the two EPAs where this research was conducted, farmers plant pigeon peas either on top or on the side of the ridge. The main reason for planting on the side of the ridge is to allow for more crops (e.g. beans) to be grown with maize on top of the ridge. Other farmers felt that planting on the side reduced wilting because the plants had more access to moisture accumulating in the furrow while others thought that the pigeon pea grows some distance away from the buried crop residues which harbour the disease. However this strategy was found to be inappropriate for dambo areas which get water logged leading to stunted growth and dying of some plants.

The main advantage of planting pigeon peas on the side of the ridge which was noticed was that the plants were growing faster due to less competition and shedding from maize and also due to accessing more moisture. However most of the farmers could not notice the difference in terms of wilting because they felt the problem had not yet started for most fields. For some who had experienced wilting at that time, they felt the side planted pigion peas were equally affected by wilting as the top planted ones.

(b) Comments from extension officials

1. Mombezi EPA

The DO felt that the trial should continue because there is a problem of wilting in the area for the local pigeon pea varieties. The trials will also act as a demonstration exercise for the variety ICP9145 and this will help in adoption and diffusion of the variety in addition to the extension efforts already underway in the area. The FA said he was not sure about performance and wilt resistance of this variety. However he indicated that they are running demonstration plot of this variety in the area to check performance of the variety.

2. Matapwata EPA

The DO indicated that the problem of wilting exists in the area especially for local pigeon pea varieties so the promotion of the new variety is a welcome exercise. On planting pigeon peas on the side of the ridge the DO as well as the FA indicated that they were not sure how this practice can work to control wilting on pigeon peas.

5. BEAN FLY TRIAL

(a) Farmers evaluation of the trial

Beanfly attack is identified as wilting of beans in the early stages of growth. The strategies against this pest which were included in the trial included seed dressing with Sevin, using a local variety Kaulesi (known to be resistant), planting at high density (5cm apart), mulching and earthing up. Some farmers had tried more than one strategy making it difficult to assess the effect of individual strategies. In the evaluation exercise, an effort was made to include farmers who had fewer alternatives on each pest problem.

Table 6. Farmers comments on control of beanfly

	TREATMENTS				
CRITERIA FOR EVALUATION	SEED DRESSING WITH SEVIN (n=8)	KAULESI VARIETY (n=10)	PLANTING AT HIGH DENSITY (n=10)	MULCHING (n=10)	EARTHING UP (n=7)
Farmers' knowledge/ understanding	• protect seed from insects (8)	• early maturing (10) • high yielding (2) • fast cooking (2) • tasty (1) • wilt resistant (1)	• to increase yield (7) • don't know (3)	• to protect beans from insects (6) • to retain moisture for good germination (4) • to control wilting of beans (1)	• to promote growth of beans (3) • don't know (4)
Farmers' experiences on planting, management and performance	• no germination due to : --- chemical (-6) - insufficient moisture (2) • poor germination on second planting (-5) • chemical expensive (-4) • application easy (6)	• beans heavily attacked by beetles (5) • low yield due to too much rain (3) • no germination due to sevin (3) • better yield than other varieties (+2)	• more time/labour to plant (-8) • requires more seed - expensive (-4) • competition among plants due to narrow spacing (-5) • beans heavily attacked by beetles (3) • higher yield due to increase plant population (5)	• did not mulch (-3) • needs more labour/tedious (-8) • no problems with mulching (+2) • leads to rotting of seed due to more moisture (-1) • crop heavily attacked by beetles (-2) • good germination due to retained moisture (+3)	• did not do the exercise - labour demanding (-4) - not necessary (weeding and banking is enough) (-5) - no germination (-1) • no problem- easy exercise (+2) • beans growing faster (+1)
Farmers' perception of effect on wilting	• can't tell effect because of germination problem (6)	• can't tell because of : - not much bean wilting this year (7) - no germination (3)	• can't tell because of : - not much bean wilting this year (6) • less wilting noted (+1) • no difference (3)	• can't tell because of : - not much bean wilting this year (4) • no difference (3) • did not mulch (3)	• can't tell because of : - not much bean wilting this year (2) • did not do the exercise (5)

* plus sign against the number of respondents means the effect is positive or beneficial while minus sign means the effect is negative or disadvantageous

Seed dressing with Sevin was found to be toxic to beans and all the beans which were treated did not germinate. No effort was made to replace the chemical as it was late for planting. However some farmers indicated that the use of chemicals may not be welcomed by many farmers because they are costly and unaffordable.

The variety **Kaulesi** is grown by many farmers and is liked mostly because it is early maturing. Other farmers liked it because it is high yielding, fast cooking and tasty. Only one farmer indicated that the variety was less susceptible to wilting. However the performance and yield of beans this year was reduced because of beetles which heavily defoliated the plants before flowering stage. The other problem was the heavy rains this year which led to stunted growth, diseases and rotting of the pods. Only two farmers indicated better yields with Kaulesi than the other varieties of beans. This year had very few beanfly wilting problems in the two EPAs so that it was difficult for the farmers to note the effect of the variety. This problem also applied to the other strategies on beanfly.

The farmers associated **high density planting** with increasing yield due to increased plant population. It was difficult to get the link between plant spacing and wilting. Most farmers however had problems with this strategy because it required more seed and labour for planting. Some farmers felt that it would promote competition among plants fro nutrients thereby resulting in less yield. To the contrary, two farmers reported higher yield due to this strategy.

The process of **mulching** was to be done soon after planting the beans before germination and the farmers understood the mulch as physical barrier against insects having access to the seed while others considered as a way of promoting good germination by retaining moisture. The major problem with this strategy is that it requires more labour to fetch the grass and mulch during critical time of planting. Due to this some farmers did not do the exercise. One farmer also feared that the mulching could lead to rotting of the seed due to excessive moisture and another farmer feared the mulch would invite insects like termites to eat the seed. However, true to their expectation, some farmers experienced good germination where mulching was done due to the retained moisture.

Earthing up was to be done one week after germination to promote growth of secondary roots and quick establishment of the bean plants thereby surviving beanfly attack. The farmers also had problems understanding the rationale of this strategy as regards wilting. Some farmers looked at it as a way of promoting growth. Most farmers did not do the exercise because they considered the exercise as demanding additional labour and not necessary. These farmers felt that weeding (done 2-3 weeks after planting) and banking would serve the purpose. The only good thing mentioned was that one farmer noticed faster growth in beans after earthing up.

(b) Comments from extension officials

1. Mombezi EPA

The DO felt that the trial was appropriate because beans are an important crop in the area but beanfly is a problem for most farmers. On specific treatments, he had reservations with 'earthing up, mulching and high density planting'. He indicated that earthing up may be labour demanding and time consuming considering that the farmers have other operations such as weeding to be done during the same period. Mulching on beans may not be adopted because some farmers feel that the mulch would attract other insects such as termites and that it is labour demanding to fetch the mulch and do the mulching. He also indicated that high density planting could be advantageous because it increased yield but labour for planting could be a problem for most farmers, especially those who plant beans in their whole maize fields.

The FA also commented on high density planting, mulching/earthing and the use of Kaulesi variety against beanfly. On high density planting, he felt that it may increase competition among plants for nutrients and sunlight so that the beans may yield poorly. He also indicated that for mulching and earthing up, there is need for intensive training and demonstrations so that the farmers can see the benefits otherwise they will see these as demanding a lot of labour from them. The use of Kaulesi variety against beanfly was seen as appropriate because farmers in the area like the variety because it is early maturing and fast cooking.

2. Matapwata EPA
The DO said he did not know much about beanfly as such he has not been putting much interest on the problem in the area. He regarded mulching on beans as difficult and requiring a lot of labour; as such may not be adopted. The FA felt that he was not yet sure on how the various treatments could work but he indicated that high density planting is advantageous and the farmers were already practising it in relay beans.

In conclusion, it should be emphasised that the effect of these strategies on reducing bean fly attach could not be directly observed this year because there was less incidence of the pest in most fields. The problem of one farmer trying more than one strategy also might have caused problems to some farmers in that they could not separate the effect of one strategy. It is thus important to reduce the treatments per farmer so that the farmers can fully understand and assess the strategy.

6. COMMENTS ON GENERAL MANAGEMENT OF THE TRIALS AND PRODUCTION ISSUES

During the discussions with the extension officials and farmers' groups, some aspects of farmer participation, extension involvement and general production issues were tackled.

(a) Farmer participation

All the extension officials acknowledged that it was good that some farmers were involved in the trials but they felt that there was need to involve more farmers especially those not directly involved (e.g. through Farmers' field days). This would improve farmers understanding of the problems and interventions right from the start considering that some of the interventions are new to the farmers. There is also need to communicate the trial results to the farmers through village or group meetings.

The local FAs however felt that farmers involvement was low so that the farmers looked at this work as researchers' and not their work. There is thus a need to involve the farmers in most aspects of the assessments so that the farmers feel they are actually doing the research themselves. Nevertheless the FAs felt that the relationship with the farmers was cordial but the farmers had high expectations from this work in terms of noticeable changes in their yields.

Most of the farmers indicated that the work was good (because they were benefiting seed of various crops) and interesting (because they were learning some aspects of research trial management) so that they were willing to continue participating. On their participation, most farmers also felt the same way as the FAs in that they felt left behind in some aspects of the assessments. They requested to involved or informed of the assessment being done and the outcomes of the trials in their fields as well as other farmers fields.

(b) Extension involvement

The extension officials indicated that they appreciate their involvement in the running and evaluation of the trials and in the field days because they learn a lot from these activities . They all pledged their support to the trials for the benefit of the farmers in their areas. The involvement of local extension Field Assistants (FAs) in the trials was good but once in a while there is need to invite FAs from neighbouring sections to help transfer the information.

The FAs felt that the involvement was not adequate because of the researchers were not inviting them in most of the times. They therefore urged the project to involve them in actual assessments of the treatments in the field so that they are aware of the performance and problems associated with the interventions. In addition the FAs requested for their involvement in planning next season's trials so that they are aware of what is happening before farmers.

(c) Production issues

Production in the area this year has been characterised as generally low because of excessive rains which caused leaching of nutrients, flooding in some sections and difficulty in weeding for most farmers. The only crops which have done well this year are sweet potatoes, groundnuts and field peas. However, dimba vegetables were expected to do better than last season because of the excess moisture this year.

The use of no fertiliser in the trials caused a lot of concern to the farmers. This is because most of the farmers fields are infertile so that the yield from the trial plots was very low or even non existent. This situation made it difficult for some of the farmers to take care of the crops and assess the effects of the PMS because they perceived no benefits from the trials. For example, some farmers would not bother to assess termite damage in the trial plots for a maize crop which was going to give them no yield. During the group discussions, the farmers therefore requested the use of fertiliser in the trials so that it can be worthwhile assessing the PMS and taking care of the trials otherwise it is going to be a waste of time.

The extension officials felt that this poor production would reduce the enthusiasm of farmers towards the trials as it is difficult for the farmers to see the benefits of the trials. They rated production of maize and beans as poor, tobacco, groundnuts and soya as average. The farmers and the extension officers indicated that production of pigeon peas this year was going to be lower because there were no winter rains for pod filling. Beans this year were also badly attacked by beetles in most of the two EPAs resulting in low yield. These pests have been there in the past but this year there was an increase because of favourable weather. In maize, there has been an increase in headsmut disease this year due to excessive rains which caused humid conditions but this was more of a problem in hybrid or recycled hybrid maize varieties. It was also indicated that in maize there has been a moderate incidence of termites in the section this year due to heavy rains and a considerable attack of stock borer in the upland while the problem of white grub still persisted in the dambo.

Lastly, the extension officials asked whether the project could think more on improvement of soil fertility using green manures because fertility was really a problem in the area. To this effect, they suggested increasing the number of green manure species used in the trials since there was only *tephrosia* being used in the *striga* trial.

CONCLUSION

The above analysis has brought out various issues/lessons which needs to be considered when designing and implementing on-farm research. This understanding of these issues will help in designing and improving the various PMS so that they fit the farming systems. This will assist in determining the final response of the farmers to the PMS and thereby adoption.

1. Farmers' understanding and perceptions of the PMS depends on whether the effects are direct or indirect. It is easier for farmers to understand the PMS which have **direct** effects on the pests (e.g. chemical seed dressing on maize) but for the PMS having **indirect** effects (e.g. use of soya and tephrosia on the striga trial) there is need for continuous communication and interaction with the farmers so that they can appreciate the aims of the PMS. Farmers can only assist in evaluation of the trials if the understand the PMS and this can also affect their adoption.

2. The number of strategies being assessed at a time also affect farmers' understanding and their ability to assess the effects PMS in the trials. It is also easier for the farmers to understand and assess the effects of one or two strategies on a particular pest. Combining assessments for various PMS on one or two pests in one farmer's plot can result in difficult interactions which farmers may fail to assess or observe effectively. For example, due to the nature of the design of the FSIPM trials, some farmers were involved in two or more PMS on beanfly and this made it difficult for the farmers to observe distinct effects of each strategy and make comparisons with their own (without strategy) plots. One notable incidence was with the seed dressing of beans with sevin which resulted in no germination

of beans and thereby making it difficult to assess the effects of other strategies for those farmers who had additional strategies on beans.

3. The evaluations have also revealed that farmers use various criteria to assess the PMS. Some criteria have direct bearing to the effects of the strategy while other criteria relate to other aspects of the farming system. Some criteria may be more important than others and may relate to the priorities farmers put on the PMS as well as the farmers' objectives. The farmers criteria or objectives are broader than the researcher's. The criteria so far used relate to labour requirements, costs associated with the PMS, technical aspects like planting, weeding, and application of the PMS as well as the associated problems. A technology/PMS may perform well or may be favoured on some criteria but it may not be favoured on other criteria. For example, on the concept of planting beans at high density in the bean fly trial, the farmers considered aspects of cost of seed, increase in yield in addition to the researchers objective of control of beanfly. It is therefore important to understand the criteria the farmers use in assessing the PMS and the importance of those criteria on the farming system because these will affect the farmers perceptions on the usefulness of the PMS.

4. Finally, it is also very important to assess farmers' expectations and perceived benefits in their participation of the trials. In most cases farmers want direct and immediate benefits like seed, fertiliser, and yield. But some of the PMS may not be associated with these benefits and situation of bad weather and low fertility could result in reducing some of the benefits from the research work. This would erode the farmers enthusiasm in participation and assessment of trials. In situations of bad weather and low fertility, farmers may not consider PMS as a priority issues because their expected benefits are not there and it is of no use protecting the crops from pests.

REFERENCES

1. Ashby, J.A. (1990) **Evaluating technology with farmers. A handbook.** CIAT, Cali, Colombia.

2. Martin, A. and Sherington. J. (1997) **Participatory research methods - implementation, effectiveness and institutional context.** *Agricultural systems,* Vol. 55, No. 2, pp 195-216

3. Quiros, C.A., Gracia, T. and Ashby, J.A. (1991) **Farmer evaluations of technology: methodology for open-ended evaluation.** Instructional Unit No. 1. IPRA/CIAT, Cali, Colombia.

4. Ssennyonga, J.W., Goodel, G., Lako, G.T. and Tedla, S. (1994) **Social and economic aspects of IPM in the tropics.** *Insect Science and its applications,* Vol.15/6, pp 633-648.

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Proposals for farmer evaluation of FSIPM Project on-farm trials 1997-98

J.M.Ritchie

26 Feb 1998

Background

Ideas for farmer evaluation have been derived from internal discussions. literature sources (e.g. CIAT manuals). comments from Savitri Abeyasekera. Roger Sterne. Last year's (1996/97) experience (Paul Jere) highlighted the issue of complexity of trial design and lack of alternatives for comparison visible to the individual farmer. The design involved incomplete replication with a large number of treatment combinations distributed between about 70 farmers with only one experimental field per farmer matched with a "farmer's plot" which had the farmer's preferred spacing of local maize with beans and/or pigeonpeas (if the farmer had them available). Thus farmers were unable to see and express preferences between alternative treatments.

This year trial design (1997/98) has been radically simplified by:
1. reducing the number of treatments per intercrop: and
2. increasing the number of (smaller) plots to four per farmer with all major alternatives visible to each farmer.

Note that this design still leaves combinations of varieties of beans and pigeonpea with maize seed dressing or banking unreplicated on each farm since it appeared reasonable to believe that interactions would not be discernible by the farmers whereas the relative performance of different varieties and any effect due to the presence or absence of banking or seed dressing would be things which farmers could easily understand and evaluate. Any interactions between bean varieties and pigeonpea varieties or between each of these and seed dressing or banking will be detectable in the statistical analyses of yield and plant survival.

Calendar of issues for evaluation
(crop stages in italics)

Date	Activity	Beans	Maize	Pigeonpea
Mid-February	Farmer field Days: main trial & *Tephrosia* demo plots	*Just pre-harvest:* Relative speed of maturation, yield, diseases, pests	*Early cobbing:* initial comment on Masika performance relative to local/hybrids: fertilizer application: seed dressing	*Early vegetative:* no evaluation possible yet
Early March	Farmer meetings Matapwata	*post-harvest:* explain purpose and scope of Relay Trial after mbwera: ask farmers to choose one variety for comparison with Kaulesi.	N/A	explain reason for mbwera with relay beans in presence of pigeonpea
Early March	Farmer field school/focus group: *Striga* trial farmers (6) plus others with *Striga*	N/A	• Strengthen farmer knowledge of *Striga* biology: • clarify rationale for trial treatments: • Discuss effects and "costs" of trap cropping: low fertilizer input and *Tephrosia* green manure • Discuss possibilities for hand pulling of flowering Striga and options for next season	N/A

Calendar of issues for evaluation (contd)
(crop stages in italics)

Date	Activity	Beans	Maize	Pigeonpea
Mid March to early April	Semi-structured interviews (Matapwata & Mombezi): Main trial farmers (10 per village, as far as possible equal split between genders and zones).	*post-harvest:* criteria for varietal performance within trial vars & relative to local vars (e.g. Chimbamba): seed size, yield, diseases, pests, rainfall, speed of maturation, seed quality etc. Encourage selected farmers in Mombezi with high yields to cook samples of each variety and comment	*maturity:* varietal performance vs local/hybrids: foliar pests/diseases, rainfall, speed of maturation, termites, yield, cob sheath & pests/diseases	*vegetative:* ?initial survival differences: vigour, disease, pest attack (wilting etc)
May	Interview same 40-farmer sample as above or sub-sample?	Return for cooking/taste comments?	*post-harvest:* Ask farmers to comment on cob size, poundability, storage and taste	N/A
May-June (check?)	Relay beans: Matapwata only, interview 20 farmers	*Just pre-harvest:* Relative speed of maturation, yield, diseases, pests (expect to focus on wilting due to BSM)	N/A	N/A
August-September	Interview same 40-farmer sample as above or sub-sample?	N/A	N/A	*flowering/podding:* Relative speed of maturation, yield, diseases, pests
Late September - early October	N/A	N/A	N/A	*post-harvest:* criteria for varietal performance within trial vars & relative to local): seed size, colour, yield, diseases, pests, rainfall, speed of maturation, seed quality etc. Encourage selected farmers with high yields to cook samples of each variety and comment

NB Mangunda pigeonpea and sweet potato trials are not shown yet in this scheme. They need to be added

Evaluation Information on Main trial to be given to /sought from farmers

Draft Checklist

Clarification of researchers' reasons for evaluation

We are interested in hearing what the farmer thinks about the things that have been done on his or her field. We want to know whether the things we tested

- would be manageable for a farmer.
- whether they worked or not.
- whether they work but cause problems of labour or expense or availability of inputs.
- whether they can be adapted (and if so, how)

We are happy to get negative as well as positive opinions.

Add other reasons?

Farmers' understanding of trial purpose

What do you understand was the researchers' purpose in:

- trying several bean varieties?
- trying several pigeonpea varieties?
- using seed dressing on maize?
- having two plots banked and two not banked on each farm?
- Carrying out mbwera on two out of four plots?

Maize variety used

Have you used Masika before?
How did it compare with your own maize (and state variety)? (Disease, vigour, response to rain, response to fertilizer)

Fertilizer use

The project applied fertilizer at a rate of x bags per acre/hectare *(what is best way to describe this?)* soon after emergence.

On those parts of your maize which you fertilized, how much fertilizer did you apply?

(Is any of this available already from the baseline survey? Can we choose baseline farmers to make use of it?) (Good integration of quantitative/qualitative data!!)

When and how did you apply fertilizer (once or twice, dolloped (one or two) in hole/on surface)?

How do expected maize yields from research plots compare with those from the rest of your (fertilized) crop? Why is that d you think?

Please may we mark out an area of you own maize comparable to one of the experimental plots (net plot!) and weigh the harvest from it for comparison? We would arrange to do the harvesting with you present.

(Return to this subject after we have harvest data. Do actual yields confirm farmer's expectations?)

Plot layout

How does our spacing of maize, beans and pigeonpeas compare with your usual spacing?

What effect do you think that has had on the three crops?

Would you make any changes in planting pattern as a result of what you have seen this year?

Bean varieties

Which (if any) of these varieties have you grown before?

In general how did bean yields this year compare to an average year? (Above or below average?)
(last year was not typical)

What are the most important qualities you look for in a bean variety?

In general how did the experimental plot beans perform compared to your own beans (give variety?)

Did any of the varieties have particularly good features? Which one and what were they?

Did any of the varieties have particularly bad features? Which one and what were they?

What was the most serious problem with beans this year?

If that was not a pest problem, what was the most serious pest or disease problem?

Note that the same series of questions can be asked later for pigeonpeas

Banking

Do you normally bank the field where the trials are situated? Why? When?

If you did not bank the plots you were asked to bank, why was that?

Sensitive issue, but interesting; we can ask the technical team about cases of failure to bank. Also ask about those who "pseudo-banked" and probe why they did not do thorough banking?

What differences did you later observe between the banked and unbanked plots in the trial (if both were present)?

(In Chiradzulu dambo all are banked)

Termites

Did you have termite attack on maize in any of the plots or the surrounding field this year? When?

Did you expect to have termite attacks in that field from past experience?

Did you notice any difference in termite lodging between banked and unbanked experimental plots?

Whitegrubs

Did you have whitegrub attack in the field where the trials were this year? What stage of crop? Was it more or less serious than an average year?

Was there any difference between seed dressed and untreated plots in terms of damage?

Have you used seed dressing to control whitegrubs before? If so what and how much? Did you feel it was worthwhile?

If it was available, would you be prepared to buy gaucho seed dressing for your maize?
If yes, how much would you be prepared to pay for enough seed dressing to treat one bucket of seed?
(Is this the right measure?) Is willingness to pay information likely to be useful?

Mbwera

Do you normally carry out mbwera in this field? What do you grow?

Did you notice any effect of mbwera on the maize, the pigeonpea?

General

Are there any other comments or questions about the trials you would like to say ?

Do we revisit farmers used for pretesting when we have a substantive checklist?

If an experiment fails in one area, e.g. beans in Matapwata in rainy season or pigeonpea in Chiwinja dambo fields, should we omit evaluation of it?

PRELIMINARY REPORT ON FARMER EVALUATION OF MAIN INTERCROP PEST MANAGEMENT TRIAL 1997/98

Background

The purpose of the evaluation of the main trials is to determine farmers opinions on crop cultivation problems, and the relationship between farmers' normal practices and the trial interventions. In this context we then seek farmer' views on diferent aspects of the technologies being tested and their perceived effectiveness or lack of it. Ideas for farmer evaluation have been derived from literature sources (e.g. CIAT manuals), comments from Savitri Abeyasekera and Roger Sterne (SSU, Reading) and from last year's experience (Paul Jere).

Trial design issues

The 1996/97 evaluation report highlighted the issue of complexity of trial design and lack of alternatives for comparison visible to the individual farmer because the design involved incomplete replication with a large number of treatment combinations and only one experimental field per farmer matched with a "farmer's plot" which had the farmer's preferred spacing of maize with beans and/or pigeonpeas. Thus farmers were unable to express preferences between alternatives which were clear to them.

This year trial design has been radically simplified by 1. reducing the number of treatments per intercrop; and 2. increasing the number of (smaller) plots to four per farmer with all major alternatives visible to each farmer. Note that this design still leaves combinations of varieties of beans and pigeonpea with maize seed dressing or banking unreplicated on each farm since it appeared reasonable to believe that interactions would not be discernible by the farmers whereas the relative performance of varieties and the presence or absence of banking or seed dressing would be things which farmers could easily understand and evaluate. Any interactions between bean varieties and pigeonpea varieties or between each of these and seed dressing or banking will be detectable in the statistical analyses of yield and plant survival.

Open-ended evaluation

Interviews were conducted using an open-ended questionnaire with 6 participating farmers from Mombezi and Matapwata, which established a number of issues which were of particular innterest to farmers (see Annex 2 for an example of a completed questionnaire). Each interview bagan with a statement of researcher neutrality, to reassure farmers that negative views were welcomed as well as positive ones. It was explained that the interviewers wished to learn whether the interventions being tested

- were were useful or not useful
- would create problems of labour or expense or availability of inputs for an ordinary farmer
- can be improved (and if so, how).

Much time was devoted to eliciting the farmers' own criteria for evaluating varieties since these qualites will govern the acceptability and uptake of any new varieties which we may wish to introduce.

Main evaluation questionnaire

A more detailed questionnaire incorporating insights gained from the open-ended evaluation, was designed by the project team as an excel spreadsheet (Annex 3), with the assistance of Dr S. Abeyasekera and Dr I. Wilson of the Statistical Serices Unit, Reading University (see their visit report). A sample of 40 farmers was interviewed twice each between April and June to cover issues relating to maize and beans. It was found that farmers were unable to distinguish which plots had which pigeonpea varieties so the plots were remarked and the farmers were taken to the plot and shown the different varieties. A further visit to each farmer will be made in September to cover pigeonpea evaluation. Data entry forms have been prepared and data entry is commencing. The timetable and issues to be covered in the different stages of the evaluation is shown in Annex 3.

Initial implications

Some initial findings are already emerging from the questionnaire survey.

- Most farmers had no difficulty using a 1-5 rating scale, though one lady needed to see this scale visualised by using 5 stones of differing sizes to imply more or less good. She was able to score qualities of bean varieties by touching the appropriate sized stone with a stick.
- Gender had an influence on farmers' ability to answer questions and the kind of answers given. For example women valued the good poundability of Masika maize variety, while men were unaware of this characteristic.
- As indicated above, most farmers were unable to make specific comments about the performance of different pigeonpea varieties, though this did not seem to be the case with beans.
- In general farmers felt that Masika was a good variety and rated it about 4 out of 5 on a one to five scale where 1 is very poor and 5 is very good. This rating was as good as or better than most other varieties.
- Many farmers are adopting the project's 90 cm maize spacing, especially between rows though also often within the row. Others however feel that yield is being lost due to low plant population.
- Farmers frequently had few or no varieties of beans or pigeonpeas to plant.
- Farmers consistently expressed the view that if a single fertilizer dose is applied, this must be applied between knee-height and tasselling stage. Our application soon after emergence was considered likely to lead to yield losses.
- The "local check" bean variety, Kaulesi, is generally preferred to all other varieties.

Annex 1. Timetable for evaluation: issues for evaluation *(crop stages in italics)*

Date	Evaluation Activity	Beans	Maize	Pigeonpea
Mid-February	Farmer field Days: main trial & *Tephrosia* demo plots	*Just pre-harvest:* Relative speed of maturation, yield, diseases, pests	*Early cobbing*: initial comment on Masika performance relative to local/hybrids; fertilizer application; seed dressing	*Early vegetative*: no evaluation possible yet
Early March	Farmer meetings Matapwata	*post-harvest:* explain purpose and scope of Relay Trial after mbwera; ask for choice of two varieties for comparison.	N/A	explain reason for mbwera with relay beans in presence of pigeonpea
Early March	Farmer field school/focus group: *Striga* trial farmers (6) plus others with *Striga*	N/A	Effect of trap crop; effect of low fertilizer input +/- Tephrosia	N/A
Mid March to early April	Semi-structured interviews (Matapwata & Mombezi): Main trial farmers (10 per village, as far as possible equal split between genders and zones)	*post-harvest:* criteria for varietal performance within trial vars & relative to local vars (e.g. Chimbamba); seed size, yield, diseases, pests, rainfall, speed of maturation, seed quality etc	*maturity:* varietal performance vs local/hybrids; foliar pests/diseases, rainfall, speed of maturation, termites, yield, cob sheath & pests/diseases	*vegetative:* ?initial survival differences
September			Any follow-up questions arising from previous questionnaire?	*pre- or post-harvest:* criteria for varietal performance within trial vars & relative to local var; seed size, yield, diseases, pests, rainfall, speed of maturation, seed quality etc
August/September	Meetings with farmers to review results/perceptions and plan 1999 trials			

ANNEX 2

Exploratory open ended evaluation

Background information

Farmer Name	Dorothy Ayimu
Household type	FHH [Tobacco farmer]
Village	Lidala
EPA	Mombezi
Dambo or upland	Upland
Date	18 March 1998
Interviewer	M. Ritchie/J. Lawson-McDowall/C. Chiumia

N.B. The interview began with
a) statement of researcher neutrality
b) clarification of researchers' reasons for evaluation

Trial

How do you find the trial?	The seed dressed plots have better stand. Fertilizer was too early and was leached out. Beans did well until early posdding but then got "burnt" by wind and rain. They did better than least year. Napilira is not suitable. Pigeonpeas are yellowing and stems are thin. Local this year (and last year) is doing better than other varieties this year.

Maize

What qualities do you look for in a maize variety?	1. Large long cobs 2. Early maturing 3. yield per acre MH 18 did well last year even without fertilizer (50Kg). Believes her plots are better than ours in yield per acre [check this].
What is your opinion of Masika so far? Compared to others you have seen?	Producing like local; cobs not as big as MH 18 or NSCM 42. It had a good appearance at knee height compared to MH 18 but later began to look less good.
What other varieties have you planted this year? n.b. check if name hybrid that is not recycled	Local, NSCM 41 (recycled, 4th year)
How does masika compare to these varieties or any other varieties that you know already?	Masika is doing better than NSCM 41. She will plant some next year.

Fertiliser

Did you use fertiliser on your fields this year? Which maize varieties did you use fertiliser on?	Applied CAN to all fields and both varieties. One field of local; 2nd field was part MH 18 and he fertilized that
How much did you use? How many fields did you use it on? When did you apply the fertiliser?	1 teaspoonful per planting station, dolloped in hole and covered. Applied between knee-high and just before tassellling.
What did you think of our way of using fertiliser?	Good, to double dollop but should be later to give two cobs per plant.
If it was up to you, how would our amount of fertiliser be applied? What difference would this make?	Would apply both sides after banking. Would get better yield with two dollops than with her usual practice of only one dollop. Late application ensures that fertilizer stays next to plant.

Beans

What characteristics do you look for in a bean variety? (probe for particular characteristics? why are these important?)	1. Resist wind / flower shedding 2. Early maturing - beans in plot 1 (Napilira) were exposed to pests and wind for longer.
What do you think about the different varieties of beans?	Yield order: 1. Kalima, 2. Nagaga, 3. Kaulesi, 4. Napilira.
How did rain affect production?	No effect but Napilira not suitable for the soil. Her friends also had low yield.
Before harvest, what differences did you see between the varieties? Taste and cooking?	Napilira had good growth but poor yield. It is being eaten while seed of others is kept for planting. Taste order: 1. Nagaga, 2. Kalima, 3. Kaulesi, 4. Napilira - slow cooking
What varieties did you grow this year? What varieties have you grown previously?	Chimbamba (Zophira = red) and Nanyati. Only Zoyera (large white)
What differences are there between them ?	When too much rain Nanyati and Zoyera do well because climbers; Nanyati has thin skin and good taste. Zoyera thicker skin. Chimbamba looks good but not good taste. Small white cooks faster than Zoyera which is similar to Chimbamba for time. Zoyera affected by wind when flowering so less yield than Chimbamba. Two types of Nanyati are grown. A whiter seeded dwarf variety and a pinker seeded climber which lost its flowers in the wind.
How did your varieties perform this year?	[not asked]

Crop Spacing

What do you think of the crop spacing? (beware reluctance to criticise) Why was it good? Do you think we will get more grain?	It is good. Farmer felt his own was v. close Bigger cobs because of more space per plant. Maybe a similar amount overall.
What is your normal spacing for crops? Can you give us some examples from your fields this year?	Used to have 40-50 cms between maize stations. This year adopted research spacing of 90 cm because she saw that it produced a cob on each plant. BEANS: One climbing bean station (2-3seeds) next to each maize station and two dwarf bean stations between maize plants (3 seeds each). She alternated Chimbamba and Nanyati between maize along the ridge.
What do you think of having pigeon pea in the plot? Do you have some pigeonpea planted? How would you plant it? Why?	OK. Yes. She used to sideplant it but now feels local does beter on top.
Do you normally plant beans, pigeon peas and beans all in one field? If so, how do you space them?	Yes. No problem. Can be placed between dwarf beans between maize stations. all on same ridge.

Mbwera

What is your normal practice in a field if you have grown and harvested beans? What else?	After maize harvest cut stalks and weeds and lay them in furrow with a little soil. This makes room for the pigeonpeas. In Sept/Oct cut pigeonpea stalks and lay down to shed leaves. Remove stalks and after pigeonpea leaves fall make new ridges. Does Mbwera in her hill field.
Describe what you do.	Starts in March. Puts maize leaves in furrow and makes new ridge. Waits two weeks before planting. Plants beans. Stoney field traps moisture. Also gets dew on hillside. Only uses hill field because more fertile [and wetter?]
Do you normally have pigeon pea in a field where mbwera is carried out? What is the effect if you do?	Yes It's OK.

Blank Page

Termites and banking

Termites	
Do you have a problem with termites?	Yes.
How do you deal with this	Yes. breaks off pieces of nkhadze [*Euphorbia tirucalli*] and pushes the cut end of the twigs into the ground next to the damaged maize plant. She will also dig out the queen from termite mounds.
Banking	
What is your main field activity after first weeding?	Starts banking immediately after finishing first weeding. Applies fertilizer after banking.
Describe what you do (what do you do with the weeds) What effect does this have	Scoop up soil from one side of the furrow to ridge. Repeats for the other side. Buries weeds after hand-pulling big ones onto ridge. [not asked]
Do you do this in every field with every crop? What else?	Yes. Yes. If she misses first weeding then she does kwojekera (one-sided banking)(means doing two things together). This involves hoeing weeds from one side of the furrow to the opposite ridge. This way she combines first weeding and banking
In your opinion what effect does banking have?	Deepens soil on ridge and binds roots. Prevents lodging but does not otherwise affect yield compared to just weeding.
What change does she make to banking if termites are present?	Still banks but leaves a space around the maize roots with no soil.
Can you do mbwera after kusenda?	Not possible to do because there is not enough soil on ridges.

Whitegrub - Seed Dressing

Do you have a whitegrub [*matono* or *mbozi*] problem on any of your crops?	No, just stem borers which attack when plant is tasselling. Maize was all dying. Poisons birds on hill plot with maize bran laced with Temmic. Used to paint it on maize sheaths to stop bush pigs too.
Did you have a problem with this in the past?	She had whitegrubs in her dambo field but is no longer using it.
Do you have any way of dealing with this?	No.
What is your opinion of seed dressing?	She thinks it is effective. See above.
Have you ever tried seed dressing?	No.
Can you show us which plots had the seed dressing on?	Thinks Plots 3 and 4 have it on and have better cobs and better plant stand at germination. [This perception was correct for plot 3 which is treated, the other treated plot is 2. We need to ensure that all plots are correctly and visibly marked up and farmer is shown the labels. Here plot 3 had no labelling at all].

Changes

What changes would you like to see made this year?	Get rid of Napilira. Carry on with Masika. Change to later fertilizer application. Too early to comment on pigeonpeas.

ANNEX 3

1.0 Background Information

1.1	EPA	
1.2	Village	
1.3	Name of head of household	
1.4	Household member(s) interviewed	
1.5	Dambo or Upland	
1.6	Date	
1.7	Interviewers	

Participation

1.8 Did you or anyone in your household take part in the following activities on your research plots:
Yes = 1; No = 0

1.8.1	Planting	
1.8.2	Applying fertilizer	
1.8.3	Bean harvest	
1.8.4	Maize harvest	
1.8.5	Other (specify)	

Other relevant comment:

Farmer Name:		Village:	Date:

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2.0 Maize

2.1 How many fields did you plant with maize this year?

< 1	1	2	3	4	5	>5

2.2 What maize varieties have you planted this year (insert names below and years of recycling)?

2.3 What qualities do you look for in a maize variety (tick or insert farmer's choices below and number them in order given by farmer)? [DO NOT PROMPT!]

2.4 Are other criteria important? (Yes=1, No=0) (read out other criteria one by one and ask question 2.5 for each of them in turn before continuing to next criterion)

2.5 For each of the qualities you regard as important, please give a number for each of your varieties and for Masika on a scale of 1-5 where 1 is very poor and 5 is very good?

					2.2 Farmer's varieties:								
	2.3	Farmers' choice of criteria (number in order listed by farmer: 1, 2, 3 etc)	2.4 Are other criteria important? (1=Yes; 0=No)	CRITERIA	First variety =	Recycling code	Second variety =	Recycling code	Third variety =	Recycling code	Fourth variety =	Recycling code	2.5 RESEARCH VARIETY
Source of criteria:				Insert maize variety & recycling codes ===>									MASIKA
Open-ended evaluation	2.3.1			High yield									
	2.3.2			Large cob size									
	2.3.3			Many seeds per cob									
	2.3.4			High number of cobs/plant									
	2.3.5			Closed type of cob sheath									
	2.3.6			Speed of maturation									
	2.3.7			Response to fertiliser									
	2.3.8			Cob rot resistance in field									
	2.3.9			Poundability									
FSIPM	2.3.10			Resistance to drought									
	2.3.11			Resistance to flood									
	2.3.12			Recyclability									
	2.3.13			Marketability									
	2.3.14			Large grain size									
	2.3.15			Pest resistance									
	2.3.16			Disease resistance									
OTHER	2.3.17			Plant vigour									
	2.3.18												
	2.3.19	Overall, on a scale of one to five what is your opinion of Masika?											
FERTILIZER	**3.0**	**Did you use any fertilizer on your maize varieties this year? (insert code for fertilizer type)**											
	3.1		Mixed [1] Unmixed [2]										
	3.2		No of teaspoons per PS										
	3.3		One side [1] both sides [2]										
	3.4		Heaped [1] Unheaped [2]										
	3.5		In hole [1] Surface [2]										
	3.6		Covered [1] Uncovered [2]										

3.7 How many bags of each fertilizer did you buy?

3.8 How many bags of fertilizer would you have needed to buy to fertilize all your maize at the level you described?

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Codes for Maize Varieties

MH 17	A
MH 18	B
NSCM 41	C
Bantam	D
Popcorn	E
Katswiri Pan	F
Local	G
Other	H

Codes for recycling

New seed this year	0
Recycled once	1
Recycled twice	2
Recycled thrice	3
Recycled > 3 times	4

Codes for maize scoring

Don' t know/not relevant	0
Very poor	1
poor	2
Average/OK	3
good	4
very good	5

Codes for fertilizer

Fertilizer	Code
23: 21: 0 + 4S	1
Urea	2
CAN	3
	4
	5
	6

3.9 Fertilizer Timing

3.9.1 If you have some fertiliser, when do you apply it?

1 Soon after emergence
2 Just before tasselling
3 Later than this
4 Other (specify)

3.9.2 If you have some fertiliser, do you apply it:

1 Pre-banking
2 Post-Banking

Remind the farmer that we applied fertilizer to the plots soon after emergence, then ask:

3.9.3 Do you think the result of the research team's early fertiliser application will be:

[Tick whichever applies]
1 Less yield than if we applied the same amount just before tasselling
2 Same yield as if we applied the same amount just before tasselling
3 More yield than if we applied the same amount just before tasselling
4 Don't know

Remind farmer that we used about 3.5 teaspoons per station then ask:

3.9.4 How would you apply the same amount of fertilizer that we used to the same area of land i.e. the plot?

[Tick whichever applies]
1 Apply all soon after emergence
2 Apply all just before tasselling
3 Half just after emergence and half just before tasselling
4 Half just before tasselling and rest elsewhere on farm
5 Other
6 Don't know

Any other comments?

4.0 Beans

4.1 What problems were there with Beans this year?

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Initially record farmers spontaneous choices in column 3, then prompt with others (column 4) and ask the farmer to score all the ones they consider important on a scale of 1-5 (column 5) where 1=least serious and 5 = most serious.

	Problem	Farmer's spontaneous choices [0/1]	Are other criteria important? (1=yes; 0=no)	Scoring out of five
4.1.1	Wind removing flowers			
4.1.2	Too much rain			
4.1.3	"Burning" of leaves			
4.1.4	Wilting			
4.1.5	Stem Rot			
4.1.6	Pod rot			
4.1.7	[Other]			
4.1.8				

Problem scores

no problem	1
slight problem	2
medium problem	3
serious problem	4
very serious problem	5
Don' t know/not relevant	0

4.1.9	Which is most serious problem?	

(Insert most serious problem in 4.4.12 below)

4.2 What were the most serious bean pests this year?

Initially record farmers spontaneous choices in column 3, then prompt with others (column 4) and ask the farmer to score all the ones they consider important on a scale of 1-5 (column 5) where 1=least serious and 5 = most serious.

	Problem	Farmer's spontaneous choices [0/1]	Are other criteria important? (1=yes; 0=no)	Score out of five
4.2.1	Snails			
4.2.2	Sucking bugs			
4.2.3	Whitegrubs			
4.2.4	Ootheca			
4.2.5	aphids			
4.2.6	pod borers			
4.2.7	Other			

Problem scores

no problem	1
slight problem	2
medium problem	3
serious problem	4
very serious problem	5
Don' t know/not relevant	0

4.2.8	Which is most serious pest problem?	

(Insert most serious problem in 4.4.13 below)

Codes for bean scoring

Don' t know/not relevant	0
Very poor	1
poor	2
Average/OK	3
good	4
very good	5

Codes for bean varieties

Chimbamba/Zofiira	1
Zoyera	2
Small white	3
Yellow	4
Kaulesi	5
Nanyati (Dwarf)	6
Nanyati (climber)	7
Nambewe	8
	9
	10

4.3 What other bean varieties have you planted this year? (insert names below)

4.4 What qualities do you look for in a bean variety? (tick or insert farmer's choices below and number them in order given by farmer) [DO NOT PROMPT!]

4.5 Are other criteria important? (Yes=1, No=0) (read out other criteria one by one and ask question 4.6 for each of them in turn before continuing to next criterion)

4.6 For each of the qualities you regard as important, please give a number for each of your varieties and for each of the four research varieties on a scale of 1-5 where 1 is very bad and 5 is very good

					4.6 Research/farmer's variety comparison scoring (1-5)							
		4.4 Farmers' choice of criteria (number in order listed by farmer: 1, 2, 3 etc)	4.5 Are other criteria important? (1=Yes; 0=No)	**Criteria**	Farmer's variety 1 =	Farmer's variety 2 =	Farmer's variety 3 =	Farmer's variety 4 =	Research varieties			
	Source of criteria:			**Insert bean variety codes ===>**					Kaulesi	Kalima	Nagaga	Napilira
4.4.1	OEE			Yield								
4.4.2				Speed of maturation								
4.4.3				Marketability								
4.4.4				Number of beans in pod								
4.4.5				Taste								
4.4.6				Cooking time								
4.4.7	FSIPM			Pest resistance								
4.4.8				Disease resistance								
4.4.9				Tolerance of excessive rain								
4.4.10	OTHER											
4.4.11												
4.4.12	MOST SERIOUS	Most serious problem:										
4.4.13		Most serious pest:										
4.4.14	OVERALL	**Overall, which is your preferred variety?**										

4.5 Additional farmer comment or researcher interpretation of interview:

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5.0 Pigeon Peas

Please give a rating for each of the four research varieties on a scale of 1-5 where 1 is very bad and 5 is very good for each of the following qualities:

	Criteria	Local	ICP9145	ICEAP 00040	ICEAP 00053
5.1	Plant survival (i.e. stand)				
5.2	Wilting				
5.3	Vigour /growth				
5.4	Any other feature you feel is important (describe below)				

Codes for pigeonpea scoring

Don' t know/not relevant	0
Very poor	1
poor	2
Average/OK	3
good	4
very good	5

6.0 Crop Spacing

6.1 What is your normal spacing for maize? (Look at a nearby field) (show on diagram A below)

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0-40 cms		1
41-50 cms		2
51-60 cms		3
61-70 cms		4
71-80 cms		5
81-90 cms		6
>91 cms		7

KEY

Maize	M
Beans	B
Pigeonpea	P

6.2 Do you normally intercrop beans with the maize?

Yes		1
No		2

6.3 If so where do you position the bean plants? (show on diagram A below)

diagram A

Ridge Side 1							
Main Ridge		M					
Ridge Side 2							
Centimetres	-20	0	20	40	60	80	100

6.4 Do you normally intercrop pigeonpeas with maize?

Yes		1
No		2

6.5 If so where do you position the pigeonpea plants? (show on diagram B below)

diagram B

Ridge Side 1							
Main Ridge		M					
Ridge Side 2							
Centimetres	-20	0	20	40	60	80	100

6.6 Do you normally intercrop pigeonpeas with maize and beans in the same ridge?

Yes		1
No		2

6.7 If so where do you position the beans and pigeonpea plants? (show on diagram C below)

diagram C

Ridge Side 1							
Main Ridge		M					
Ridge Side 2							
Centimetres	-20	0	20	40	60	80	100

6.8 How many seeds per station do you plant?

crop	seeds
Maize	
Beans	
P pea	

6.9 We have had various reactions to our crop spacing practices on the research plots
Do you agree or disagree with each of the following statements

Agree		1
Disagree		2
Don't know		3

6.10 If you agree, what effect do you think this practice has had?

		Agree/not		
6.9.1	Maize too wide apart at 90 cms		6.10.1	effect:
6.9.2	Too many bean stations		6.10.2	effect:
6.9.3	Can't grow pigeonpeas with beans		6.10.3	effect:

Are there any other problems you have seen with the crop layout on the research plots?

Yes		1
No		2

6.11 If yes, please specify:

6.12 Have you made or do you intend to make any changes to your own cropping practices
as a result of what you saw on the plots this year or last year?

Yes		1
No		2

6.13 If yes, please describe these changes:

7.0 Mbwera

7.1 Information on mbwera (actual practice verified by research team):
mbwera = 1; no mbwera = 0

	Practice requested by researchers	Actual practice carried out by farmer
Plot 1		
Plot 2		
Plot 3		
Plot 4		

7.2 Do you normally carry out mbwera in some of your fields?

Yes		1	if so, go to 7.4
No		2	

7.3 If not, why is that?

If no, go to 7.7

7.4 If you plant pigeonpea in a field, does this mean that you can't do mbwera?

Yes		1
No		2

7.5 If you cannot do mbwera, please explain why not
If you can do mbwera, please explain how you manage

MATAPWATA ONLY. In Chiradzulu skip to 8.0

7.6 Do you normally carry out mbwera in the field where the research plots are?

Yes		1
No		2

7.7 How many research plots did you actually carry out mbwera in? (tick)

None	
1	
2	
3	
4	

7.8 Since doing mbwera what differences did you notice between crops in plots with and without mbwera?

7.9 Several farmers have told us that they have done mbwera in all their plots, although we only asked for it in two plots.
We would like to understand why they might have done this and have guessed several possible reasons.
We would like to hear your opinion. Do you agree or disagree with the following suggestions.

	Farmers did mbwera on all four plots because:	Agree/Not
7.9.1	not to do so would have been a waste of land	
7.9.2	not to do so would have been a waste of fertilizer	
7.9.3	they misunderstood instructions from the research team	
7.9.4	they did not get instructions from the team in time	

Agree	1
Disagree	2
Don't know	3

8.0 Banking

8.1 Information on research plot banking (actual practice verified by research team):

banked = 1; unbanked = 0

	Actual practice	Practice requested by researchers
Plot 1		
Plot 2		
Plot 3		
Plot 4		

8.2 Do you normally bank any of your fields?

Yes		1	go to 8.3
No		2	If not, why is that?

If not, go to 8.4

8.3 Do you normally bank the field where the research plots are?

Yes		1
No		2

8.4 How many of the research plots did you actually bank? (tick)

1	
2	
3	
4	
None	

If farmer is from Chiradzulu North with research plots in dambo field, go direct to 8.7

8.5 Some farmers have banked all four of their plots, although they were only asked to bank two. This puzzles us. Have you any ideas why they might have done this?

8.6 Since banking what differences have you noticed between crops in banked and unbanked plots?

8.7 Did you have a termite problem in the plots this year?

Yes		1	
No		2	If No, go direct to Section 9

8.8 If yes, at what stage of the crop did you notice damage?

Emergence or soon after	1
Knee-high	2
Tasselling	3
Cobbing	4
Maturity	5

8.9 Was this more or less serious than in the preceding 2 years?

Less		1
Same		2
More		3
Don't know		4

8.10 Did you expect to have termite attacks in that field from past experience?

Yes		1
No		2

8.11 Did you notice any difference in termite lodging between banked and unbanked plots?

Yes	
No	

9.0 Whitegrubs

9.1 Did you have whitegrub attack on maize plants in the research plots this year?

Yes		1
No		2
Don't know		3

9.2 If so, at what stage of the crop did you notice damage?

Emergence or soon after			1
Knee-high			2
Tasselling			3
Cobbing			4
Maturity			5

9.3 Was this more or less serious than in the preceding 2 years?

Less		1
Same		2
More		3
Don't know		4

9.4 Were there any differences between plots in terms of maize plant survival before banking?

Yes		1
No		2
Don't know		3

9.5 If so, which plots lost most plants?

None	
1	
2	
3	
4	
Don't know	

9.6 Was the maize in any of the research plots seed dresssed?

Yes		1
No		2
Don't know		3

9.7 If so, which plots?

1	
2	
3	
4	
Don't know	

9.8 Actual plots seed dressed (researcher information):

1	
2	
3	
4	

9.9 **Only if 9.7 answered correctly**, ask:
In your opinion has there been any effect of using seed dressing this year?

Yes, good effect		1
Yes, bad effect		2
No noticeable effect		3
Don't know		4

9.10 If yes, please describe the effect:

9.11 Have you used seed dressing yourself before?

Yes		1
No		2
Don't know		3

9.12 If so what was it and what effect did it have?

10. Changes

10.0 Are there any changes you would like to see in the type of experiments done on the research plots next year? Please explain

10.1	Different crop spacing	
10.2	Different fertilizer timing	
10.3	Different intercrops	
10.4	Other (specify)	
10.5	Other (specify)	
10.6	Other (specify)	

General comments and/or interviewer perceptions:

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT

REPORT ON A MEETING WITH SWEET POTATO WEEVIL TRIAL FARMERS IN MANGUNDA

BY
B. Mwale

24 AUGUST 1998

MINISTRY OF AGRICULTURE AND IRRIGATION
DEPARTMENT OF AGRICULTURAL RESEARCH
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INTRODUCTION

The field visit to the Sweet Potato Weevil Trial was planned with five specific agenda items:

- Meet five farmers at 1.00 P.M.
- Review with them last years trials
- Describe and discuss with farmers this year's trial strategy
- Draw up time frame/ Calendar for crack sealing
- Follow up on the Rapid Seed Multiplication Programme on the three varieties which farmers collected when they came for Seed multiplication training course.

The meeting began at around 2.10 P.M. at Mrs Chisanga's place. Only Four farmers came to the meeting. Mr Makwiti did not attend the meeting because he was sick. At the time the team visited Mr Makwiti, he was actually found noise breeding.

The meeting began with welcoming statements from the Field Assistants, Mr Kanyika. This was followed by self-introduction. Mr Alex Koloko and Tonny Maulana facilitated the proceedings of the meeting. Comments were recorded by Blessings. Envance translated for Mark Ritchie and Charity took notes on interactions between farmers and researchers. The meeting ended around 4.OO P.M.

REVIEW OF LAST YEARS TRIALS

Farmers Knowledge of the trials and its objectives

Mr Alex Koloko, first, thanked the farmers who came to the meeting. He advised that the purpose of the meeting was to share experiences in Last Year's Trials and discuss this year's trial strategy. Farmers were, initially, asked more broadly what last year's trials were all about. They recalled that they were given 6 varieties last year, although they could not remember the specific names of the varieties. With regard to the objectives of the trials, farmers indicated that it was to compare sweet potato weevil damages between the crack sealed and unsealed plots. **Apparently, there was no mention by any of the farmers about the objective of variety resistance. However, farmers indicated that TIS variety did not perform well.**

Farmers observations

Mrs Chisanga said there was little weevil attach on the sealed plots compared to the unsealed plots and generally the size of the tubers were small on the sealed plots.

Mr Mwenyekeni said there were not significant difference in weevil attach between sealed and unsealed plots and agreed with Mrs Chisanga that size of tubers were smaller in the sealed.

Mr Phambala said the plots did not perform well partly because late planting. heavy rains and poor weeding.

Mr Mahinje said he made no observations on the plots

Then, Mr Koloko informed the farmers that, apparently, their observations were not different from what the project also found out after analysing the data.

What farmers perceived to explain for the differences in the plot performance:

Farmers generally agreed that crack sealing reduces weevil infestation. Again. frequent crack sealing might have affected the size of sweet potato tubers. especially in heavy soils. They felt so many crack sealing might have put a lot pressure on the tubers. thereby. making them difficult to expand. It might have also adversely affected soil temperature. which is necessary for tuber growth. They. however. said the number of crack sealing may vary according to soil type.

DESCRIBE AND DISCUSS WITH FARMERS THIS YEAR'S TRIAL STRATEGY

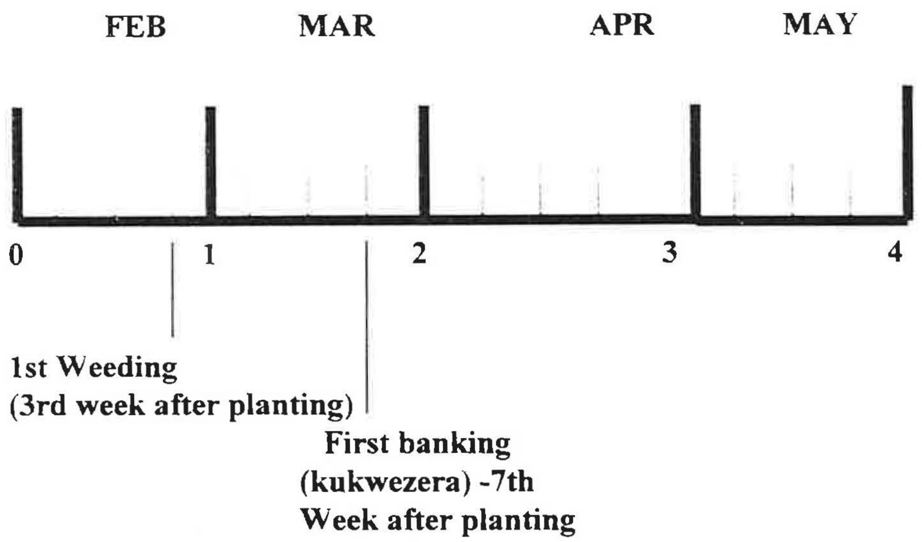
Mr Koloko advised farmers that for this year. the project was proposing to use only one variety. **Kenya**. and reducing number of crack sealing from **8 or 9** to a maximum of **three.**

- Farmers overwhelmingly agreed to have Kenya variety in this year's trials
- Size of plots should be the same as last year's
- Location of plots will be different from last year. Farmers reckoned the fact that monocropping encourages pest and disease build-up. resulting in low yield
- Time of planting will from 1st March 1999 after which you really experience weevil infestation. and thus fits the trial objective
- Farmers agreed to the proposed three maximum crack sealings
- land preparation will be done in February

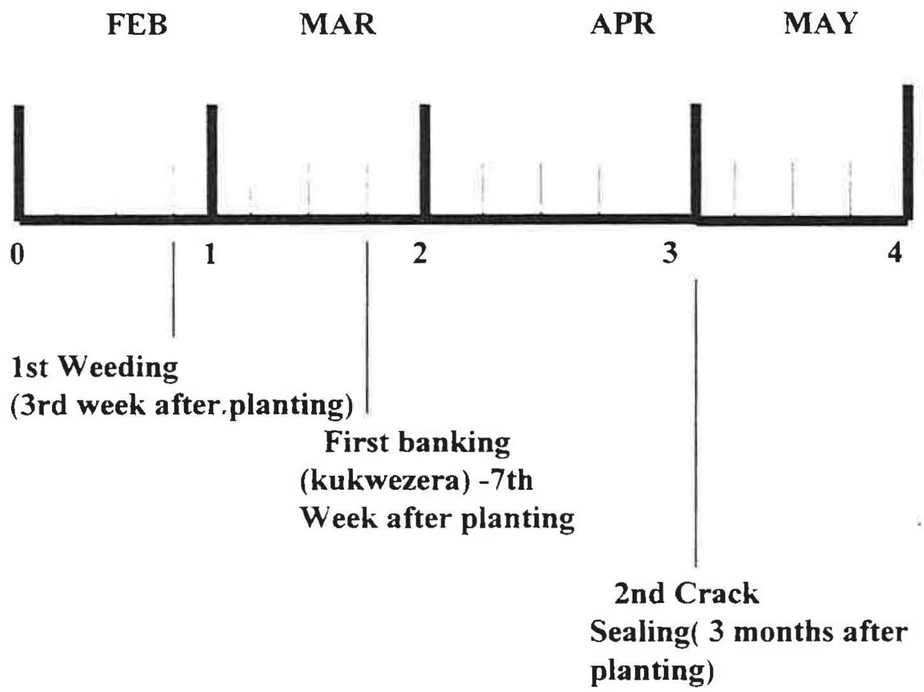
DRAW UP TIME FRAME/ CALENDAR FOR CRACK SEALING

Farmers with the assistance of the Research team developed the time line or calendar of crack sealing taking into account farmers' existing practice. The following were revised agreed calendar for crack sealings based on a four months period of planting to harvesting:

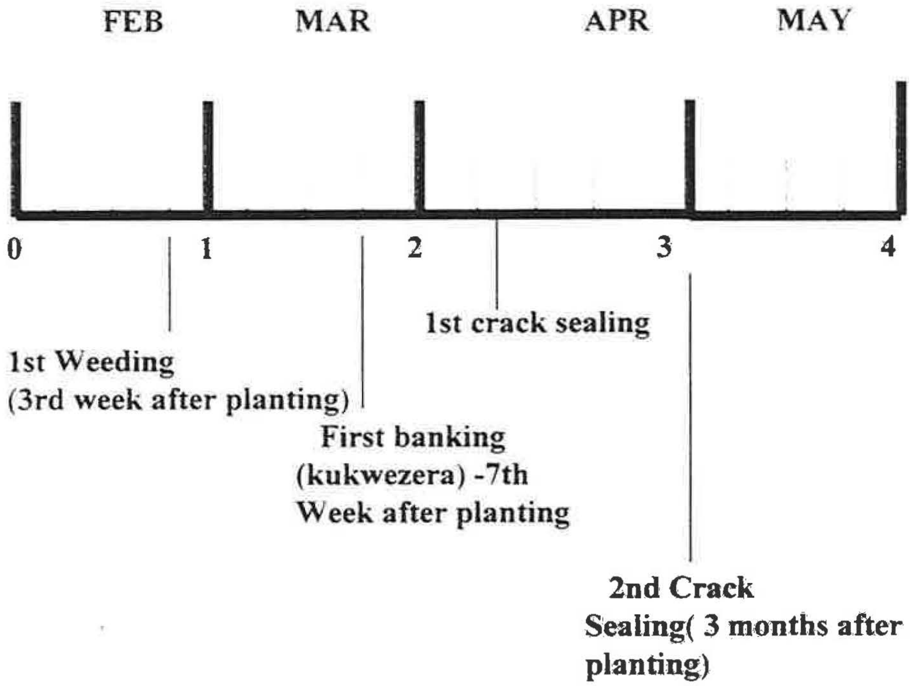
Control Plot



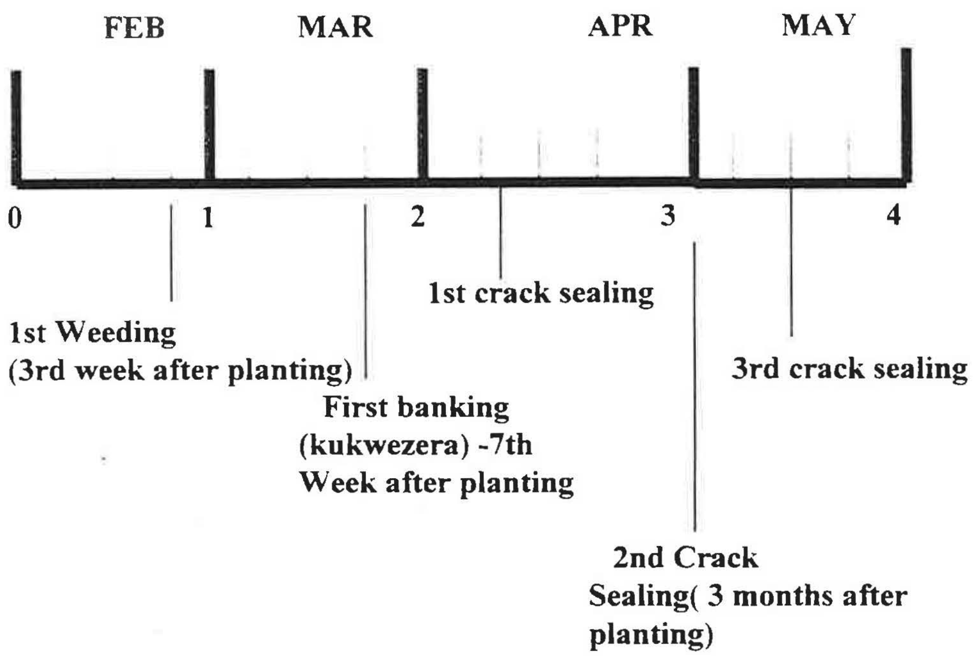
One crack Sealing



Two crack Sealing



Three crack Sealing



Note. Farmers wondered whether they could use their feet to seal the cracks especially in the forth month when the farmer is essentially waiting for potential buyers. In that case, the farmer just goes to spots where the cracks have developed instead working on the whole field.

LESSONS

- Farmers were willing to continue participate with the trials as proposed
- Farmers were happy to have been consulted at this early stage so that they can get prepared
- There are other farmers in the area who are also interested to participate in the trials
- Number of crack sealing may vary depending on type of soils
- Planting should be delayed to tally with the time when sweet potatoes face high weevil attach

ACTION POINTS

- The project should consider selecting one or more farmers to participate in the trials
- There is need to work out seed requirement on time i.e. seed multiplication on-station
- A briefing session for Mr Makwiti and the new farmers should be arranged

- Farmers need to be given copies of the Calendar of Crack Sealing as agreed at the meeting
- Time of planting needs to be revisited as March was considered to be too late. Rains sometimes stop much earlier than that.
- Conduct economic analysis of the trials

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

Sweet potato trial, 1997/98: farmer diagnosis and evaluation, with economic analysis.

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14 August, 1998

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LIMBE

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Abstract

An OFT was conducted in the 1997/98 season in Mangunda section, Matapwata EPA, to test the effectiveness of crack-sealing against the sweet potato weevil (*Cylas puncticollis*) and to identify resistant sweet potato varieties. Cracks were covered weekly for nine weeks, starting 30 days after planting. Results showed an average of 47 % damaged tubers on unsealed plots, compared to 43 % on sealed plots. Farmers believed crack-sealing reduced damage from *Cylas* but saw no difference in *Cylas* damage between varieties. Kenya and LRS 407 were preferred as the highest-yielding and most saleable varieties. Farmer diagnosis of the *Cylas* problem showed infestation was highest when sweet potato was planted late, matured during the dry season, and when harvesting was delayed. *Ex ante* economic analysis suggested that two crack-sealings were profitable if they reduced *Cylas* damage by 20 %. Farmer perceptions were used to derive a set of recommendations for a new OFT in 1998/99. These included: (1) focus on crack-sealing rather than varietal resistance; (2) reduce the frequency of crack-sealing to a maximum of three; (3) include the number of crack-sealings as a treatment; (4) teach farmers about the life-cycle of *Cylas*; (5) choose a more representative sample of participating farmers.

1. Introduction

Sweet potato (*Ipomoea batatas*) production in Malawi has grown nine-fold since 1990 and now accounts for 10 % of total foodcrop production. The rapid growth in sweet potato production is explained by several factors. The release of the high-yielding variety Kenya (originally developed at Amani, Tanzania, as Zero SPN/0) has stimulated commercial production. Recent droughts have led to the promotion of sweet potato by both government and NGOs on grounds of food security. Finally, successive increases in the real price of fertiliser have forced resource-poor farmers to grow sweet potato as a substitute for unfertilised local maize.

The sweet potato weevil *Cylas puncticollis* (Boheman) is the most destructive insect pest of sweet potato in Malawi. IPM pest management strategies include varietal resistance and cultural control. Yoyera, Kenya, and Babache are recommended as 'resistant' varieties (MOALD, 1994). Only Kenya is both 'moderately resistant' and high-yielding, however (Munthali, 1989). Cultural control methods include avoidance of adjacent planting, crop sanitation, and sealing cracks on the planting ridges to prevent adult weevils from reaching the developing tubers below ground (Smit and Matengo, 1997). Crack-sealing has proved to be effective against the weevil *Cylas formicarius* (Pardales and Cerna, 1987). The Soil Pests Project conducted an OFT in 1993/94 in Katuli EPA, Mangochi, to test the effectiveness of crack-sealing against *Cylas puncticollis* but the results did not receive a fomal statistical analysis (Khonga, 1997). An on-station trial by the FSIPM Project at Bvumbwe in 1996/97 gave no results because of low rates of *Cylas* infestation. In 1997/98, therefore, the FSIPM Project conducted an OFT in Mangunda section, Matapwata EPA, where many farmers grow sweet potato and where *Cylas* infestation is high.

This report brings together information from (1) preliminary results of the 1997/98 OFT; (2) farmers' diagnosis of the *Cylas* problem and their evaluation of the OFT; and (3) available published sources on sweet potato weevil. In combination, these allow a more accurate appraisal of the *Cylas* problem in Mangunda and will help the Project design a more appropriate OFT for the following season.

2. Trial objectives, design, and results

Although no formal statistical analysis has yet been made, a preliminary report is available (Ritchie *et. al.*, 1998). The objectives of the trial were to test the effectiveness against *Cylas* attack of (1) crack-sealing; and (2) resistance of different sweet potato varieties.

Design

Five commercial sweet potato growers were purposely selected for participation in the trial (Mkandawire *et. al.*, 1997). Five varieties of sweet potato were evaluated (Babache, Gisukulume, LRS 407, Mukobwa, and TIS 3290), with Kenya as the local check. With a total of six varieties and two replicates per farmer, the trial consisted of twelve plots for each participating farmer. Each plot measured 10.8 m x 5.4 m, with six ridges 90 cm apart. Each plot was divided into two subplots of 5.4 m each in one of which the cracks were sealed and in the other left unsealed. The OFT was planted between 20 December 1997 and 4 January 1998. Sealing cracks was done weekly starting 30 days after planting and afterwards for nine weeks. Farmers provided labour for crack-sealing. At harvest the net plot of four ridges per subplot (4.2 x 3.8 m) was assessed for each variety. All the tubers from each net subplot were sorted into damaged and undamaged categories and weighed. Ten damaged tubers were chosen at random, dissected, and weevils found counted.

Experimental results

Results showed a high average proportion of damaged tubers (> 45 %). Although some damage is attributed to tuber rot, the results confirmed the severity of *Cylas* infestation at Mangunda. The data showed that crack-sealing produced only a slight reduction in Cylas damage (43 % damaged compared to 47 %). Crack-sealing severely reduced average yields, however. Net plot yields (4.8 x 3.8 m) were 26 kg on unsealed plots compared to 22 kg on sealed plots. By disturbing the vines, crack-sealing may have reduced the above-ground biomass and thus the capacity of sweet potato for photosynthesis, thereby reducing yields..

3. Farmer diagnosis

A Project meeting was held to plan the format of the farmer evaluation anmd prepare a checklist of questions. All five participating farmers were interviewed, both individually and as a group, to obtain their perceptions of the *Cylas* problem and of the OFT. Interviews were conducted on 21-22 July, about two months after harvest. We also interviewed Mr. Kanyika, the FA for Mangunda section.

Pest infestation

Figure 1 shows that *Cylas* infestation begins at the end of the wet season in May, becomes gradually more severe in June and July and peaks in August. Similar farmer perceptions of the pattern of *Cylas* attack have been reported elsewhere (Kapeya *et. al.*, 1997). Farmers identified the three main factors determining this pattern of infestation as: (1) dry weather, high temperaures; (2) late planting; and (3) delayed harvesting.

First Crop

Since *Cylas* damage is concentrated in the dry season, the first crop of sweet potato planted with the first rains in December normally suffers the least damage. Farmers believe that rain helps seal any cracks during this period. Since farmers are unable to stock enough vines during the dry season, the main function of the first crop is to provide planting material for subsequent crops. Cuttings are normally taken after first weeding once the crop is well established.

Second Crop

The second planting represents the main commercial crop, planted in January and harvested in April. It is sold immediately it reaches maturity, often directly from the field. Adoption of the short-duration variety Kenya (four months' field duration *versus* six months for local varieties) has reduced the period of exposure to *Cylas*, except when the crop is harvested late. Reasons given for delayed harvesting included: (1) failure to find a buyer; (2) priority was given to harvesting maize; (3) Kenya cannot be stored for more than one month, so is best kept in the field; and (4) late planting due to lack of suitable *dambo* land for nurseries, forcing farmers to use cuttings from the first crop.

Third and Fourth Crops

A third crop is frequently grown and, if there have been good rains, a fourth and last crop may also be planted. The third crop is relay-sown into standing maize in February as an *mbwera* crop, in which the maize leaves are stripped and incorporated into a new planting bed made in the furrow between the maize ridges. In the fourth crop, sweet potato is grown as a sole crop after the harvest of maize in March-April. Harvesting of the the third and fourth crops may extend until August. These crops are used for food and as a source of planting material for the next season. If used chiefly for planting material, farmers may harvest only as much as they need for their nurseries. Sweet potato planted from February onwards suffers most damage from *Cylas*. Damage to the first and second crops may be more important in economic terms, however, since they are grown primarily for cash income.

Weeding practices

Farmers normally give a first weeding (*kupalira*) to loosen the soil one month after planting. This is followed by a second weeding (*kukwezera*) when tubers develop and cracks start to appear in the ridges. The technique of *kukwezera* involves standing on top of the ridge, moving vines to one side, and pulling earth upwards with a hoe to cover cracks made by developing tubers. *Kukwezera* differs from banking (*kubandira*). In banking, the ridges are built up with lots of soil, which makes it difficult for moisture to reach the tubers. The lighter soil covering obtained with *kukwezera* allows moisture to penetrate to the tubers. The timing of *kukwezera* varied. One farmer started *kukwezera* immediately after finishing first weeding and before cracks had appeared. Others waited for cracks to appear. In general, *kukwezera* started three months after planting for the first crop and two months after planting for the second crop (Figure 1). *Kukwezera* is done not to prevent access to the tubers by *Cylas* adults but to remove weeds and to place soil around the tubers and help them grow bigger. Exceptionally, some farmers might do a second *kukwezera* or bank their sweet potato ridges (*kubandira*). This was done only if they could not find a buyer and the crop had to be left in the ground for a long time after reaching maturity.

One weeding and one or two 'bankings' (which probably refers to *kukwezera*) appear to be the standard practice among sweet potato growers in Malawi. A survey of sweet potato growers in four districts in central and southern Malawi show that none banked more than twice (Kapeya *et. al.*, 1997, Table 20).

4. Farmer evaluation

Knowledge of objectives

Farmers were well informed on the objective of crack-sealing. All five said this was to prevent weevils entering the cracks. They also mentioned that crack-sealing increased the size of the tubers (and gross yield) by ensuring that they remained covered with soil. Only one farmer mentioned varietal resistance as a specific objective of the OFT.

Previous research has shown that because farmers do not understand how insects reproduce they are not aware of the link between weevil larvae and adults, or that adult weevils enter cracks in the ridges to lay eggs inside the tubers. Farmers therefore cannot appreciate the rationale for crack sealing, which is to deny adult weevils access to tubers (Riches *et. al.*, 1993; Smit *et. al.*, 1994).

Surprisingly, we discovered that despite their participation in the OFT, our five farmers were equally ignorant of the link between adult weevils and eggs. They understood that crack-sealing prevented entry of adult weevils but did not know that eggs in the tubers were laid by these adults. This being so, can they really have understood the reason for crack-sealing ? This underlines the need for teaching farmers about the weevil so they can evaluate the effectiveness of the IPM strategy. Since IPM is knowledge-based, it is essential that *science* is transferred to farmers and not just technology because, without the science, farmers will not understand the rationale for the technology. If farmers know the reasons for what is being done they will be in a stronger position to evaluate the intervention and improve existing practices.

Varieties

Matrix ranking of the five varieties tested showed that Kenya, LRS 407, and Gisukulume scored highest for yield and taste (Figure 2). Only Kenya and LRS were considered marketable, however, since consumers were reluctant to buy varieties with which they were not familiar. Kenya remained the most preferred variety. The rankings reflected the preferences of commercial growers. Farmers growing primarily for home consumption might well have ranked the same varieties differently. At the end of the exercise, farmers were asked if they had noticed any difference in *Cylas* damage between varieties. They all said 'No'. Farmers requested Kamchiputu vines for next season. Although this variety is highly susceptible to *Cylas* (Munthali, 1987) its sweet taste commands a price premium among consumers. The finding that farmers did not perceive any difference between varieties in resistance to *Cylas* is also supported by survey data (Kapeya *et. al.*, 1997).

Crack-sealing

All five participating farmers believed that crack-sealing had reduced damage from *Cylas*. Results from the OFT show that this was not true. There are several possible reasons for farmers' misperception on crack-sealing. They were being asked to judge yield differences between six varieties, most of which were not familiar to them. They were not interviewed in the field at time of harvesting. Finally, since they did not know that the eggs were laid by adult weevils, they may not have understood exactly how crack-sealing might reduce damage from *Cylas*.

Nearly all farmers commented that labour shortages made it difficult to do crack-sealing on a large scale. Most had never done *kukwezera* more than once. *Kukwezera* was rarely done with the third or fourth crops, possibly because weeds are less of a problem when it is dry. One farmer observed that *kukwezera* was easier to do when the soil was wet while another commented there was little point doing *kukwezera* in the rains since the rain sealed the cracks anyway.

5. Economic analysis

Labour requirements

The trial design required a total of nine crack-sealings per farmer. Two farmers managed eight sealings, one managed seven, and two managed six. Labour requirements for crack-sealing on OFT plots were timed with a watch. A total of 114 observations were made for five farmers for nine weeks after planting. Times per unit area were converted to a hectare basis and weighted according to the type of labour used (1.0, male; 0.8, female; 0.5, child). ANOVA showed a significant difference in mean labour requirements between farmers ($F = 30.285$, $P < .000$). This may reflect variation in soil texture or level of *Cylas* infestation. Table 1 shows that mean labour requirements were 152 hours/ha (weighted) and 163 hours/ha (unweighted). These figures are close to the standard figure of 170 hours/ha for first weeding (Werner, 1987). In view of the high variation around the mean, the weighted median figure of 131 hours/ha was used in economic analysis.

Table 1. Labour requirements for crack-sealing, Mangunda, 1997/98.
(hours/ha)

Variable	Unweighted	Weighted
Mean	162.605	151.684
Median	151.500	131.000
Mode	143.000	97.000
St. dev	85.278	87.023
Variance	7272.400	7572.944
Maximum	434.000	434.000
Minimum	34.000	34.000

Source: FSIPM Survey. Note: n = 114 observations, 5 farmers.

Partial budget analysis

Since the results showed only slight reduction in *Cylas* damage from crack-sealing, no economic analysis was made for the OFT. The potential benefits from crack-sealing may be illustrated with an *ex ante* economic analysis for two additional crack-sealings (*kukwezera*). A 20 % yield increase was assumed from crack-sealing, which is likely to be the minimum required by farmers. Only one of the five farmers interviewed used exclusively family labour for first weeding and banking. The others used a mixture of hired and family labour or relied on permanent labour. Wage-rates for permanent labour were 50 MK/week for men and 40 MK/week for women. The partial budget suggests that where sweet potato is sold two crack sealings are profitable (Table 2).

Table 2. ***Ex ante*** **partial budget for crack-sealing sweet potato, Mangunda, 1997/98**

Variable	**Treatment**	
	Unsealed	**Sealed X 2**
Yield (kg/ha) [a]	7153	8584
Adjusted yield (kg/ha) [b]	5722	6867
Gross field benefits (Mk/ha) [c]	8011	9614
Cost of labour for additional *kukwezera* (MK/ha) [d]	0	660
Total costs that vary (MK/ha)	0	660
Net benefits (MK/ha)	8011	8954

Notes:

a Unsealed: 5-year mean, Blantyre Shire Highlands RDP, Third Crop Estimates.
Sealed: assumed 20 % yield increase.
b adjusted downwards by 20 %
c farmgate price of 1.4 MK/kg
d 131 hrs/ha, 4 hours/day, wage-rate 10 MK/day

A low input, high return crop ?

One reason farmers may be unwilling to adopt labour-intensive IPM strategies for sweet potato is that they regard it as a low-input crop and are willing to tolerate high crop losses from pests (Fielding and Crowder, 1995). Table 3 compares returns to labour for sweet potato with three crops. Fertilised hybrid maize was used as the index for comparison. Expressed in kilocalories, returns to labour from sweet potato were similar to those from fertilised hybrid maize. This suggests that sweet potato in Malawi cannot be described as a 'low-input' crop. Cassava, with almost twice the kilocalories/manday as fertilised hybrid maize, might fit this description. Returns to labour from sweet potato were almost three times higher than for unfertilised local maize, however. Farmers might tolerate high losses if sweet potato were grown as a substitute for this crop.

Table 3. Comparative returns to labour from maize, cassava, and sweet potato

(hybrid maize=100)

Variable	Hybrid maize, fertilised	Local maize, unfertilised	Cassava	Sweet potato
Labour [a]	100	96	105	113
Yield (kg/ha) [b]	100	37	209	395
Yield (kcal/kg)	100	100	92	32
Returns to labour:				
Kg/manday	100	39	199	350
Kcal/manday	100	38	184	111

Notes:

[a] Werner (1987); Sam (1995); Sam (nd).
[b] 5-year mean, Blantyre Shire Highlands RDP, Third Crop Estimates.

Economic model of crack sealing

The economics of crack sealing are outlined in a geometric model (Figure 3). The model is schematic and based on imperfect knowledge but it captures the main variables necessary for a formal economic analysis. These are: (1) the relationship between the number of crack-sealings and yield; (2) the farmgate price of sweet potato for different plantings, and the cost of labour for crack-sealing; (3) labour requirements for crack sealing; (4) the relationship between planting date and *Cylas* damage.

Information is already available for variables (2) and (3). The OFT must be designed to provide information on (1) by including number of crack-sealings as a treatment. Information on (4) can be collected through year-round monitoring using pheromone traps and by destructive sampling of the crop.

6. Recommendations for 1998/99

It is important that the Project learns from farmer perceptions to design a more appropriate OFT next season. In this section, we summarise seven important farmer perceptions and outline lessons for design of a new OFT. Some proposed changes will require more discussion with farmers before the design is finalised.

1.* Cylas *damage is more severe in dry season months (July/August).

The incidence of *Cylas* should be monitored throughout the year to establish the calendar for this pest. In 1997/98 monitoring was only done for the duration of the OFT (February-April). The OFT should be timed to coincide with farmers' main crop, planted in January. Results from the OFT in 1997/98 show that this crop may also suffer severe damage from *Cylas* (> 45 %).

2. Economic damage is greatest to the main crop when harvested late

The reasons for delayed harvesting and its frequency should be identified. This may form part of a comprehensive survey on sweet potato which will explore reasons for growth in sweet potato production in Mangunda and Mombezi.

3. Optimum time for crack-sealing is two-three months after planting

In the OFT, crack-sealing began in mid-February, one month after planting. Farmers saw no need to seal cracks during the wet season and generally started *kukwezera* for the second crop two months after planting. Trials in the Philippines with the weevil *Cylas formicarius* timed crack-sealing at four, six and eight weeks after planting (Pardales and Cerna, 1987). Previous trials in Malawi have used two crack sealings at four and eight weeks after planting, followed by one weeding 10 weeks after planting since vines had spread and further sealing would have damaged them (Munthali, 1989).

4. Labour shortages make frequent crack-sealing difficult

In the 1997/98 OFT farmers were asked to seal cracks no fewer than nine times. None of the five participating farmers managed this, yet these were commercial growers, several of whom employed permanent labourers. Most farmers seal cracks only once. It is unrealistic and probably uneconomic for farmers to seal cracks more than twice.

5. No link between adult weevils and eggs in tubers

If farmers are to participate effectively in the OFT they must understand how crack sealing reduces damage from *Cylas*. Since farmers do not know the life cycle of the sweet potato weevil, we must teach them using samples of sweet potato eggs, larvae, and adults, and a simple diagram showing the cycle of insect reproduction. Training should be given before planting the OFT.

6. No difference in resistance to Cylas *between different varieties*

Since breeders have so far failed to identify varieties of sweet potato which are more than 'moderately' resistant to *Cylas,* it does not seem appropriate to include varietal resistance as a treatment in OFTs for crack-sealing. Moreover, testing two IPM strategies (varietal resistance, cultural control) in one OFT confuses farmers and makes it difficult for them to evaluate results. Since farmers liked some of the varieties we used, however, we could continue to supply vines of recommended varieties for them to grow and multiply if they wished.

7. Sweet potato varieties valued chiefly for yield and saleability

It seems likely that commercial growers have different criteria for sweet potato varieties than resource-poor farmers, who may also find it more difficult to find sufficient labour for crack-sealing. Choosing a more representative sample of participating farmers would allow a more accurate evaluation of the appropriateness of both IPM strategies.

ABBREVIATIONS

ADD	Agricultural Development Division
EPA	Extension Planning Area
FA	Field Assistant
FSIPM	Farming Systems Integrated Pest Management
IITA	International Institute of Tropical Agriculture
IPM	Integrated Pest Management
MOALD	Ministry of Agriculture and Livestock Development
NGO	Non-Government Organisation
OFT	On-farm trial
RDP	Rural Development Project
SARRNET	Southern Africa Root Crops Research Network

References

W. J. Fielding and L. V. Crowder (1995). 'Sweet Potato Weevils in Jamaica: Acceptable Pests?' *Journal of Sustainable Agriculture*, **5** (4): 105-117.

E. H. Kapeya, E. S. Matabwa and C. M. Chikaunga (1997). Sweet Potato Production as a Drought Relief Measure: Farmers' Experience in Sweet Potato Production. Paper presented at 4th Chitedze Public Seminar, Lilongwe, 28 November. Mimeo, 17 pp.

E. B. Khonga (1997). *Integrated Pest Management of Soil Pests in Malawi*. EMC X0147 (Phase 2). Final Technical Report. University of Malawi, Chancellor College: Soil Pests Project. Mimeo, 50 pp.

Ministry of Agriculture and Livestock Development (MOALD) (1994). *Guide to Agricultural Production in Malawi, 1994/95-1995/96*. (Lilongwe: MOALD).

C. B. K. Mkandawire, A. Koloko, T. Maulana, T. Milanzi and E. Shaba (1997). Diagnostic survey on sweet potato weevil (*Cylas pucticollis*) problem in Mangunda Section of Matapwata EPA. Mimeo.

D. C. Munthali (1989). 'Susceptibility of five locally grown sweet potato (*Ipomoea Batatas*) cultivars to *Cylas Puncticollis* infestation in Zomba, Malawi', Pp. 219-227 in M. N. Alvarez and S. K. Hahn, (eds.) *Root Crops and Low-Input Agriculture. Proceedings of the Third Eastern and Southern Africa Regional Roots Workshop, Mzuzu, Malawi, 7-11 December*. (Ibadan: IITA).

J. R. Pardales and A. F. Cerna (1987). An agronomic approach to the control of sweet potato weevil (*Cylas formicarius elegantulus* F.), *Tropical Pest Management*, **33** (1): 32-34.

C. R. Riches, L. J. Shaxson, J. W. M. Logan, and D. C. Munthali (1993). *Insect and Parasitic Weed Problems in Southern Malawi and the Use of Farmer Knowledge in the Design of Control Measures*. ODI Agricultural Administration (Research and Extension) Network, Paper No. 42. July.

J. M. Ritchie, C. B. K. Mkandawire, A. Koloko, and T. Milanzi (1998). Preliminary report on OFTs of crack-sealing with six sweet potato varieties for control of sweet potato weevil (*Cylas Puncticollis*) in Matapwata EPA. Paper presented at Annual Crop Protection Meeting., NRC, Lilongwe, 3-6 August. Mimeo.

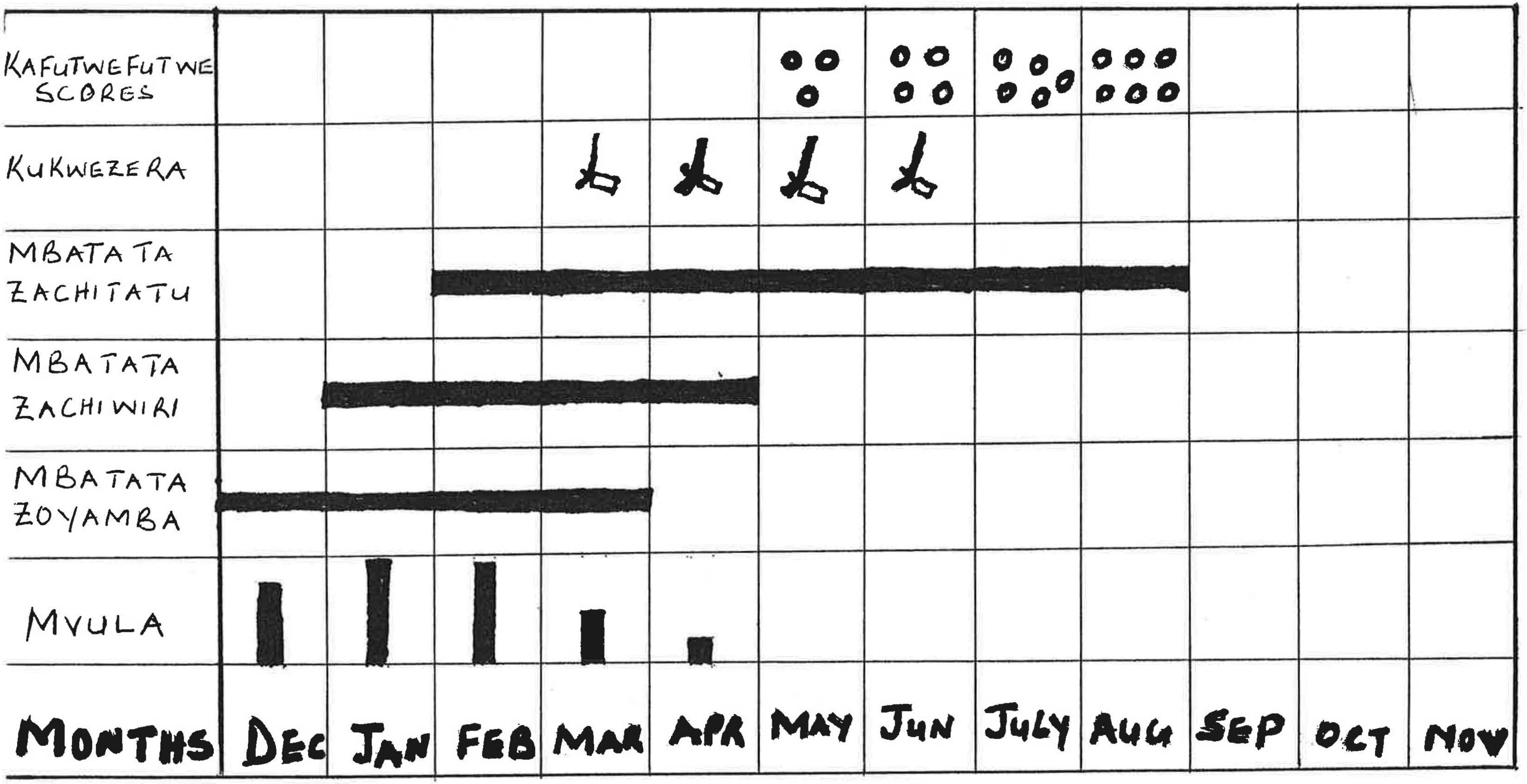
S. Sam (nd). Sweet Potato Production in the Central Region of Malawi. (Lilongwe: SARRNET). Mimeo, 14 pp.

S. Sam (1995). Economic Analysis of Cassava Production Along the Lakeshore Areas of Malawi. (Lilongwe: IITA/SARRNET). Mimeo, 18 pp.

N. E. J. M. Smit and L. O. Matengo (1995). 'Farmers' cultural practices and their effects on pest control in sweet potato in south Nyanza, Kenya', *International Journal of Pest Management*, **41** (1): 2-7.

J. Werner (1987). Labour requirement and distribution for smallholder crops. Adaptive Research Section, Liwonde Agricultural Development Division. Mimeo, 44 pp.

RAINFALL PATTERN, GROWING PERIODS, TIME OF KUKWEZERA AND SCORES & PERIOD OF WEEVIL ATTACK OF SWEET POTATO AT MANGUNDA IN THYOLO DISTRICT ON 21st JULY, 1998.
MATAPWATA E.P.A.

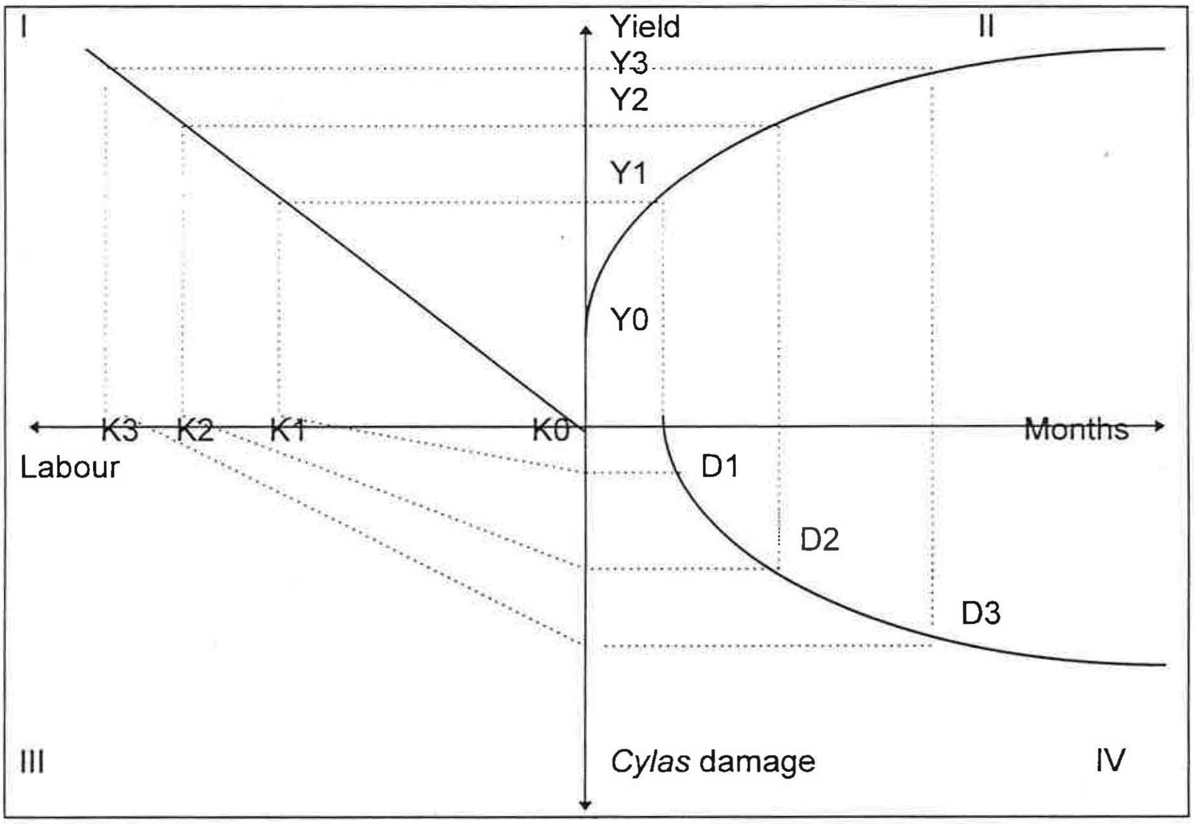


MATRIX RANKING OF YIELD, TASTE, MARKETABILITY, ADOPTION AND VARIETIES REQUIRED BY FARMERS OF SWEET POTATO AT MANGUNDA IN THYOLO DISTRICT ON 21st JULY, 1998.
MATAPWATA E.P.A.

MITUNDU YA MBATATA	KUBERERA	KUKOMA	MALONDA	ADOPTION	VARIETIES REQUIRED BY FARMERS
KENYA	o o o o o	o o o o o	o o o o o	5	1
MASAMBA OFIIRA (LRS)	o o o o o	o o o o o	o o o o o	5	2
BABACHE	o o	o o o o		2	
TIS 3290	o o o	o o o		2	3 GOOD STORAGE
GISUKULUME	o o o o o	o o o o o		3	4

NB KAMCHIPUTU FARMERS WANT IT TO BE GROWN THIS COMING SEASON

Appendix 3. An economic model of crack sealing for sweet potato



Quadrant II shows the potential yield response curve for sweet potato in relation to time. Yield is assumed to follow a modified exponential trend. Quadrant IV shows the damage function for *Cylas* weevil. Quadrant I shows the relationship between crack-sealing and yield. Three crack-sealings are shown (K1, K2, K3). With zero crack-sealing (K0) farmers will obtain yield (Y0).At this pont there is no damage from *Cylas*. One crack-sealing is required to obtain yield Y1, at damage level D1. This represents existing farmer practice. When damage reaches level D2, two crack-sealings (K2) are needed to obtain potential yield Y2. Note that the increase in yield from two crack sealings is lower than from a single crack-sealing ((Y1-Y0 >Y2-Y1). At damage level D3, potential yield is obtained with a third crack-sealing (K3). Again, yield benefits from K3 are lower than from K2 (Y3-Y2 <Y2-Y1). Marginal revenue and cost curves are not shown in this diagram.The economic number of crack-sealings is obtained when the the marginal revenue (additional yield X value) equals the marginal cost of labour (additional labour X wage).

FARMING SYSTEM INTEGRATED PEST MANAGEMENT PROJECT

REPORT ON FARMER EVALUATION FOR THE PIGEON PEA TRIALS FOR MANGUNDA CONDUCTED ON 11TH SEPTEMBER 1998

Introduction

The field visit to the Pigeon pea Trial was planned with the following specific programme items:

- Remind farmers of last year's trial
- Ask farmers criteria for pigeon pea evaluation
- Ask farmers to rank criteria
- Explain evaluation process, using a scoring method of 1-10 beans, before going to Mr Phambala's field.
- Do actual evaluation and discuss results
- Discus future trial strategy
- Follow-up on the extra seed of the pigeon peas that was give to farmers last year
- Revisit date of planting for sweet potatoes
- Ask for extra names of farmers (two) to participate in this year's sweet potato trials

The meeting was convened at Mrs Chisanga's house. It started and closed with a prayer by **Mr Mankhanamba.** After the opening prayer, the Field Assistant, **Mr Kanyika**, made some welcoming remarks. This was followed by self-introduction.

Six farmers attended the meeting. Two of them were women and four were men. These farmers were: **Mr Phambala; Mrs Phambala; Mrs Chisanga; Mr Mwenyekeni; Mr Mankhanamba; and Mr Makwiti**. It was learnt that Mr Mahinje has voluntarily decided not to participate in this year's trials, for both pigeon peas and sweet potatoes.

Bonex Mkandawire facilitated the rest of the discussions with farmers. **Blessings Mwale** was the rapporteur, **Mark Ritchie , Savitri Abeyasekera, Hastings Mputeni** and **Charity Chanza(**Bunda Masters Student) were observers. **Phillip Kapulula** translated for Mark Ritchie and Savitri Abeyasekera. In the field Hastings and Savitri assisted in counting the scores during the trial evaluation.

In his opening remarks, Bonex thanked Mrs Chisanga who has always hosted all the project meetings with the other farmers. He also welcomed Mrs Phambala who came to the meeting for the first time and Mr Mankhanamba, a new farmer.

He told the farmers that the purpose of the visit was to discuss the performance of the pigeon peas from the last year's trial plots and plan for this year's trial strategy. He noted that that Mrs Chisanga had lost all her pigeon peas due to maize shading effect. However, he hoped that she could still join the other members in making observations about the trial.

Review Of Last Years Trials

When asked about the objective of last year's trials, Mr Phambala said that it was to test whether the new varieties were suitable in their own area. The farmers recalled that they were given 7 varieties for last year's trial but did not remember specific names of the varieties. Samples of the seven varieties, from Mr Phambala's field, were shown to the farmers before deciding on the criteria to use for evaluating the varieties. The same samples were also placed against each plot in the field during trial evaluation.

Farmers Observations/Comments

Mr Phambala observed that QP38 and ICEAP00053 were the least resistant to wilt and other pests. He, however, said much of the comments on the trial would be made by his wife because she was the one responsible for the trial plots.

Mrs Chisanga made no observations on the trial plots. All her pigeon peas died because of the shade effect from maize canopy. She planted her pigeon peas two weeks after she had planted maize and the pigeon peas did not cope with the fast growth of maize.

Mrs Phambala said she observed some weevils on the ICP9145. She also indicated that she had cooked and tasted ICEAP00020 and ICEAP00040. Relative to local variety, she said both ICEAP 00020 and ICEAP00040 tasted better than local variety but ICEAP 00020 was the best. She had not cooked the other new varieties yet.

Criteria For Evaluation And The Process

Before going to Mr Phambala's field for evaluation, farmers were asked the criteria they use when they want to grow pigeon peas. The following were the major criteria the farmers use:

Yield
Wilt Resistance
Taste
Marketability
Seed size
Cooking Time
Maturity
Firewood

The criteria were ranked as follows:

1 Yield
2 Seed size
3 Cooking Time
4 Taste
4 Marketability

6 Wilt Resistance
7 Maturity
8 Firewood

Bonex explained to the farmers that, at the field, every individual farmer would score for each criterion using ten bean seeds in **'pots'**. They were advised to give **a maximum score of ten** bean seeds to the variety they preferred most and **a minimum of one seed** for the least preferred variety for each characteristic.

Field Evaluation and Discussion of Results

At the field, farmers scored for each criterion in turns. Blessings, Hastings and Savitri helped to count the scores as the farmer moved from one variety to the other. Each farmer had his/her own score sheet. Six farmers participated in the scoring process. The taste and cooking time criteria were not scored because only Mrs Phambala indicated that she had cooked some of the varieties. Mrs Chisanga and Mr Mankhanamba did not score for maturity because they did not observe any crop in their field. Thus, only four farmers scored maturity time of the varieties.

The results of the evaluation by the individual farmers were summed up and presented to the farmers after regrouping at Mrs Chisanga's house. Farmers were happy with the scores. In most respects, farmers' scores were agreeable. For instant, **ICEAP 00020 dominated** in many respects, **followed by ICEAP 00053,** then **ICEAP 00040**. Royes and ICP9145 had more or less the same scores. QP38 had the least scores for most of the criteria.

Statistically, there were significant differences amongst the varieties with respect to farmers' scoring for yield, seed size, marketability, wilt resistance and firewood criteria at **5%** level of confidence. Time for maturity was not statistically significant amongst the seven varieties at the same level of confidence. This was true for both n=6 and n=4.

Below are individual and mean values for farmers' scoring of evaluation criteria for the seven pigeon pea varieties:

Farmers' Individual Scoring Of Evaluation Criteria For Pigeon Pea Varieties

Farmer No.	Name	Plot No.	Pigeon Pea variety	Yield	Seed Size	Marketability	Wilting Resistance	Time to maturity	Firewood
1.00	Mr Makwiti	5.00	ROYES	2.00	3.00	7.00	5.00	7.00	10.00
1.00	Mr Makwiti	1.00	QP 38	1.00	1.00	1.00	1.00	4.00	3.00
1.00	Mr Makwiti	7.00	ICEAP 00020	7.00	3.00	6.00	6.00	4.00	7.00
1.00	Mr Makwiti	4.00	ICEAP 00040	3.00	5.00	4.00	3.00	2.00	6.00
1.00	Mr Makwiti	6.00	ICEAP 00053	4.00	4.00	10.00	2.00	1.00	2.00
1.00	Mr Makwiti	2.00	ICP 9145	2.00	2.00	1.00	4.00	4.00	5.00
1.00	Mr Makwiti	3.00	LOCAL	1.00	3.00	2.00	3.00	1.00	8.00
2.00	Mrs Chisanga	5.00	ROYES	1.00	1.00	1.00	4.00		10.00
2.00	Mrs Chisanga	1.00	QP 38	1.00	1.00	1.00	1.00		5.00
2.00	Mrs Chisanga	7.00	ICEAP 00020	7.00	8.00	10.00	7.00		10.00
2.00	Mrs Chisanga	4.00	ICEAP 00040	1.00	7.00	10.00	4.00		10.00
2.00	Mrs Chisanga	6.00	ICEAP 00053	5.00	8.00	6.00	3.00		10.00
2.00	Mrs Chisanga	2.00	ICP 9145	2.00	2.00	2.00	10.00		7.00
2.00	Mrs Chisanga	3.00	LOCAL	2.00	4.00	6.00	8.00		4.00
3.00	Mr Mwenyekeni	5.00	ROYES	1.00	1.00	4.00	10.00	1.00	10.00
3.00	Mr Mwenyekeni	1.00	QP 38	1.00	1.00	1.00	1.00	1.00	10.00
3.00	Mr Mwenyekeni	7.00	ICEAP 00020	10.00	10.00	10.00	10.00	10.00	10.00
3.00	Mr Mwenyekeni	4.00	ICEAP 00040	5.00	10.00	10.00	10.00	10.00	10.00
3.00	Mr Mwenyekeni	6.00	ICEAP 00053	10.00	9.00	10.00	7.00	10.00	10.00
3.00	Mr Mwenyekeni	2.00	ICP 9145	3.00	6.00	10.00	10.00	2.00	10.00
3.00	Mr Mwenyekeni	3.00	LOCAL	1.00	3.00	5.00	10.00	3.00	10.00
4.00	Mrs Phambala	5.00	ROYES	7.00	2.00	3.00	8.00	6.00	10.00
4.00	Mrs Phambala	1.00	QP 38	1.00	1.00	1.00	1.00	10.00	1.00
4.00	Mrs Phambala	7.00	ICEAP 00020	10.00	10.00	10.00	10.00	6.00	9.00
4.00	Mrs Phambala	4.00	ICEAP 00040	9.00	7.00	4.00	6.00	2.00	6.00
4.00	Mrs Phambala	6.00	ICEAP 00053	9.00	10.00	9.00	7.00	8.00	6.00
4.00	Mrs Phambala	2.00	ICP 9145	4.00	4.00	5.00	7.00	7.00	8.00
4.00	Mrs Phambala	3.00	LOCAL	6.00	8.00	6.00	6.00	1.00	6.00
5.00	Mr Phambala	5.00	ROYES	3.00	1.00	2.00	7.00	1.00	10.00
5.00	Mr Phambala	1.00	QP 38	2.00	1.00	1.00	1.00	8.00	3.00
5.00	Mr Phambala	7.00	ICEAP 00020	10.00	10.00	10.00	10.00	1.00	10.00
5.00	Mr Phambala	4.00	ICEAP 00040	6.00	3.00	3.00	7.00	4.00	7.00
5.00	Mr Phambala	6.00	ICEAP 00053	4.00	8.00	8.00	4.00	5.00	10.00
5.00	Mr Phambala	2.00	ICP 9145	3.00	3.00	2.00	4.00	1.00	9.00
5.00	Mr Phambala	3.00	LOCAL	1.00	0.00	0.00	6.00	1.00	5.00
6.00	Mr Mankhanamba	5.00	ROYES	10.00	1.00	3.00	3.00		10.00
6.00	Mr Mankhanamba	1.00	QP 38	1.00	1.00	1.00	1.00		2.00
6.00	Mr Mankhanamba	7.00	ICEAP 00020	4.00	5.00	5.00	2.00		3.00
6.00	Mr Mankhanamba	4.00	ICEAP 00040	1.00	5.00	6.00	4.00		5.00
6.00	Mr Mankhanamba	6.00	ICEAP 00053	1.00	1.00	10.00	2.00		1.00
6.00	Mr Mankhanamba	2.00	ICP 9145	1.00	1.00	1.00	5.00		5.00
6.00	Mr Mankhanamba	3.00	LOCAL	3.00	5.00	6.00	5.00		2.00

Mean Values For Farmers' Scoring of Criteria for Pigeon Pea Varieties (n=6, Except Time to maturity where n=4)

Plot No.	Pigeonpea variety	Yield	Seed Size	Market ability	Wilting Resistance	Time to maturity	Firewood	TOTAL
1.00	QP 38	1.04	0.82	0.91	0.72	***5.31***	3.83	13.92[7]
2.00	ICP 9145	2.38	2.82	3.41	***6.39***	3.06	***7.17***	26.50[5]
3.00	LOCAL	2.21	3.65	4.07	***6.06***	1.06	5.67	24.00[6]
4.00	ICEAP 00040	***4.04***	***5.99***	***6.07***	5.39	4.06	***7.17***	**34.00**[3]
5.00	ROYES	2.25	1.32	3.24	5.89	3.31	***9.83***	28.75[4]
6.00	ICEAP 00053	***5.38***	***6.49***	***8.74***	3.89	***5.56***	6.33	**37.67**[2]
7.00	ICEAP 00020	***7.88***	***7.49***	***8.41***	***7.22***	***4.81***	***8.00***	**45.08**[1]
P-Value		**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.514**	**<0.001**	

Overall Rank

1 ICEAP 00020
2 ICEAP 00053
3 ICEAP 00040
4 Royes
5 ICP 9145
6 Local
7 QP 38

Mean VALUES For 4 Participating Farmers' Scoring of Criteria for Pigeon Pea Varieties (Using Mrs Phambala's Evaluation)

Plot No.	Pigeonpea variety	Yield	Seed Size	Market ability	Wilting Resistance	Time to maturity	Firewood	TOTAL
1.00	QP 38	1.00	1.00	1.00	1.00	***4.63***	4.75	13.38[7]
2.00	ICP 9145	2.75	3.50	4.50	***7.75***	3.96	7.50	29.96[4]
3.00	LOCAL	2.50	4.50	4.75	***6.75***	1.30	7.00	26.80[6]
4.00	ICEAP 00040	***4.50***	***7.25***	***7.00***	5.75	4.30	***8.00***	**36.80**[3]
5.00	ROYES	2.75	1.75	3.75	***6.75***	4.30	***10.00***	29.30[5]
6.00	ICEAP 00053	***7.00***	***7.75***	***8.75***	4.75	***5.96***	7.00	**41.21**[2]
7.00	ICEAP 00020	***8.50***	***7.75***	***9.00***	***8.25***	***6.30***	***9.00***	**48.80**[1]
P-Value		**<0.001**	**<0.001**	**<0.001**	**<0.002**	**0.729**	**0.046**	

Overall Ranking

1 ICEAP 00020
2 ICEAP 00053
3 ICEAP 00040
4 Royes
5 ICP 9145
6 Local
7 QP 38

Future Trial Strategy

Farmers agreed to continue with the trial, but they would like to grow only four varieties this year. The varieties they want to continue with were:

ICEAP00020;
ICEAP 00053
ICEAP00040; and
ICP9145.

Farmers did not want **QP38** because it flowers early, hence, subject to high pest attach. They did not want to include the **local variety** because they said they have been growing it for a long time. They would like to learn more about the other new varieties.

They did not like **Royes** in a number of respects. The crop is believed to be low yielding, not marketable, and produces very small seed sizes. It, however, compared favourably with ICP9145 in a number of respects.

When asked about preferred spacing, farmers were happy to continue with the research planting spacing recommendation of **90 cm** along the ridge. They also indicated that, this season, they would like to plant the pigeon peas as sole crop. Farmers were afraid of losing the crop under maize canopy as it happened to Mrs Chisanga last year.

On the trial plots, farmers wanted to increase the size this year. Moreover, they will only plant four varieties instead of seven. Bonex advised the farmers that they will be assisted to do the actual measurements of the plots.

Two additional farmers were proposed to participate in this year's trials (for both sweet potatoes and pigeon peas). These were: **Mr Mankhanamba** (who participated in this year's evaluation) and **Mr Kondwani**. Mr Kondwani will be briefed about this year's trial at a later date.

With regard to the **extra pigeon pea seed** that farmers got last season, farmers indicated that they intercropped it with maize but it did not do well compared to the trial plots.

Revisit Date Of Planting For The Sweet Potato Crack Sealing Trials

Farmers were asked if the date of planting sweet potatoes for the crack sealing trials could be shifted to an earlier date than **1st March 1999,** which had been agreed during the trial evaluation. The research team expressed fear of great yield and economic losses on the part of the farmers if the potatoes were planted late.

Farmers agreed to change the date to **1st February, 1999**. Land preparation for the plots will be done during the last week of **January, 1999.** The calendar for crack sealing remained the same as previously agreed with the farmers.

Concluding Remarks

Bonex thanked the farmers for their continued co-operation in the trials. He said it gives the research team strength to work even harder. He hoped the mutual relationship that has been developed will continue.

Farmers wanted to know other methods of pigeon pea utilisation, apart from the traditional way of cooking for relish. Bonex advised them that the research team will try to find out from other experts. **Action: Mark to email Richard Jones (ICRISAT) to enquire about pigeon pea utilization.**

The meeting ended at **4.00 P.M.,** but with sad news of the death of one of the relatives to Mrs Chisanga family. Bonex expressed sympathy to the family, on behalf of the group.

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT

REPORT ON FARMER EVALUATION FOR THE PIGEON PEA TRIALS FOR LIDALA AND CHIWINJA

Edited by

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26 August 1998

Ministry of Agriculture and Irrigation
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A LIDALA

INTRODUCTION

The meeting was convened at the Chief's house. Fourteen farmers attended the meeting, 10 women and 4 men. It started a little bit late because we found the farmers doing some community work. But they put a standby woman waiting for us who alerted the others about our arrival. The meeting started and closed with a prayer by **Mr C. Sapanga.**

Then, Alex informed the farmers that the team came to discuss with them the pigeon peas, which they grew in the last year's trials. He hoped members would have good memory to recall what they had been observing about the trials.

When asked the number of varieties the farmers grew last season, they all positively responded **'four'**. Then farmers started commenting on the various characteristics of the varieties, particularly taste and time for cooking. Two farmers said they had cooked and tasted ICEAP 00040 and ICEAP 00053. They said that the two varieties taste good but take more time to cook.

The farmers were then divided into two groups. Originally, the plan was to have women and men in separate groups but realising that there were more women than men and that the women looked more active than men, it was decided to include some women in the Men's Group. The mixed group had their farmer evaluation at Mr Sapanga's field while the women group was at Mrs Saidi's field.

At the field, farmers were asked to evaluate their trials (**some of the farmers had to recall what they observed in their own field)**, based on criteria which they developed themselves.

Tonny facilitated the Mixed Group; Blessings did the recording and Mark was an observer and Envance translated for Mark proceedings of the discussions. In the Women group, Charity was the Facilitator; Hastings was the Recorder and Alex was an observer/Co-facilitator.

The results of the evaluation of the two groups were discussed after the two groups met again at the chief's house. Below is a summary of the farmer's evaluation by the two groups in Lidala.

I Men/ women Mixed Group Evaluation Results Using Ranking from 1 - 4

Participants

Mr H. Taimu
Mr C. Sapanga
Mr K Sapanga
Mr D. Chimwaza
Mrs L. Muhemwe
Mrs D. Chipakula
Mrs E. Thom
Mrs L. Mpenda

Results

CRITERIA	VARIETY			
	ICP9145	LOCAL	ICEAP00040	ICEAP00053
YIELD	3	1	4	2
PODDING	4	2	3	1
HEIGHT	1	4	2	3
WILTING	4	1	3	2
TASTE[1]	3	4	2	1
COOKING[2] TIME	3	4	2	1
TOTAL	18	16	16	10

Overall ranking:

1 ICEAP00040
2 ICP 9145

Criteria Ranking

1 Yield; Wilting
2 Taste
3 Height
4 Podding

[1] Ranking of taste on ICEAP00040 and ICEAP 00053 were based on one woman who had Cooked and tasted them. The rest of the farmers had not cooked and tasted.
[2] Same comment as above

5 Cooking time

II Women Group Farmers Evaluation

PARTICIPANTS

Mrs Saina Kadango
Mrs Doroth Ayimu
Mrs Piano
Mrs Yelesi Ayidi
Mrs E. Nankhonya
Mrs Emily Mustafa

Results

CRITERIA	VARIETY			
	ICP9145	LOCAL	ICEAP00040	ICEAP00053
YIELD	4	3	5	1
SEED SIZE	2	5	4	3
FIREWOOD	0	5	0	0
WILTING	5	0	1	5
TASTE	2	5	4	3
COOKING TIME	3	4	1	5
COLOUR	2	5	4	3
EARLY MATURITY	5	2	2	4
MARKET/ SELLING	2	5	4	3
Pod bores	5	0	5	5
TOTAL	25	34	30	27

Criteria Ranking

1 Taste
2 Yield
3 Market / selling
4 Firewood
5 Seed size
6 Cooking time
7 Early maturity
8 Seed colour
9 Pod bores

10 Wilting

Overall Ranking

1 ICEAP00040
2 ICEAP00053
3 LOCAL
4 ICP9145

GENERAL FARMERS COMMENTS FROM BOTH GROUPS

- Farmers were pleased with last year's planting system and should continue for this year's trials
- Farmers looked forward to continue with the trials this year because they said they could not make conclusive statements after on season of testing
- They, however, welcome any new variety of pigeon pea that can be added to the current varieties
- Farmers perceived that the taste of pigeon peas might be affected by soil type where you plant them. One farmer said the same ICP9145 variety tastes different depending on where it was grown.
- They also expressed their gratitude to have been involved in evaluating the trials
- Farmers also requested if the harvesting could be finished fast because some of the pigeon peas is being eaten by goats

CHIWINJA

INTRODUCTION

Fourteen **(14)** farmers participated in the meeting, which was convened at Mr/Mrs.. There were **twelve** women and **two** men. Introductory remarks were made by Bonex who explained to the farmers the main aim of the meeting and recalled purpose of last year's trials. The group jointly developed criteria for evaluating the pigeon peas before splitting into two groups. The groups were split based on the method of evaluating the trials. One group supposed to use **'consensus'** approach of evaluation while the other was supposed to use the **'pot'** method.

Farmers developed their Criteria before they split into two groups

Yield
Vigour/growth
Germination
Wilting
Maturity
Cooking time
Taste

Farmer evaluation using - Consensus Group Approach

Participants

Mr Chilinkhonde
Mrs Muchera
Mrs Kaminyu
Mrs Walala
Mrs Kainga
Mrs Chilewe
Mrs Mpoya

Results

CRITERIA	VARIETY			
	ICP9145	LOCAL	ICEAP00040	ICEAP00053
YIELD	4	2	4	3
GERMINATION	4	4	4	4
GROWTH/ VIGOUR	3	2	4	3
WILTING	4	4	4	1
MATURITY	4	2	4	3
TOTAL	19	14	20	14

Overall ranking

1 ICEAP 00040
1 ICP 9145
3 ICEAP 00053
4 Local

FARMERS COMMENTS

- Two farmers said they could not compare growth because all their pigeon peas died
- One woman said that ICEAP 00053 wilted and gave thin stems inn her field
- Three varieties, except Local, did not germinate in one farmers' field
- On taste, local variety is better than ICP 9145 but it takes time to cook

GENERAL COMMENTS

- In general, farmers said that ICEAP 00040 and ICEAP 00053 were suitable varieties for their soils
- All Farmers said they would like to repeat the trials this season because they cannot make conclusions based on one season's trial
- The planting system should be the same as last year's

THE POT GROUP

Participants

Mr Limani
Mrs Chilinkhonde
Mrs Maduka

Mrs Malonda
Mrs Sapuwa
Mrs Magreen
Mrs Matekesa

Results

CRITERIA	VARIETY			
	ICP9145	LOCAL	ICEAP00040	ICEAP00053
YIELD	9	12	25	23
GERMINATIO N	20	12	19	21
GROWTH/ VIGOUR	13	27	13	20
MATURITY	28	2	25	13
TOTAL	70	53	82	77

Overall ranking

1 ICEAP 00053
2 ICP9145
3 ICEAP 00040
4 LOCAL

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FARMING SYSTEM INTEGRATED PEST MANAGEMENT PROJECT

REPORT ON FARMERS FAREWELL MEETING HELD AT BVUMBWE AGRICULTURAL RESEARCH STATION

4th November, 1999

edited by

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1.0 Background

During a planning meeting for the FSIPM Project end workshop in early June 1999, it was also agreed that a farmer to farmer farewell meeting be organised as part of an exit strategy for the collaborating farmers. An exit strategy for farmers was felt necessary for the following reasons:

- As a last opportunity for the project to encourage farmers to continue participation with other organisations,
- Leave them in a stronger position in relation to research and extension,
- Leave a good impression with farmers and
- To encourage and empower farmers further to gain visibility and access to other development organisations.
- To let farmers feel they played a meaningful part in the research processes and say goodbye.
- Build and strengthen linkages between farmers, extension staff and researchers

The specific objectives of the event were two-fold:-

- To create a forum where collaborating farmers could meet and share what they learnt from the project, during the past three years, with each other, extension staffs and with researchers.
- It was also a last opportunity for the project to highlight to farmers the main lessons learnt from the project and reinforce the messages on integrated crop management.

This report reflects on the proceedings of the farmers' farewell meeting which was held at Bvumbwe Agricultural Research Station on 4th November, 1999. It has 9 main sections, namely, the structure of the workshop, brief summary of the opening remarks by the Officer-in-charge, farmer presentations, highlight of main lessons from the project by researchers, video show, input distribution, closing remarks by the Project Manager and lastly photographs and video shooting.

2.0 Structure

The workshop was opened by the Officer-in-charge for Bvumbwe Agricultural Research Station, Mr Nsanjama. Blessings Mwale facilitated all deliberations. After the opening remarks, farmers broke into six specific groups as follows:

- Termite and whitegrub
- Fertiliser and green manure
- Sweet potato
- Striga
- Main trial
    - Matapwata
    - Mombezi

The focus of group discussions was to solicit farmers' final opinions about their participation in the trial. Specifically, farmers discussed what they did in their respective trial, what they thought they learnt in the trial with respect to its objective and any problems they observed about the trial. Each group recorded all the agreed points on flip charts and one member of the group presented the results to the rest of the farmers for comments and questions. Discussion points were recorded in vernacular. One member of staff joined each group to help clarify what the farmers were expected to do. After the farmers group presentations and discussions, Mr Chanika presented to the audience a summary of the highlights of the project teams' main lessons.

Soon after lunch, farmers were shown video recordings of some of the meetings that the project staffs have had with them. Some farmers in earlier meetings had specifically asked for this. This was followed by input distribution.

A total of 93 farmers attended the workshop. Forty-two farmers came from Mombezi EPA (Lidala and Chiwinja villages) and the rest came from Matapwata EPA (Kambuwa, Magomero and Pindani villages). Four farmers could not attend the meeting for other reasons. The field extension staffs whom the project was collaborating with from the two EPAs also attended the function. These included the Project Officer for Thyolo RDP, Acting Development Officer for Matapwata EPA plus two FAs from Mangunda and Nansadi sections (Matapwata EPA), the Development Officer for Mombezi EPA and the FA for Lirangwe section in Mombezi EPA. The list of all the farmers and Field extension staff who attended the meeting is attached in Appendix 1.

Dr Daudi, the Project Manager, closed the workshop. The programme for the workshop proceedings is presented in appendix 2.

3.0 Opening remarks by the Officer-in-charge

The Officer-in-charge (OC) expressed his gratitude to have been accorded the opportunity to open such an important meeting. He welcomed the participants, particularly farmers who accepted to leave their field operations for the sake of the meeting. He was also particularly happy with the high representation of women in the meeting.

He reminded the audience that FSIPM Project's main objective was to work together with farmers in identifying management strategies for preventing various pests and diseases that cause great losses to our crops. He thanked all the farmers for the time and effort they gave to the project team during the entire project period. He, therefore, advised that the meeting was organised to give the farmers who have been involved in the work of the project an opportunity to share with their fellow farmers, extension staff and researchers what they learnt from the various trials they were doing. On the part of the project, he also said that the researchers would share with the farmers main lessons learnt throughout the project period.

He requested the farmers to feel free in their deliberations and he hoped they would have good time. The full text of the OC's opening remarks is presented in Appendix 3.

4.0 Farmer presentations and discussions

4.1 Sweet potato trial

The group consisted of farmers from both Matapwata and Mombezi EPAs.

Past weeding practice: The farmers said that, in the past, they were weeding only once in the sweet potato fields. This was normally done three weeks after planting.

During harvest, most of the sweet potato was seen damaged by either weevils or rodents or other soil pests.

In trial, the farmers said that the objective was to see if sealing cracks could help reduce the number of tubers damaged by the weevil. They compared the level of damage of sweet potato from weevils between their existing practice of weeding only one time to weeding more than one occasion (a maximum of three occasions) which was proposed by the project. Kenya variety was planted in all the plots. Vine cuttings of 30cm long were planted at a distance of 30cm between planting stations. Ridges were spaced at 90 cm apart.

At harvest, the farmers said that they observed more damaged tubers by weevils on the plots that were weeded only once than where they weeded two or more occasions. However, farmers said that sealing of cracks had its own disadvantages:

- Depending on soil type, some farmers said sweet potatoes where cracks were sealed often had rough skin like one from last season's crop.
- Some tubers got damaged in the process of sealing cracks
- It was labour demanding
- In some cases, yield was low i.e. small tubers

Overall, the farmers said they learnt a technique for preventing sweet potato from being damaged by weevils which they never knew. Some of the farmers said they had been sealing cracks before without the knowledge that it also helps reduce weevil damage.

Comments/questions

The other farmers wanted to know the time interval for sealing of the cracks. It was advised that one week passed before doing the next sealing.

4.2 *Green manure (Tephrosia & Crotalaria)*

The group consisted of 21 farmers, all from Matapwata. They showed the other farmers samples of both *Crotalaria* and *Tephrosia* pods. They told the audience that each pod contains a lot of seed. They advised the other farmers that they planted *Crotalaria* soon after maize's first weeding by opening and spreading on one side of the ridge. For *Tephrosia,* they planted three seeds per station on the side of the ridge at 45cm apart during the same time they were planting maize. The group observed that the two crops grew very well in the field.

It was noted that this was just the first year of the trial and therefore, they could not say much on the benefits of the green manure. However, they believed incorporation of *Tephrosia* and *Crotalaria* help improve soil fertility. Some of the farmers observed that decomposition had already started where they incorporated *Crotalaria* i.e. ridges became flat symbolising break down of the *Crotalaria* leaves and stalks.

They also advised the other farmers that the best time to incorporate *Crotalaria* was soon after flowering but before podding. They also emphasised that both *Crotalaria* and *Tephrosia* need to be incorporated while green.

Comments/questions

Mr Phambala wondered how the group got convinced that *Crotalaria* and *Tephrosia* improves soil fertility when this was just the first year of the trial.

Mr Gomani (a Whitegrub Trial Farmer) said that he personally observed improvement in soil structure and soil fertility in his field where they incorporated Tephrosia and also realised higher maize yields than where no *Tephrosia* was incorporated. He also said, the other advantage of *Tephrosia* was that farmers could use the stems as firewood. Mr Mankhanamba also said he had a chance to see maize fields in another area where *Crotalaria* and *Tephrosia* were incorporated and he observed maize yields were just as good as where fertiliser was applied.

Other farmers asked where they could get seed for *Crotalaria* because it was the first time to see the seed. It was advised, the project would give all the farmers some seed. It was also advised that some *Crotalaria* is also found wild and farmers could get seed from them too.

Some farmers also asked whether *Crotalaria* and *Tephrosia* cause any competition with other the crops, particularly maize. Farmers were advised that these two crops are normally planted on the side of the ridges, so competition may not be a big problem. For *Crotalaria,* it is already indicated that you need to plant after maize's weeding. Competition at that stage could be very minimal.

4.3 Striga Trial

This group consisted of six farmers only. The group told the other farmers that the objective of the trial was to find ways of reducing *Striga* in their field. The strategies they tested involved use of trap crops such as *Tephrosia*, *Crotalaria* and Cowpeas. The group felt the objective of the trial was achieved particularly with use of *Tephrosia* which also helped improve soil fertility. Mai Goldeni said Tephrosia speeded up germination of maize as a result, the effect of *Striga* on the maize yield was reduced. Some of the members of the group also said *Tephrosia* encouraged early emergence of *Striga*, thus, reduced the active period of *Striga* on maize roots.

The group's future plan was to get enough *Tephrosia* seed which they would like to use in their fields to control *Striga* and also improve soil fertility.

Comments

Other farmers advised that uprooting and burning *Striga* before flowering also help reduce the *Striga* seed bank in the field. Uprooting before flowering was particularly emphasised.

4.4 Termite and whitegrub

The group presented two strategies which they found useful to control termites, notably,

- Banking the maize field when it is free of weeds- this is what farmers also use apart from the next strategy which was being tested in the trial. The farmers said that the weeds that are buried close to the maize plant attract termites.

- Weeding without banking

For Whitegrub, the group mentioned four strategies:

- Planting early with first rains
- Incorporating Tephrosia
- Maize seed dressing with Sevin
- Maize seed dressing with Gaucho.

The first three strategies are some of the farmers' own explorations to deal with the problem of whitegrub. Gaucho was the one that was used in the trial. The group felt all these strategies help to control Whitegrub.

Comments

Some farmers suggested that the best way to deal with termites is to kill the anthill.

4.5 Main Trial- Pigeon peas and beans

4.5.1 Mombezi EPA

Farmers in Mombezi were happy with the outcome of the trial. On pigeon pea, they observed less wilt in pigeon peas than they used to have in the past. Yield was also generally good. They also liked planting pigeon peas on top of ridges as opposed to side planting as they used to. They did not also know before that pests cause shrivelled pigeon pea pods. They used to associate shrivelled pods to bad cold air (*chisanu*).

On beans, they also liked the planting pattern of beans (two stations and not one station between maize plants) which gives high yields per unit area. However, they observed that beans do not do well with plenty rains (noted a lot leaf dropping) and dry spell also affects flowering.

Comment/question

Some farmers wondered whether pigeon pea seed can be recycled like they do with maize. If it can, how many years can a farmer continue recycling the seed?

In response, some farmers said pigeon pea can be recycled but like any other crop, good seed selection is important. It was also advised that the improved pigeon peas do not change their characteristics anyhow and none have actually been seen changing. It is only Chilinga local pigeon pea that has different characteristics. Some farmers discouraged keeping volunteer pigeon pea plants because they become a source of pests and diseases for your newly planted pigeon peas.

4.5.2 Matapwata

Farmers in Matapwata pest and diseases have been a big problem in the area, particularly for beans and pigeon peas. On pigeon pea, farmers observed most of it died of diseases this year. Chilinga local variety was the most affected. In terms of taste, they liked ICP 00053 and the local variety. Farmers also said they liked planting pigeon peas on top of ridges as opposed to side planting as they used to in the past. They also learnt that pigeon pea could be planted together with beans when all along, they thought mixing the two crops led to reduced yields.

On beans, farmers had different experiences. Some said PAD3 performed better than the rest, others liked *Mkhalira* , *Kambidzi, Nagaga*, or *Kaulesi*. *Kaulesi* is also liked because it cooks fast and it has tough leaves that may help resist pest damage. Overall, the farmers liked Mkhalira and Kaulesi. It was also something they just learnt that wilt in beans is also caused by pests and not cold air (*chisanu*).

Generally, the group felt performance of pigeon peas and beans varied depending on soil types.

5.0 Researchers' highlight of main lessons from the project.

Mr Chanika first thanked the farmers for presenting what they learnt from the work they were doing with the project. On the part of the project, the following were cited as main lessons:

5.1 Research on beans

Mr Chanika advised that the research work on beans initially looked at wilting due to bean stem maggot (BSM), a pest which farmers cannot see directly. However, the problem was rare in the rainy season but is a problem for a winter bean crop. Unfortunately farmers have lost interest in winter bean crop due to abrupt ends of rains lately. Therefore, work then concentrated on farmer criteria along with yield.

Results

- Tested new bean releases against *Kaulesi* and found *Kaulesi* better due to earliness in maturity.

- Nagaga and Napilira rather low yielders in intercrop.

- This season (1999) Mkhalira and Kambidzi (small seeded) performed well in farmers fields:
- Yield, plant vigour and plant stand (ahead of Kaulesi) but next to Kaulesi in maturity and fast cooking.

- Kaufiti wamkulu (*Alectra* – yellow flowers) affects Mkhalira and Kambidzi less than other varieties.

- If grown in pure stands, you would get higher yields by staking your semi-climbing beans.

Mr Chanika advised that the project is taking the farmers' message on early maturity as a key feature to the bean researchers.

5.2 Research on pigeon peas

- *Fusarium* wilt was identified as a major constraint on pigeonpea production in our project area. New pigeonpea varieties were tested against a released variety, ICP 9145 and a local variety was also included.

- ICP 9145 was released in 1987. It is high yielding and wilt resistant but farmers do not wholly embrace it for lack of good taste. **Dhal Millers Association does not want this variety because of problems in dehulling.**

- ICEAP 00040 is higher yielder than ICP 9145 and wilt resistant. Good firewood provider.
- Matures as early as ICP 9145 but preferred by dhal millers because its seedcoat is easily removed. Is currently being promoted by pigeonpea industry.

- ICEAP 00020 is reported to be tolerant to wilt but could be better than ICEAP 00040 in some respects.

- *Chilinga* is a medium duration variety and is large seeded. Matures earlier than ICP 9145. Is susceptible to wilt. Can lose first flowers due to caterpillars but has the potential to bear a second crop when conditions are favourable. Offers an opportunity for further selection because of variable seed size and colour.

5.3 *Research on Striga management*

- Single application of fertiliser at 50 kg N/ha (approximately 2 teaspoons per station) gave an extra 11x 90-kg bags per ha applied at maize emergence.

- More *Striga* plants emerged where fertiliser was applied and there is need to hand pull them at peak flowering long after banking.

- *Tephrosia* plants cause less *Striga* to emerge compared to Cowpeas or no legume. However, *Striga* flowers more successfully with *Tephrosia*, hence need to uproot at peak flowering.

- Initial results of effect of incorporating *Tephrosia* indicate up to 30% more maize is obtained on a *Striga* infested field.

- *Crotalaria* seemed to be encouraging *Striga* but absence of banking is probably responsible since no banking was done on the ridge side where *Crotalaria* was planted. Banking evidently disrupts the *Striga* emergence.

5.4 *Research on green manure crops*

- Low soil fertility is the major cause for low crop production for all crops in general but maize in particular. One way of rejuvenating the soil is to grow green manure crops that would add nitrogen to the soil.

- *Tephrosia* should be planted together with maize but *Crotalaria* is planted after first weeding by scattering the seed thinly along the ridge side.

- Bank only the side where *Crotalaria* has not been planted if plants are small or contract labour is used.

- Biomass production is generally satisfactory with better production from the *Crotalaria* than *Tephrosia*. Competition with maize is not serious but *Crotalaria* is more competitive with maize than *Tephrosia*.

- *Tephrosia* incorporated as late as 2 weeks before maize planting did not lead to yellowing of the maize crop, therefore decomposition is very rapid.

On green manure, Mr Chanika also noted the following key points:

- *Tephrosia* increases nematodes, so do not grow it with tobacco or in rotation with tobacco.
- Early *Crotalaria* incorporation at or before flowering could easily support a *mbwera* (relay crop) sweet potato or field peas crop or an intercrop of both.

5.5 *Research on sweet potato Cylas weevil*

- Survey results in both Mangunda and Mombezi showed that sweet potato weevil is becoming increasingly destructive in the field particularly for the late-planted crop. First season work focussed on screening varieties for resistance to *Cylas* weevil and crack sealing to block the weevil's access to tubers underground.
- Crack sealing improved tuber quality but decreased the yield of sweet potato.
- Host resistance to *Cylas* weevil was not found.
- Crack-sealing needs to be timed in such a way that it is done within 4-6 weeks after planting to avoid disturbing tuberisation when done at a later time. For a crop in a bad season, crack sealing could help to protect the tubers against weevil damage. Farmers existing practice of early planting and early harvesting is clearly effective in reducing the weevil damage.

5.6 *Research on whitegrubs and termites.*

- Maize damage due to whitegrubs and termites were reported to be extensive. Research work was started to address the two problems. Sevin and later Gaucho were tried on whitegrubs but not banking was tried on termite.
- Not banking reduced termite damage but did not lead to increased yields.
- Sevin was found to be toxic to maize seedlings though it did kill the whitegrubs.
- Gaucho is effective against the whitegrubs and increases maize production by 5.5 x 90-kg bags per ha in the upland fields but it is extremely expensive.
- Gaucho seed dressing reduced termite lodging significantly, especially when combined with banking
- However, we are trying to get the seed industry to dress maize seed with Gaucho which may reduce the cost of the chemical when economies of scale apply.

6.0 Video show

This was not only part of entertainment but also an opportunity for farmers to see and reflect on the importance of common understanding of the farmers and the researchers through working together in planning, implementing and evaluation of the trials during the project period. Working together was the key to the success of the project.

7.0 Input distribution

Another thrilling moment for the farmers came when the Project Manager called each farmer to take a package of maize seed (Masika composite + MH18- 580gm each), Kambidzi, Mkhalira and Kaulesi beans (300gm each), 260gm of Chilinga pigeon pea variety, and 320gm each of ICEAP 00040 and ICEAP 00020. Each farmer was photographed as he/she received the package and a photo album of the event has been produced.

The choice of seed given was based on their good performance (yield and resistance to pests and diseases) and farmers' acceptability.

7.0 Closing remarks by Project Manager

Just like the Officer-in-charge said in the opening remarks, the Project manger felt honoured to be part of the gathering which he said was quite memorable. He could not believe that the project has been working with farmers for such a long period. He was grateful to the Almighty God who makes everything possible. However, he sympathised with those families who lost their relatives who would have also been part of the gathering.

He again thanked all the farmers for the support they gave to the project and asked them to continue with that spirit. He hoped the farmers found the interaction they had with their fellow farmers and members of the extension and research team useful. He encouraged them to continue sharing the knowledge they gained through the project amongst themselves and friends. Members of staffs were also urged to continue interacting with the farmers wherever possible.

Lastly, he hoped the farmers would make use of the little seeds that the project gave them wisely so that they could get maximum benefits from them. Full text of the Project Manager's closing remarks is presented in Appendix 4.

8.0 Photos and video shooting

J.M. Ritchie took photographs of farmers, first by village and then the whole group. The whole event was also recorded on a video with the assistance of Julie Lawson McDowall. These are part of the project's archives.

Appendix 1: List of OFT farmers and field staffs who attended the farewell function

Village	EPA	Name	No.	Trial
Kambuwa	Matapwata	Mai Nambewe	1	GM
Kambuwa	Matapwata	Mai Tholo	2	GM
Magomero	Matapwata	Mai Maluwa	3	GM
Magomero	Matapwata	Mai Kwikanda	4	GM
Kambuwa	Matapwata	Bambo Sapali	5	GM
Kambuwa	Matapwata	Mai Kalibeti	6	GM
Magomero	Matapwata	Bambo Sukali	7	GM
Kambuwa	Matapwata	Mai Mkweza	8	GM
Magomero	Matapwata	Mai Makoto	9	GM
Magomero	Matapwata	Mai Mukhumba	10	GM
Magomero	Matapwata	Roya Chitedze	11	GM
Magomero	Matapwata	Davision Mangochi	12	GM
Magomero	Matapwata	Linda Laudoni	13	GM
Magomero	Matapwata	Estere Rabichi	14	GM
Magomero	Matapwata	Njiwa Chiwoko	15	GM
Magomero	Matapwata	Yolamu Willie	16	GM
Magomero	Matapwata	Mai Zaburoni	17	GM
Magomero	Matapwata	Dickson Julius	18	GM
Magomero	Matapwata	Mai Tobias	19	GM
Magomero	Matapwata	Bambo Mondiwa	20	GM
Magomero	Matapwata	Bambo Kapoto	21	GM
Chiwinja	Chiradzulu	Daina Chilinkhonde	22	MT
Kambuwa	Matapwata	Mai Butao	23	MT
Kambuwa	Matapwata	Mai Chelewani	24	MT
Kambuwa	Matapwata	Mai Vakala	25	MT
Lidala	Chiradzulu	Linny Mpenda	26	MT
Lidala	Chiradzulu	Tereza Luwera	27	MT
Lidala	Chiradzulu	Felia Matchado	28	MT
Lidala	Chiradzulu	Dorothy Piano	29	MT
Lidala	Chiradzulu	Saina Kadango	30	MT
Lidala	Chiradzulu	Enifa Mwadala	31	MT
Lidala	Chiradzulu	Dorothy Ayimu	32	MT
Lidala	Chiradzulu	Mai Muhemwe	33	MT
Lidala	Chiradzulu	Esther Thom	34	MT
Lidala	Chiradzulu	Elube Nankhonya	35	MT
Magomero	Matapwata	Mai Mazinga	36	MT
Magomero	Matapwata	Mai Muthowa	37	MT
Magomero	Matapwata	Mai Lombola	38	MT
Chiwinja	Chiradzulu	Beatrice Chilewani	39	MT
Chiwinja	Chiradzulu	Mai Kainga	40	MT
Chiwinja	Chiradzulu	Mai Mpoya	41	MT
Kambuwa	Matapwata	Bambo Baluti	42	MT
Lidala	Chiradzulu	Dyson Chimwaza	44	MT
Lidala	Chiradzulu	Yelesi Ayidi	45	MT
Lidala	Chiradzulu	Howard Taimu	46	MT
Kambuwa	Matapwata	Bambo Chimombo	47	MT
Magomero	Matapwata	Frazer Mazinga	48	MT
Magomero	Matapwata	Bambo Sitima	49	MT
Chiwinja	Chiradzulu	Elina Walala	50	MT

Kambuwa	Matapwata	John Pahuwa	51 MT
Kambuwa	Matapwata	Mai Kachotsa	52 MT
Lidala	Chiradzulu	Emily Mustafa	53 MT
Magomero	Matapwata	Chief Magomero	54 MT
Chiwinja	Chiradzulu	Isaac Chilinkhonde	55 MT +swp
Chiwinja	Chiradzulu	Stanley Kainga	56 MT
Chiwinja	Chiradzulu	Lozalio Limani	57 MT
Chiwinja	Chiradzulu	Yelesiya Kundala	58 MT
Chiwinja	Chiradzulu	Enelesi Kaminyu	59 MT+swp
Mangunda	Matapwata	Mai Chisanga	60 PPEA
Mangunda	Matapwata	Bambo Makwiti	61 PPEA
Mangunda	Matapwata	Bambo Phambala	62 PPEA
Mangunda	Matapwata	Bambo Mangani	63 PPEA
Mangunda	Matapwata	Bambo Mankhanamba	64 PPEA
Magomero	Matapwata	Mai Kazembe	65 STG
Kambuwa	Matapwata	Mai Golden	66 STG
Magomero	Matapwata	Mai Karonga	67 STG
Kambuwa	Matapwata	Gustino Simon	68 STG
Magomero	Matapwata	D Simeon [Magomero]	69 STG
Kambuwa	Matapwata	Chief Kambuwa	70 STG
Chiwinja	Chiradzulu	Mai Chintedza	71 SWP
Chiwinja	Chiradzulu	Bambo Chitseko	72 SWP
Lidala	Chiradzulu	Kaunda Nelesani	73 SWP
Lidala	Chiradzulu	Saiti Mwanyanji	74 SWP
Lidala	Chiradzulu	Mai Tangale	75 SWP
Lidala	Chiradzulu	Nelson Kaunda	76 SWP
Chiwinja	Chiradzulu	Malita Sapuwa	77 TRM+swp
Chiwinja	Chiradzulu	Lucy Magreen	78 TRM+swp
Kambuwa	Matapwata	Bambo Basikolo	79 TRM
Kambuwa	Matapwata	Bambo P. Chikoti	80 TRM
Kambuwa	Matapwata	Bambo Kawerenga	81 TRM
Kambuwa	Matapwata	Bambo Kamoto	82 TRM
Kambuwa	Matapwata	Mai Mafaiti	83 TRM
Lidala	Chiradzulu	Kasimu Sapanga	84 TRM+swp
Magomero	Matapwata	Mai Kusala	85 TRM
Kambuwa	Matapwata	Mai Jana	86 TRM
Kambuwa	Matapwata	Mai Kwizombe	87 TRM
Chiwinja	Chiradzulu	Emily Muchera	88 WTG
Lidala	Chiradzulu	Daina Chipakula	89 WTG
Magomero	Matapwata	Mai Marichi	90 WTG
Chiwinja	Chiradzulu	Bambo Chilewe	91 WTG
Kambuwa	Matapwata	Bambo Tomato	92 WTG
Lidala	Chiradzulu	Charles Sapanga	93 WTG
Magomero	Matapwata	Bambo Gomani	94 WTG
Chiwinja	Chiradzulu	Mai Malonda	95 WTG+swp
Lidala	Chiradzulu	Nelia Kasimu	96 WTG

Field Staffs

Mr Kabuluzi	Project Officer	Thyolo RDP
Mr Dausi	Development Officer	Mombezi EPA
Mr Gwembele	Acting Development Officer	Matapwata EPA
Mr Kapeleta	FA	Nansadi Section, Matapwata EPA
Mr Kadalinga	FA	Lirangwe Section, Mombezi EPA

Appendix 2: Programme for Farmer farewell meeting

• Opening and introductory remarks by Officer-in-charge			8.30-9.00
• Farmer group discussions (30-40 minutes)			9.00-9.30
	Group 1	Termite & whitegrub- **Facilitator: CSM**	
	Group 2	Sweet potato (Mangunda chooses between sweet potato or pigeon peas in main trial- Facilitator: B. Mwale	
	Group 3	Main Trial- Mombezi - Facilitator: C. Chanza	
	Group 4	Main Trial- Matapwata- Facilitators: D. Saiti + C. Kaunda	
	Group 5	Fertiliser and green manure (both *Tephrosia* & *Crotalaria*)- Facilitator: Bonnex	
	Group 6	Striga- Facilitator: Mputeni	
• Farmers reassemble in hall			9.30-9.35
• Start presentations			
	Group 1	Termite & whitegrub	9.35-9.50
	Group 2	Sweet potato	9.50-10.15
	Group 3	Main Trial- Mombezi	10.15-10.30
• Break + soft drinks			10.30-10.40
	Group 4	Main Trial- Matapwata	10.40-10.55
	Group 5	Fertiliser and green manure	10.55-11.10
	Group 6	Striga	11.10-11.25
• Highlights from FISPM Project by CSM Chanika			11.25-12.00
• Break for lunch			12.00-1.20
• Video show			1.20-1.30
• Input[1] distribution (with individual photos taken)			1.30-2.00
• Closing remarks by the Project Manager			2.00-2.30
• Photos (by village then group)			2.30-2.40
• Farmers go back			from 2.50

[1] Co-ordinated by Desire Mkwamba

Appendix 3: Opening speech by the Officer-In- Charge, Bvumbwe Agricultural Research Station at the Farmer to farmer farewell workshop of the FSIPM Project

All farmers gathered here
All extension staffs
Members of the FSIPM Project
Ladies and gentlemen

- It is a great honour for me this morning to be part of such an important farewell meeting for you farmers who have been part of the FSIPM Project. This is a rare opportunity for me and I hope it is also yours. For some of you, this is not the first time to come to Bvumbwe. For those who have come to the station for the first time, all I can say is feel at home and enjoy your stay. This is your own station.

- Let me also have this opportunity to welcome everybody who has come to this meeting. I thank you very much for coming to this function. I know we all have our own tight programmes of activities. Particularly, I thank the farmers for sparing their time during this period when everybody is busy preparing the fields for the next cropping season.

- As you will recall, the FSIPM Project started its activities in 1996. The objective of the project was to see how we could jointly work together in identifying management strategies for preventing various pests and diseases that cause great losses in our crops. Such pests include *Striga*, Whitegrub and termites in maize, bean stem maggot, *Cylas* weevil in sweet potato and *Fusarium* wilt in pigeon peas. You will also recall that during the first year, we did not use fertiliser in our trials but we all realised that declining soil fertility was a real problem. In the second year, we thus included a trial on soil fertility improvement using green manure, such as *Tephrosia* and *Crotalaria,* as alternative management strategies for soil fertility improvement to using fertiliser which is now a high cost input.

- Three years have now passed since we started this work with you. I should thank very much for the time, effort and co0operation that you gave us during this period. Without you, we would not have been here today. Admittedly, it is not always easy to work with people whom you don't know and have never met. I remember some of you farmers in the first year had fears that the introduction of the project was meant to take away land from you. Three years later, that land still belongs to you. In addition, the project was even giving back to you all the crop harvests we were realising from their trials. I am pleased that through the interactions that we shared all these years, we have become people who trust each other, believe in each other and work together as partners in research and development. Once again, thank you very much for the time and support you gave us and I hope you shall do the same in our future activities.

- In any project, time comes when you need to sit down and reflect on what you have achieved and what you could have done better to improve the situation. Ladies and gentlemen, it is the objective of this meeting that farmers who have been involved in the various trials have an opportunity to share with their fellow farmers, extension staffs and researchers on what they learnt through their involvement in the on-farm trials. On our part, my colleagues will also share with you what we thought have been the main lessons we got from the project through working with you in the past three years.

- But to make our meeting a success, I therefore urge you to feel free during your discussions. I very much look forward to hearing what you have been doing in the past three years and any lessons you have drawn from the work that you have been involved in. I shall also be pleased to hear any suggestions that you may have that might assist us to improve what we will be doing with you in our future programmes.

- Once again, thank you for coming to this meeting and I thank you for your attention. I wish you fruitful discussions and an enjoyable day.

Appendix 4: Closing Remarks by the Project Manager

- Today indeed we were blessed because of the presence of all of you who came to this important meeting. As the Officer-in-charge said to you this morning, meetings of this magnitude and nature are rare. I am also pleased to have been part of this gathering.

- Looking at the programme of activities that you had today, I know it has been a hard day for all of you. However, allow me to say a few words before we finally bid each other our last farewell.

- First, when the Officer-in-charge was reminding us this morning that three years have passed since we started working together, I could not just believe it. Time really flies. I think we should all be grateful to the Almighty for keeping us all to this date. Sadly, however, I know some of the people we started with are not here today because of deaths and other unfortunate circumstances. In certain cases we still continued the research work with the relatives of the deceased members. Some of these relatives are here with us. I sincere express my sympathies to these members and the rest of the farmers but also thank them for taking over the work their beloved ones were doing with us.

- Strictly speaking, these three years have not just been rosy. At times we were asking your support at a time when you were really busy. But still, you persevered with us and you gave us what we wanted from you. Many thanks have already been extended to you this morning by the Officer-in-charge. I just want to emphasise once more that we sincerely thank you for the support you gave us. You have really been a wonderful community to work with. Continue this support in any future work that may come in your villages by whichever group.

- With respect to today's programme, it is indeed my hope that you found this day fruitful to you. Through the interactions we have had with each other, I hope each one of us has learnt one or two things. It also my hope that the sharing of information that you have done today will even continue when you go back home. To the extension staffs who are here today, these farmers will need our support. Let us all try our hard to see how best we can continue to interact with them in our future programmes.

- Again, I am grateful for the issues that you have raised in your discussions. They are pertinent and we have taken note of them.

- Lastly, I hope you will accept the little the little seed that the project prepared for you to take home. These seeds are given to you not only as an expression of appreciation but also as something we can remember each other in future. I hope you will make use of them wisely, multiply it so that you can have maximum benefits from them.

- I thank you very much for paying attention and the support you gave us during the entire project period.

- Thank you

FSIPM Project

Monitoring Reports
1998-99 Trials

Main Trial (Rounds 1-5)
Striga Trial (Rounds 1&2)
Whitegrub Trial (Rounds 1&2)
Termite Trial (Rounds 1&2)

(Internal Working Document)

by
P.Kapulula
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Farming Systems Integrated Pest Management Project, Bvumbwe Research Station

1999 Main Trial (Bean and Pigeonpea) Monitoring: Round 1, Germination

By P. Kapulula and J.Lawson-McDowall

Introduction

This was the first monitoring visit made in the season. The exercise was organized in order to check the position of varieties with farmers, noting spatial arrangement and combination of crops. Farmers were asked to score the establishment of each variety on a 1(very poor) to 5 (very good) scale. Other probing questions were asked to let farmers comment on any differences observed between varieties and possible reasons for them. In addition to this, farmers were asked to say what they hoped to learn from the observation plots. Thirty-nine main trial farmers were interviewed in this exercise.

Table 1. Planting date for beans on the observation plots.

Date planted	Frequency of responses
22/11/98-30/11/98	20
01/12/98-16/12/98	18

Planting was done within a period of 25 days. The first 20 farmers had their beans planted by November 30. The rest planted in December and the latest farmer planted on December 16.

Table 2 :Planting date for Pigeonpeas.

Date planted	Frequency of responses
22/11/98-30/11/98	19
01/12/98-16/12/98	20

By the end of November, 19 farmers had planted their pigeon peas. The remaining farmers planted their crop in December and the last date of planting was 16th December. Like the planting of beans, the planting of pigeon peas also took place within a period of 25 days.

Table 3. Bean seeds per planting station

Number of seeds per station	Frequency of responses
One seed per station	1
Two seeds per station	25
Three seeds per station	16
Four seeds per station	3

A total of 25 farmers planted 2 bean seeds per planting station. Sixteen farmers planted three bean seeds per planting station. Three farmers planted four seeds on each planting station while only one farmer planted one seed per station. It appears that most farmers are used to planting 2-3 bean seeds per planting station.

Table 4. Pigeon pea seeds per planting station

Number of seeds per planting station	Frequency of responses
Two seeds per station	5
Three seeds per station	33
Four seeds per station	5
None response	1

The table above shows that most farmers planted 3 pigeon pea seeds per planting station. Five farmers planted 2 seeds and 3 seeds per planting station respectively. It might be concluded that mostly pigeon peas is planted at a density of three seeds per planting station.

Table 5: Soya bean seeds per station

Number of seeds per planting station	Frequency of responses
Two seeds per station	5
Three seeds per station	7
Four seeds per station	4

It appears that not many of our farmers planted Soya beans. This table indicates that the number of Soya bean seeds per planting station ranges from 2-4. The difference is not so much pronounced. However it is seen that generally, most farmers plant 3 seeds per station.

Table 6: Maize spacing

Spacing	Number of people practicing
51-60 cm	20
71-80 cm	8
61-70 cm	4
81-90 cm	3
>90 cm	2

20 farmers planted their maize at a distance of 51-60 cms. Eight (8) farmers planted their maize at a distance of 71-80 cms. Four (4) farmers planted their maize at a distance of 61-70 cms. Three (3) farmers planted their maize at a distance of 81-90 cm and only 2 farmers planted at a distance of over 90 cm. Despite the fact that farmers have seen the research team using 90 cm maize spacing in the trials, they still plant their maize as densely as it is shown above. It may be that farmers are failing to adopt this recommended maize spacing due to scarcity of land. But it could also mean that they feel some land will be wasted should they adopt this spacing. The space between adjoining maize planting stations looks too wide to be left unplanted.

Table 7: Planting patterns and reasons for using those patterns

Planting pattern	**Reason for planting pattern**	**Frequency of responses**
1. One bean station midway between adjoining maize planting stations	To avoid overcrowding crops in the field	4
	So that if one crop fails you may be compensated from the others	4
	We imitate the pattern of the research plots	1
	Its our traditional planting pattern	1
	Two beans per station to plant a large area	1
	Just wanted to intercrop beans, pigeon peas and Soya separately with maize	1
	To make sure that every space between maize stations has been utilized	1
	Wanted to compare its results to their normal planting	1
	Because of lack of land	**15**
2. Two bean stations equally spaced between maize stations	There is no special reason	2
	We imitated this practice from the European farmers formerly working in our area	1
3. One bean station and one pigeon pea station equally spaced between maize stations	There is no special reason	3
	Because of lack of land	1
	So that if one crop fails you may be compensated from the others	2
	We imitate the pattern of research plots	3
	Its our traditional planting pattern	2
	Two beans per station to plant a large area	2
	Maize, beans and pigeon peas have bean intercropped but beans will be harvested earlier and it will provide space for the other two crops	1
	Sub-total for reasons supporting planting pattern 3	**17**
4. One pigeon pea station midway between adjoining maize stations	To avoid overcrowding crops in the field	3
	There is no special reason	2
	So that if one crop fails you may be compensated from the others	2
	Because of lack of land	2
	Its our traditional planting pattern	1
	Two beans per station to plant a large area	1
	Just wanted to intercrop beans, pigeon peas and Soya separately with maize	1
	To sure that every space between maize stations has been utilized	1
	Sub-total for reasons supporting planting pattern 4	**13**

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Question 2.5/2.6 (continued)

Planting pattern	Reason for planting pattern	Frequency of responses
5. Two bean stations with one pigeon pea station side-planted between bean stations, between maize stations	We imitate the pattern of research plots	2
	Because of lack of land	1
7. One bean station and one pigeon pea station between maize stations but pigeon peas planted on the ridge side	Pigeon peas planted on the side of the ridge to allow for the cultivation of mbwera field peas	1
8. One bean station and one pigeon pea station equally spaced between maize stations, with one station of Soya side-planted near to each maize station	To avoid overcrowding crops in the filed	1
10. Two bean stations with one side-planted pigeon pea station between them, between maize stations	Two beans per station to plant a large area	1
11. Two bean stations between maize stations, with two rice stations side-planted and one pigeon pea station between the rice stations	So that if one crop fails you may be compensated from the others	1
12. One bean station between maize stations with one pigeon pea station side-planted near to each maize station	Because of lack of land	1
13. Two bean stations with one pigeon pea station between them, with one station side-planted sorghum	We imitate the pattern of research plots	1
14. One bean station between maize stations and one pigeon pea station midway between maize stations after three stations of maize	Pigeon peas planted on the sides of the ridge to allow for the cultivation of mbwera field peas	2
15. Three Soya planting stations between maize stations	There is no special reason	2
	We imitate the pattern of research plots	1

Question 2.5/2.6 (continued)

16. One Soya station between maize stations	To avoid overcrowding crops in the field	1
	So that if one crop fails you may be compensated from the others	1
	Wanted to compare its results with their normal practice	1
17. Two pigeon pea stations equally spaced between maize stations	We imitated the practice from the European farmers formerly working in our area	1
18. Two Soya bean stations equally spaced between maize stations	Wanted to compare its results with their normal practice	1
19. Two pigeon pea stations side-planted near to each maize station	Wanted to compare its results with their normal practice	1

From the table above, there is a total of 64 responses and that farmers practice 19 different planting patterns for maize, beans, pigeon peas and Soya beans. Planting patterns 1, 3 and 4 have been the most popular amongst the trial farmers interviewed but farmers gave different reasons for adopting them in their farming system.

(a) Planting Pattern 1**(One bean station midway between adjoining maize planting stations)**

There are fourteen reasons offered in favour of this planting pattern. The most frequent reasons given point out that this is done to avoid overcrowding of crops in the field. It is also adopted to make sure that if one crop fails one may be compensated by the yield gotten from the other crops. The second reason does however suggest that the field has been densely planted, which is not the case as one reads the statement in the planting pattern. Amongst the other reasons given in favour of this planting pattern, there is no other strong reason which can compare with the first reason cited above. Some farmers did it as mere imitation from the research plots while others wanted just to experiment whether by using this pattern they would realize any better yield than that which they would get by using their normal pattern.

(b) Planting Pattern 3 **(One bean station and one pigeon pea station equally spaced between maize planting stations)**

Thirteen reasons were given in support for this planting pattern. Three farmers said that they do it this way after seeing what the researchers do in the trial plots. Three others said there are no special reason for practicing this planting pattern. Two farmers said that they adopted this planting pattern because it is the traditional way of planting these crops.

(c) Planting Pattern 4 **(One pigeon pea station midway between adjoining maize stations)**
Twelve farmers adopted and supported this planting pattern. Three farmers said that they adopted this planting pattern in order that crops should not overcrowd the field. Two farmers said that there was no special reason for using this pattern. Two other farmers adopted this pattern for the reason that if one crop fails one might be compensated from the others. The remaining reasons given do not single out any unique aspect apart from using this pattern because it is traditional.

The other planting patterns appear to reveal a more densely populated planting where four or more crops are intercropped and these are maize, beans, pigeon peas, rice and soya. Two farmers said that this is done due to lack of land. Three farmers did it as an experiment to see whether the outcome would do be better than just planting it their normal way. Three other farmers just imitated what they had seen in the research plots or somewhere else. Some farmers planted it this way so that if one crop failed they could be compensated from the others.

Table 8. Use of inputs.

Use of other inputs	Frequency of responses
No	30
Yes	9

Nine farmers had used other inputs particularly fertilizer. on their observation plots. Thirty farmers had not any other inputs by the time this monitoring exercise was being conducted. Thirty farmers did not use any other inputs.

Table 9. Crop Establishment for beans(observation plots)

Scale for scoring
1: very poor, 2: Poor, 3:Average ok, 4: Good, 5: very good

Kaulesi	Nagaga	Napilira	Kalima	PAD 3	G22501	Mkhalira	Kambidzi	Soya
18	22	20	18	19	17	19	17	5
9	4	6	6	8	7	6	7	2
1	9	5	5	5	3	5	3	
3		3	1	2	2	3	4	1
1	1		4		2		2	
32	36	34	34	34	32	33	33	8
4.03	**4.44**	**4.10**	**4.18**	**4.29**	**4.06**	**4.24**	**4**	**4.38**

Table 9 above presents farmer scoring of bean crop establishment (emergence and vigour) a few weeks after germination. From the average scores it is seen than Kaulesi, Nagaga, PAD 3 and Mkhalira had done well compared with Napilira, Kalima and G22501. The poorest establishment had been observed from Kalima. For those who grew Soya bean it generally had germinated well.

Table 10 Crop Establishment for pigeonpeas(observation plots)

ICEAP 00053	ICEAP 00040	ICP 9145	ICEAP 00020	Chilinga	ICEAP 00068	ICEAP 00073	ICP 6927
14	16	15	13	15	5	2	6
8	6	5	7	6	2	7	5
5	11	9	7	4	5	7	5
4		5	3	8	4	1	6
3	3	2	4	2	2	3	2
3.68	**3.87**	**3.24**	**3.65**	**3.69**	**3.22**	**3.2**	**3.79**

Table 10 gives us the picture of how farmers had assessed the establishment (emergence and vigour) of pigeon peas at the start of the season. The overall look at pigeon peas indicates that generally the crop had a medium score on establishment. However, ICEAP00040, ICP 6927, ICEAP 00053 were seen to have had a relatively better establishment than the other varieties. The poorest varieties were ICEAP 00068 and ICEAP 00073.

Table 11. Lesson learnt from the observation plots.

Lesson	Frequency of responses	Percentage
To learn about vigour, maturity and what yield these different varieties of beans and pigeon peas will give as compared to local varieties	13	32.5%
Learn to grow new and different varieties of pigeon peas and beans and asses their yield	8	20%
To learn about planting definite numbers of seeds and their spacing	4	10%
Unable to tell	4	10%
To asses the yield and taste of these varieties	2	5%
Difference in yield and tolerance of these varieties to pests	1	2.5%
Obtain new seed for future use	1	2.5%
Learn nothing	7	17.5%
Total	**40**	**100%**

From this table we learn that 52.5% of our farmers were hoping to asses the performance of the new bean and pigeon pea varieties they had planted on vigour, time of maturity and yielding capacity as compared to local varieties. More than 25% of responses said that they either did not expect to learn anything or could not yet tell what they were expecting to learn from the observation plot. The other responses (about 15%) mention farmers' interest in assessing the performance of the bean varieties on tolerance to pests, yield in relation to planting density and spacing and how good they tasted.

Table 12. Question 4.2: Farmers anticipation of planting any other crop in the observation plot

Response	Frequency
No	38
Yes	1

Almost all the farmers did not anticipate of planting any other crop in the observation plot at the time of the monitoring exercise. Only one farmer was planning to grow a relay crop of field peas

Table 13: Crop Establishment for beans(research plots)

Score	Meaning	Kaulesi	Nagaga	Napilira	Kalima
5	**Very good**	16	25	20	18
4	**Good**	13	9	11	14
3	**Average**	7	3	2	4
2	**Poor**	1	1	4	2
1	**Very poor**	2	1	2	1
	Total responses	39	39	39	39
	Average scores	**4.03**	**4.44**	**4.10**	**4.18**

According to farmer assessment, all bean varieties had established very well on the research plot. However the best performance was observed from Nagaga and the poorest performance was shown by Kaulesi.

Table 14. Question 5.1: Crop Establishment for pigeonpeas(research plots)

Score	Meaning	Local	ICEAP 00053	ICEAP 00040	ICP 9145
5	**Very good**	11	14	16	9
4	**Good**	13	10	9	5
3	**Average**	9	7	9	14
2	**Poor**	2	2	1	6
1	**Very poor**	3	5	3	4
	Total responses	38	38	38	38
	Average scores	**3.71**	**3.68**	**3.89**	**3.24**

Pigeon peas on both the observation and research plots was seen to have established rather poorly. However, ICEAP 00040 had a better establishment than the rest of the varieties. The poorest of all the varieties was ICP 9145.

Table 15: Difference between research and observation plot?

Response	Total	Percentage
There is no difference in establishment between research and observation plots	23	57.5%
Establishment in research plots is better than observation plots	7	17.5%
Establishment in the observation plots is better than the research plots due to earlier planting by farmer (because the soil was not yet compacted by heavy rains)	4	10%
There are differences in spacing between research and the observation plot	2	5%
Establishment in upland observation plot better than dambo research plots	1	2.5%
Establishment of pigeon peas better in the observation plots than the research plots	1	2.5%
No response	2	5%
Total	**40**	**100%**

Comparing crop establishment on research and observation plots, 57.5% of the respondents did not see any difference between the two plots. Only 17.5% of the respondents said that crop establishment on the research plots was better than the observation plots. 10% of the respondents saw that the observation plots were better in establishment than the research plots. The remaining proportion of answers focussed on the minor differences between the two plots in spacing and individual crop establishment.

Table 16: Lessons learnt from the research plots?

Response	Total	Percentage
The intercropping pattern and the resulting yield	20	50%
Spacing of ridges and planting stations	14	35%
Planting position of pigeon peas	1	2.5%
New methods of farming	1	2.5%
Nothing particular	1	2.5%
Unable to tell	2	5%
No response	1	2.5%
Total	**40**	**100%**

It is clear from the table above that 85% of the farmers were keen to learn what yield the intercropping pattern and the spacing of planting stations and ridges would give. The other responses mention new farming methods and planting position for pigeon peas.

Table 17: comments on any aspect of the trial.

Response	Total	Percentage
Thanking the project for information on plant spacing, planting pattern and plant density	5	12.5%
There is a better crop this year than last year	4	10%
Maize is not doing well	3	7.5%
Why crops prone to pests	2	5%
Happy about fertilizer application in the trials	2	5%
Why are you mapping the observation plot	1	2.5%
Why don't you supply where there is one plant or two?	1	2.5%
Why don't you open border ridges for water drainage	1	2.5%
Happy about research team's frequent visits	1	2.5%
Why do you take so long time to plant after first rains	1	2.5%
No comment	12	30%
Blank	2	5%
Happy with kanthu nkako package	1	2.5%
Asking if there is a control for snails in beans	1	2.5%
Ridge and planting station spacing is good	1	2.5%
Poor crop establishment in the observation plot	1	2.5%
Worried about the problem of ootheca	1	2.5%
Total	**40**	**100%**

No comments were heard from 35% of the respondents. Different questions were posed to project staff as comments, particularly in relation to technical activities which are undertaken in the trials like fertilizer application, supplying planting stations where seed did not germinate and other pest problems.

Farming Systems Integrated Pest Management Project

1999 Main Trial Monitoring: Second Round, Pre-harvest Beans

By P.Kapulula and J.Lawson-McDowall

This exercise was done just before the bean crop was harvested. It was done with the aim of letting the farmers evaluate the performance of the different bean varieties on both their observation plot and the research plot. The other reason for engaging in this exercise was to find out from farmers about what they had observed to be the main pests of beans this season plus other general problems which have contributed to low bean yields.

Table 18:.Important General Problem on Beans

Problem	Frequency	Percentage (35)
Too much rain	29	82.9%
Burning of leaves	15	42.9%
Wilting	8	22.9%
Stem rot	7	20%
Pod rot	6	17.1%
Ootheca	4	11.4%
Poor emergence	3	8.6%
Snails	2	5.7%
Low soil fertility	1	2.9%
Lodging	1	2.9%
Turkey	1	2.9%
Elegant grasshopper	1	2.9%
Early germination of seed in pod	1	2.9%
Termites	1	2.9%

From Table 18 above, it is quite clear that the most significant general problems on beans this year were too much rain (82.9%) and burning of leaves (42.9%). These problems have been seen to have made a significant loss of bean yield this season. From the table above, it is quite clear that the most significant general problems on beans this year were too much rain (82.9%) and burning of leaves (42.9%). These problems have been seen to have made a significant loss of bean yield this season.

Table 19: Important pest problem

Problem	Frequency	Percentage(35)
Ootheca	14	40%
Snails	6	17.1%
Elegant grasshopper	4	11.4%
Pod borer caterpillars	4	11.4%
Alcidodes	3	8.6%
Sucking bugs	2	5.7%
Whitegrubs	2	5.7%
Aphids	2	5.7%
Kaufiti wamkulu (alectra)	2	5.7%
Millipedes	2	5.7%
Leaf caterpillars	1	2.9%
Bean stem maggot	1	2.9%
Loopers	1	2.9%
Mearly bugs	1	2.9%
Turkey	1	2.9%

The commonest pest problem of beans this season was ootheca. This pest defoliated bean leaves thereafter resulting into failure of the bean plant to photosynthesise. The other important pests were snails, elegant grasshoppers and pod borer caterpillars.

Table 20: Performance of bean varieties against most serious general problem

Problems	Frequency	Kaulesi	Nagaga	Napilira	Kalima	PAD 3	G22501	Mkhalira	Kambidzi
Too much rain	25	2.9	2.9	3.2	3.4	**3.5**	3	3.4	**3.5**
Wilting	1	2	3	3	3	3	3	3	3
Elegant grasshopper	1	1	1	1	1	1	1	1	1
Snails	2	**5**	3	3	4	3.5	3.5	**5**	3
Termites	1	2	**5**	4	4	**5**	4	4	3
Early germination of seeds in the pods	1	4	4	**5**	**5**	**5**	4	1	1
Ootheca	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
None	1	0	0	0	0	0	0	0	0

From the table above it can be observed that the most serious general problem was too much rain. Only four bean varieties(Kambidzi, Mkhalira, Kalima and PAD 3) had relatively resisted the damage caused by this problem. No other problem had an overall destructive effect on beans for most farmers.

Table 21: Performance of beans against most serious pest problem

Problems	Frequency	Kaulesi	Nagaga	Napilira	Kalima	PAD 3	G22501	Mkhalira	Kambidzi
Ootheca	11	**4.33**	3.27	3.27	3.27	3.27	3.18	3.18	3.18
Snails	4	1.5	2.25	2.75	**3.25**	2.25	3	2.5	2.5
Millipedes	2	4.5	4.5	5	5	5	5	5	5
Turkeys	2	4.5	5	5	5	4.5	5	5	4.5
Alcidodes	2	**3.5**	3	2	2.5	2.5	1.5	2.5	3
Small whitish flies	1	2	3	3	3	3	3	3	3
Sucking bugs	1	**5**	4	2	2	4	2	2	2
Aphids	1	**5**	1	3	2	1	3	2	2
Pod borer caterpillars	1	1	**5**	2	1	4	**5**	**5**	4
Elegant grasshoppers	1	**3**	1	1	1	1	1	1	1
Leaf caterpillars	1	1	**5**	2	3	4	4	5	5
None	7	0	0	0	0	0	0	0	0

Ootheca was the most serious pest problem this season and 11 farmers mentioned it. Kaulesi coped up very well against this pest of all the varieties. A general outlook about these varieties shows that Kaulesi scored well with regard to sucking bugs, aphids and elegant grasshoppers. Nagaga scored well against pod borer caterpillars and leaf caterpillars. The other significant pest was a snail against which only Kalima scored well. Amongst the farmers, 7 did not experience any pest problem on beans.

Table 22: Use of fertilizer or manure

Response	Frequency (35)	Percentage
Farmers using fertiliser/manure	29	82.9%
Farmers not using fertiliser	6	17.1%

Amongst the farmers, 82.9% applied either manure or fertiliser on the observation plots. 17.1% did not use any of these.

Table 23: Record of first weeding

Response	Frequency
Done completely	35
Not interviewed	4

All farmers managed to do first weeding on their observation plots.

Table 24: Record of banking

Response	Frequency (35)	Percentage
Done completely	27	77.143%
Done partially	6	17.143%
Not done at all	2	5.743

Only 27 farmers managed to bank their fields completely. Six did it partially and two farmers failed to bank.

Table 25: Problems with weeding or banking

Problem	Frequency(35)	Percentage
No problem	15	42.86%
There was too much water/too much rain	6	17.1%
Sickness	4	11.4%
Funerals in the village	3	8.6%
Termite were lodging my crops	3	8.6%
Too much work	1	2.9%
The field was too big	1	2.9%
I was tired because I did all this work alone	1	2.9%
Some time was taken to do ganyu	1	2.9%

Most farmers (17.1%) failed to do second weeding in their observation plots because the fields were water logged. Another smaller proportion (8.6%) did not do so for fear that termites would lodge their

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crops. A bigger proportion of these farmers (21.6) failed to accomplish this due to usual problems of lack of labour, funerals, sicknesses and inadequate household labour.

Table 26: Partial or complete failure to bank (Genuine problems)

Record of banking	Frequency (35)	Percentage	Too much rain	Avoiding termites lodging	Lack of labour
Done partially	6	17.14%	3	2	2
Not done at all	2	5.71%		1	1

Table 27: Performance of beans on observation plots.

Variety	Plant stand	Plant vigour	Earliness of maturity	Expected yield
Kaulesi	3.8	3.69	**4.42**	2.86
Nagaga	4.06	4.14	3.21	3.06
Napilira	4.09	4.09	2.82	3.09
Kalima	4.11	3.94	3	3.26
PAD 3	4.34	**4.4**	2.82	3.26
G22501	4.18	3.91	2.97	3.18
Mkhalira	**4.54**	**4.31**	**3.33**	**3.62**
Kambidzi	**4.51**	**4.26**	**3.29**	**3.77**

It is obvious from the table above that Kambidzi and Mkhalira performed better in all agronomic qualities than the rest of the varieties except for Kaulesi on time of maturity. It is not surprising therefore that farmers have had a keen interest in keeping seed for these varieties for future use.

Table 28 Comparison of agronomic qualities of beans on research and observation plots

Variety	Plant stand		Plant vigour		Earliness of Maturity		Expected yield	
	Res	**Obs**	**Res**	**Obs**	**Res**	**Obs**	**Res**	**Obs**
Kaulesi	4.2	**3.8**	3.8	**3.69**	4.6	**4.42**	2.85	**2.86**
Nagaga	4.1	**4.06**	3.8	**4.14**	3.7	**3.21**	2.83	**3.06**
Napilira	4.1	**4.09**	3.7	**4.09**	3	**2.82**	2.57	**3.09**
Kalima	3.9	**4.11**	3.6	**3.94**	3.1	**3**	2.5	**3.26**

It appears that beans performed better on the research plot than the farmers' observation plots in most of the agronomic qualities except for Kalima which had a better plant stand, vigour and yield on the farmers' observation plot than on the research plot.

Table 29: Comment on obvious differences between plots (of beans)

Comment	Frequency
I have not seen any difference	8
There are differences in terms of earliness to maturity, yield and tolerance of too much rain	3
Mkhalira has given me more yield than the rest of the varieties	2
All the new varieties are high yielding and early maturing	2
Kalima has done badly as compared to other varieties	1
Kaulesi has given higher yield than any other variety and was the earliest to mature	1
Kaulesi, Kambidzi, Mkhalira and Nagaga are high yielding	1
Mkhalira , Kambidzi and Kaulesi Have given me better yields than any other variety	1
I have observed differences in development, growth and podding	1
Except Kaulesi, the other varieties have performed equally well that I can not differentiate	1
G22501 is very slow in growth but high yielding	1
Kambidzi and PAD 3 are early maturing and high yielding	1
Kalima, Napilira and PAD3 are resistant to excessive rain and are high yielding	1
I have observed that G22501 and Kambidzi are early maturing and high yielding	1
I have observed that PAD 3, Mkhalira and Kambidzi are high yielding	1
Mkhalira and Kambidzi are high yielding varieties	1
PAD 3 performed badly	1

A total of eight respondents observed that there were no differences in the performance of the eight bean varieties. However, several comments were made with reference to either good or bad characteristics of these bean varieties. Three farmers said that they observed differences among the bean varieties in terms of time of maturity, the amount of yield produced and their tolerance to excessive rain. A general comment was made in favour of the new varieties (PAD 3, Kambidzi, Mkhalira and G22501) that they are high yielding and early maturing.

Mkhalira and Kambidzi have been mentioned more than six times that

- they have produced more yield than any other variety
- they are early maturing (two times and four times respectively)
- are better on podding than the other varieties

G22501 has been mentioned four times that it gave better yields and three times that it is early maturing. However it has also been observed that this variety is slow in development

PAD 3 was three times singled out to be a good variety when it comes to podding, it is resistant to excessive rain and it is high yielding. One comment pointed out that this variety did very badly.

Regarding the varieties which have been part of the trials for some seasons, Kaulesi, Napilira and Kalima have been singled out as high yielding. Kalima and Napilira were said to be resistant to excessive rain. Nothing particular was said about Nagaga.

Table 30: General Comments on the New Varieties

	Mkhalira	Kambidzi	PAD 3	G22501
Early maturing	2	4	3	3
High yielding	7	8	5	4

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Table 31: Use of the varieties for relish (leaves) or for green beans.

Variety	Used as relish	Not used as relish	Total	Quality of relish
Kaulesi	**20 (57.1%)**	15 (42.9%)	35	4.1
Nagaga	18 (51.4%)	17 (48.6%)	35	4
Napilira	16 (45.7%)	19 (54.3%)	35	3.5
Kalima	18 (51.4%)	17 (48.6%)	35	4
PAD 3	15 (42.9%)	20 (57.1%)	35	3.3
G22501	16 (45.7%)	19 (54.3%)	35	4
Mkhalira	**24 (68.6%)**	11 (31.4%)	35	**4.2**
Kambidzi	**23 (65.7%)**	12 (34.3%)	35	**4.6**

Most people had used Kaulesi, Mkhalira and Kambidzi for relish (leaves and green beans). This has implications in relation to time of maturity between Kaulesi and the new varieties.
More people had used Mkhalira and Kambidzi for relish than it was the case for Kaulesi. It is also clear from the column of quality of relish that the new varieties (Kambidzi and Mkhalira) score higher than the rest of varieties with which the farmers were acquainted for more than two seasons.

Table 32: Lessons learnt about beans from the observation plots

Lesson	Frequency (35)	Percentage
Have not learnt anything	8	22.9%
The new varieties are high yielding /early maturing/cook fast	8	22.9%
The pattern of bean planting practised in the research plots is beneficial because beans are given enough space and bear more pods	3	8.6%
Planting two seeds per station to realise more yield	3	8.6%
Planting a number of varieties of the same crop is a ready help for your household and ensures one of a high yield	2	5.7%
We have learnt that there are other high yielding and early maturing bean varieties besides Kaulesi	2	5.7%
Mkhalira, Kambidzi and G22501 are certainly good varieties	2	5.7%
Kaulesi still produces pods under poor conditions	1	2.9%
Your research encourages us to grow beans despite the problem of ootheca (which is a great drawback)	1	2.9%
Kambidzi is early maturing and high yielding	1	2.9%
Has gained seed for multiplication	1	2.9%
We should plant a number of varieties of beans because you get compensated by the others if one fails	1	2.9%
Beans suffer a lot when there is excessive rain	1	2.9%
We need to plant different varieties of beans separately in order to evaluate them on yield	1	2.9%

We learn from this table that 22.9% of the respondents learnt nothing on their own observation plot. Another 22.9% of the respondents learnt that the new varieties given to the farmers this season

(Kambidzi, Mkhalira, G22501 and PAD 3) were high yielding, early maturing and cook fast. 17.2% of the respondents saw that the planting pattern adopted in the research plots provide ample space for the crop to grow well and produce a high yield. Farmers have seen that growing a number of varieties of the same crop increases yield but it can also help to cushion the farmer in the advent of a bad season where some varieties could perform better than others. Farmers have learnt that there are other bean varieties which are early maturing and high yielding beside their local variety Kaulesi. These varieties are Kambidzi, Mkhalira and G22501.

Table 33: Intention of doing mbwera on these observation plots?

Response	Frequency (27)	Percentage
Yes	11	40.7%
No	1	3.7%
Don't know	15	55.6%

This question was posed only to Matapwata farmers where a relay crop of beans or field peas is grown in the furrow before maize is harvested. 40.7% of the farmers were hoping to plant a relay crop of either beans or field peas. Over half of these farmers (55.6%) were not sure at the time of interview whether they would grow a relay crop of beans/field peas or not. One individual said no to this question because she had no field pea seed.

Table 34: Reasons for doing mbwera]

Reason	Frequency	Percentage
I would like to multiply the little seed I have realised and examine the performance of these new varieties	6	40%
To grow a relay crop of the new seed separately	3	20%
We are used to doing mbwera when the rains are favourable	1	6.7%
We would like to see how nsawawa will perform compared to beans	1	6.7%
Lack of bean /field pea seed	2	13.3%
Not applicable	2	13.3%

Some farmers (60%) wanted to multiply the little seed they harvested from the observation plots for a further evaluation. Others just wanted to do mbwera because they are used to this practice or because they were not satisfied with the performance of beans and wanted to try field peas instead. However, although some told us that they wanted to do mbwera, their answer for wanting to do it was not clear. to do mbwera because they were lacking bean or field peas seed. But one farmer was quite sure that she would not do mbwera because she had no bean/field peas seed.

<u>**RESEARCH PLOTS.**</u>

Table 35: Performance of beans on the research plot against most serious pest and general problem.

Variety	Most serious general problem *Too much rain*	Most serious pest *Ootheca*
Kaulesi	3.15	2.44
Nagaga	2.88	2.44
Napilira	2.82	2.44
Kalima	3	2.34

The table shows that Kalima and Kaulesi coped reasonably well with the excessive rain compared to the rest of the varieties. When we compare this performance with the same varieties on the observation plots (see Table 21), we find out that it is only Kalima, which coped well. All the varieties performed reasonably well against ootheca on the observation plots. Unlike on the observation plots, these varieties faired equally badly against ootheca on the research plots. It might be concluded that yield was drastically affected by the leaf defoliation by ootheca on the research plots.

Table 36: Differences between varieties on research and observation plots.

Response	**Frequency (35)**	**Perceived reasons for the difference**
These varieties performed better on my observation plot than on the research plot	14	1.Delay in planting the research plot 2. No water logging 3. Observation plots planted on virgin land
There was no difference	10	1.No idea 2. Grown under same conditions
These varieties did better on the research plot than on my observation plot	7	1. Farmer thinks we have been spraying the research plots 2. Poor management of observation plots 3. Farmer delayed to plant the observation plot
Kaulesi performed better on my observation plot than on the research plot	1	
No comparison made because on the research plot The crop was wiped out before maturity	1	
Napilira and Kalima performed better on the observation plot than on the research plot	1	Due to variety characteristics
Not applicable	5	

(The varieties: Kaulesi, Nagaga, Napilira and Kalima)
A total of 14 respondents observed that these varieties performed better on the observation plot than on the research plot because the research plots were either planted late, or farmer's plot was not affected by water logging conditions or farmer's plot was on virgin land . Ten respondents observed no difference at all on the performance of these varieties on both plots because they were grown under same conditions. Seven respondents observed that these varieties showed a better performance on the research plot than on the observation plot. It was thought that may be the research team was spraying pesticides on the research plot. Some thought that it was due to delay in planting the observation plot and others concluded that it was due to poor management of their observation plots.

Table 37: Lessons learnt about beans on the research plots.

Lesson	**Frequency (35)**	**Percentage**
Have learnt nothing	9	25.7%
Planting two bean stations between maize stations with one pigeon pea in between	6	17.1%
Ridge spacing which seems to create more land	2	5.7%
That you do not supply where plants have not germinated	1	2.9%
Planting 3 bean seeds per station as opposed to 4-5 by the farmer	1	2.9%
Planting our beans early will assist the beans to run away from the effect of excessive rain	1	2.9%

Table 37 continued

All varieties were attacked by ootheca and diseases	1	2.9%
Beans do well with good management of the field	1	2.9%
Time of planting of beans is critical on the expected results	1	2.9%
Kaulesi and Kalima can perform well despite receiving excessive rains	1	2.9%
You encouraged us to practice good management of the field	1	2.9%
These bean varieties are high yielding	1	2.9%
Beans do well even when they are intercropped with pigeon peas and maize	1	2.9%
Growth of the crop and its development was good	1	2.9%

25.7% of the respondents felt that they learnt nothing from the research plots. 17.1% said that they learnt the planting pattern (two bean station between maize stations with one pigeon pea station in between). The other lessons relate to time of planting which is critical on crop performance, tolerance to excessive rain of some bean varieties and good field management that enhances preferable crop performance.

Farming Systems Integrated Pest Management Project

1999 Main Trial (Bean and Pigeonpea) Monitoring: Round 3, Medium Duration Pigeonpeas (draft)Chiradzulu only.

By P. Kapulula and J.Lawson-McDowall

Introduction

At the village meetings, farmers expressed the desire to be given seed of suitable crop cultivars to test under their own management. Accordingly 25 farmers in Chiradzulu (where pigeonpeas usually does well) were given seeds of promising bean and pigeon pea varieties to grow on their own observation plots. This monitoring exercise was conducted to let farmers score expected yield and to let them tell us their perceptions of the strengths and weaknesses of each variety. This includes; early maturity, vigour, wilting, pests and loss flowers. Only 18 farmers were interviewed.

FARMER OBSERVATION PLOTS.

Table 38: Farmers knowledge on the four varieties

Response	Frequency
Yes	16
No	2

Only 16 farmers were able to tell the four medium duration varieties apart.

Table 39: Characteristics used in separating the four varieties

Differentiating Characteristics	Frequency
Pod colour (some pods have stripes others do not)	16
Earliness in maturity	6
Pod size and the number of seeds in the pod	3
Texture of pods (how soft or hard the pods are)	2
Number of pods	2
Plant heights	1
Wilting and the lack of it	1

The commonest distinguishing characteristic was the colour of the pods. The next distinguishing characteristic was time of maturity. Amongst these varieties there were some which were earlier in maturing than others. Some varieties have hard pods but others have soft. Some varieties produce a large amount of pods per branch but produce just a few. Some farmers considered difference in plant heights and wilting or the lack of it as useful distinguishing characteristics.

Table 40: Problems affecting reduction in yield of pigeonpeas.

Response	Frequency
Yes	16
No	2

Sixteen of the 18 farmers interviewed said that there have been some problems this year, which have reduced pigeonpea yields. Only two farmers said that they haven't had problems of any kind.

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Table 41: Important problems.

Problem	Score out of five	Frequency	Total	Average score
Poor germination	2	2		
	3	1		
	4	4	7	3.29
Pod borers	2	5		
	3	1		
	4	1	7	2.4
Water logging	4	1		
	5	2	3	4.7
Wilting	2	1		
	4	1		
	5	1	3	3.7
Poor pod filling	3	1		
	5	2	3	4.3
Loss of flowers	3	2	2	3
Late flowering	5	2	2	5
Pod suckers	3	1		
	5	1	2	4
Yellowing of leaves	2	1	1	2
Aphids	2	1	1	2
Snails	3	1	1	3

Poor germination and pod borers were the problems that farmers mentioned most frequently although the average scores the severity of the problems do not suggest that these are serious problems (3.29 and 2.4 respectively) where 1 would be no problems. Other serious problems were poor pod filling, wilting and water logging.

Problems of loss of flowers and pod suckers were also important in their own right.

Table 42: Most serious general problems.

Problem	Frequency
Poor germination	5
Poor grain filling	3
Wilting	2
Pod borers	2
Water logging	1
Late flowering	1
Loss of flowers	1
Snails	1

Poor germination was considered to be the most serious general problem this season. This problem was particularly pronounced for Chilinga where weevils so damaged so that much of it did not germinate. This was a great draw back for people like Dyson Chimwaza's observation plot where team members administering the questionnaire found no standing plant. Following this problem was what the farmers call "mphwephwa"(poor grain filling) which also was noticed especially on ICP 6927. The third in the order is pod borers, which were observed in almost every field although some farmers did not mention it during the interview.

Table 43: Occurrence of wilting

Response	Frequency
Yes	9
No	9

Only half of the respondents observed the problem of wilting in their fields this year.

Table 44: Average scores of wilt.

Variety	Chilinga	ICEAP 00068	ICEAP 00073	ICP 6927
Average score	1.7	2	1.44	1.9

These average scores denote a very slight problem on all varieties given that the score of 1 means no problem.

Table 45: Flower damage.

Response	Frequency
Yes	10
No	8

Chilinga appears to have had more of the problem of loss of flowers than the other varieties. Field experience confirmed that Chilinga was the first to produce flowers and that it produced more flowers than any other variety. However, farmers' assessment emphasised that the number of pods formed from those flowers was proportionally very small in a number of fields.

Table 46: Flower loss average scores.

Variety	Chilinga	ICEAP 00068	ICEAP 00073	ICP 6927
Average score	2.89	2	2.38	2

Table 47: Nature of damage and cause.

Response	Frequency
Deflowering due to wind	6
Competition for moisture with other standing plants	1
Pre-mature flower drop due to the fact that flowers were not well developed or born properly	1
Caterpillars causing leaf fall	1
Lack of moisture (due to a rock present underneath the soil)	1

The commonest cause for the loss of flowers in pigeonpeas was said to be wind. But other farmers also spotted lack of moisture, which led to flowers not emerging properly. It was also observed that caterpillars, which were cutting the flowers, caused some flower loss.

Table 48: Pod damage.

Response	Frequency
Yes	15
No	3

Table 49: Nature of damage and cause?

Response	Frequency
Boring of pods by pod borers	7
Shrinking of pods due to lack of water	4
Pod suckers absorbed sap from the pods and this caused the pods to shrink	3
Before the pod fills it wilts and dies	1
Poor pod filling due to soil fertility	1

The most common pod damage observed in farmers' fields this season has been the boring of pods by pod borers. The other important forms of damage are shrinking of pods and damage caused by pod suckers. Farmers believed that these suckers drained the sap that was meant to form the grain in the pods and consequently the pods were reduced in size and shape. Other forms of damage were poor grain filling and wilting.

Table 50: Scoring for pod damage

Variety	Chilinga	ICEAP 00068	ICEAP 00073	ICP 6927
Average score	1.86	2.07	1.86	3

On average, ICP 6927 suffered the most serious damage on pods. Evidence from the field showed that the common nature of damage on this variety was wilting of the pods and poor grain filling. In some cases, pod damage was confused with early maturity when the pods were seen to have dried. However, other farmers noted that this drying was premature.

Table 51:Field operations carried out on the kanthu nkako plots.

After maize harvest, no field operations were done in most fields. Five farmers had cleared and buried the weeds in an operation called "kuojeka". A few others had grown a relay crop of either field peas or sweetpotato.

Activity	Chilinga	ICEAP 00068	ICEAP 00073	ICP 6927
No operation	12	13	12	11
Kuojeka	4	4	5	5
Mbwera(sweetpotato and field peas)	1		1	1
Mbwera and Kuojeka				1

Table 52: Pigeonpeas growing in the previous season on kanthu nkako plots.

Response	Frequency
Yes	14
No	4

A large number of these farmers grew their kanthu nkako pigeonpeas on pieces of land where pigeonpeas was also previously grown.

Table 53: Performance of the observation plots: expected yield and agronomic qualities of varieties

Quality	Chilinga	ICEAP 00068	ICEAP 00073	ICP 6927
Plant stand	3.4	3.5	3.2	**3.6**
Value of firewood	3.2	3.3	3	**5**
Earliness of maturity	**4.8**	3.5	3.2	**4.2**
Seed size	**4.8**	3.8	2.8	3.7
Expected yield	3.4	3.5	**3.8**	3.6
Average Score.	**3.92**	**3.52**	**3.2**	**4.02**

Chilinga scored well with regard to time of maturity and seed size. ICEAP 00073 scored highest on expected yield while ICP 6927 had the highest scores on plant stand, value of firewood and is next to Chilinga for early maturing.

Table 54: Obvious differences between varieties?

Difference	Frequency
Earliness of maturity	8
Difference in yield	4
Colour of pods	2
Pod size	1
Difference in flavour and taste	1
Vigour in growth	1
Seed size	1
Insect damage	1
Difference in plant heights	1
Time of flowering	1
Difference in pod filling	1
No difference	1

A good number of farmers pointed the difference in time of maturity between the varieties. The other difference was observed in the amount of yield that each variety was expected to give. The other minor differences were observed on time of flowering, seed size, pod size, colour of pods, plant heights and insect damage.

Table 55: Use of the varieties for green beans.

Response	Frequency
Yes	15
No	3

Fifteen farmers used some of the varieties for green beans. Only 3 had not used them for relish.

Table 56: Comments on taste

Variety	Number of people who have used it for green beans	Average score on taste
Chilinga	15	4.7
ICEAP 00068	5	4.8
ICEAP 00073	3	3.7
ICP 6927	9	4.4

A reasonable number of farmers used Chilinga and ICP 6927 for green beans. This might give an indication as to the time of maturity. Average scores on taste from those who had cooked the beans show that Chilinga, ICEAP 00068 and ICP 6927 are to the taste of our farmers but ICEAP 00073 is only considered to give medium satisfaction.

Table 57: Lesson learnt so far about pigeonpeas from the observation plots.

Lesson	Frequency
That there are other different varieties which mature fast than expected while others are late	7
That there are other varieties which are high yielding and early maturing	6
We have been encourage to keep seed through the kanthu nkako initiative brought by the research team	1
That pigeon peas may be grown at close spacing and can still give good yields	1
That some of these varieties can adapt well to our soils	1
When you have a number of varieties you make a choice on what to consume according to taste	2
That these varieties cook fast	1
That you gain more by planting a number of varieties in your field	1
Has been able to compare different varieties on earliness of maturity, yield and taste	1
These short duration pigeon peas are early maturing and may assist in times of hunger	2

Nearly half the farmers interviewed said that they now knew that these are new varieties which mature fast. Another point is that these varieties are high yielding. Because of this earliness in maturity households may have an early relief in the event of hunger. Farmers have also pointed out that through the kanthu nkako plots they have learnt to keep seed. Some farmers have also said that now they will have a wide choice of which varieties they may wish to consume according to their taste. It has been observed that some of these varieties adapt well to their soils.

Table 58: Comments on any aspect of the trial?

Comment	Frequency
There were no problems in conducting the trials/ work has gone on smoothly	2
Farmer hopes to get a high yield	2
Appreciate the services of the research team	1
The farmer feels ICEAP 00073 is late to mature	1
Asking for seed for next year	2
Appreciates for having known new pigeon pea varieties	2
These short duration pigeon peas are early maturing and may assist in times of hunger	1
The farmer would like to know how she can protect her pigeon peas from pests	1
The farmer regrets that these short duration pigeon peas have been given to them when the project is about to finish	1
The farmer has observed that ICEAP 00073 is late to mature	2
No comment	6

Two farmers observed that ICEAP 00073 matures late. Other comments were made in appreciation of how research work has been conducted this year and the provision of seed for farmers to grow under their own management. Other farmers stressed again that these short duration varieties are early maturing and high yielding.

Farming Systems Integrated Pest Management Project

1999 Main Trial (Bean and Pigeonpea) Monitoring: Round 4, Long Duration Pigeon Peas (Mombezi EPA only)

By P. Kapulula and J.Lawson-McDowall

By Phillip Kapulula

Introduction

Pigeonpea monitoring on the farmers' observation plots was divided into two phases. The first phase was done on four medium duration pigeonpeas namely ICEAP 00068, ICEAP 00073, ICP 6927 and Chilinga a local cultivar obtained from Mombezi before the start of this season. This second and last phase was conducted on ICP 9145, ICEAP 00040, ICEAP 00053 and local which are long duration cultivars. As it is with the other monitoring exercises, farmers were asked to score plant stand, value of stems as wood, earliness of maturity, seed size and expected yield. Scoring was done on 1 (very poor) to 5 (very good) scale for agronomic qualities and 1(no problem) to 5 (very serious) for pests, diseases and other general problems. Farmers were asked to comment on any obvious differences between varieties and possible reasons for them. In addition to these questions, farmers were asked what they hoped to learn from the plots. In this exercise, 17 farmers were interviewed.

Table 59 Farmers knowledge on the four varieties

Response	Frequency
Yes	15
No	2

Table 60: Characteristics used in separating the four varieties

Response	Frequency
Pod colour (have varieties have stripes others do not)	11
Seed colour	4
Growth habit of the plant	3
Pod size (and number of seeds per pod)	2
Earliness of maturity	2
Not applicable	2
Stem colour	1
Differentiates by pod colour, pod size, seed colour and growth habit of the plant	1
Seed size	1

15 Farmers were able to tell the four long duration varieties apart. Most of them **(11)** were able to distinguish between different varieties using the colour of pods. Some pods are said to have stripes while others do not. The other common characteristics were seed colour and growth habit of plants.
On seed colour some farmers said that

- ICP 9145 had pearl small seeds,
- ICEAP 00040 has bigger seeds which are also pearl
- ICEAP 00053 has round seeds with large markings
- Local has large seeds which are oval and also have markings

Describing the growth habit of different plants some farmers said ICEAP 00053 has tall stems with few branches and bunchy podding while the other varieties are short and wide.
Farmers were also able to tell the varieties apart through differences in time of maturity, seed size, stem colour and pod size. It should be noted that some farmers were able to tell these varieties apart using multiple characteristics. This is why we have more characteristics than respondents.

Table 61: Most serious general problem in reducing pigeonpea yields.

Problem	Frequency
Water logging	4
Pod borers	2
Poor pod filling	2
Loss of flowers	2
No problem	2
Insufficient podding	1
Wilt	1
Early end of rainy season	1
Poor germination	1
Loss of soil fertility (poor soil fertility)	1
Aphids	1

The most serious and most frequently mentioned general problem was water logging and this was particularly bad for dambo farmers. Other common problems were pod borers, poor pod filling and loss of flowers. A few other farmers' pigeonpeas suffered seriously from wilt, poor germination, aphids, early end of rainy season and poor soils.

Table 62: Average performance of the long duration varieties against all serious problems

Variety	Average score
ICEAP 00040	2.4
Local	2.3
ICP 9145	2.0
ICEAP 00053	1.8

Given that the score of 2 means a slight problem, it appears that ICEAP 00053 and ICP 9145 only performed well against a range of problems but ICEAP 00040 and Local did less well.

Table 63: Wilting problem.

Response	Frequency
Yes	5
No	12

For those who said there was a problem of wilt on their pigeon peas, the problem was very minor.

Table 64: Scoring of varieties against wilt (average scores)

Variety	Average score
ICEAP 00040	1.4
Local	1.3
ICEAP 00053	1.2
ICP 9145	1.2

Table 65: Flower damage.

Response	Frequency
Yes	9
No	8

Half the farmers interviewed had observed flower damage or indications of flower damage in their fields. The most important observed cause was loss of flowers due to wind. Two farmers just assumed there had been some flower damage after seeing that there was a presence of aphids and other flying insects on the flower buds. Average scores on the performance of these varieties against the problem shows that the problem was trivial given that a score of 2 means slight problem.

Table 66: Nature and cause of damage

Damage and cause	Frequency
Not applicable	8
Loss of flowers due to wind	7
Flying insects around the flowers but no damage has been observed	1
Aphids causing loss of flowers	1

Table 67 Scoring of varieties on flower damage (average scores)

Variety	Average score
Local	2
ICEAP 00040	1.6
ICEAP 00053	1.4
ICP 9145	1.4

Table 68: Pod damage.

Response	Frequency
Yes	9
No	8

Half the farmers interviewed observed pod damage on their pigeonpeas. The most serious pod damage was boring of pods and eating of immature or developing seed by borers. The other problems were poor pod filling referred to as "*mphwephwa*" and drying of pods before seed formation is done inside.

Table 69: Nature and cause of damage.

Damage and cause	Frequency
Pod borers eating immature/developing seeds	7
Drying of pods without forming seed inside but the cause is not known	1
Poor pod filling caused by wind	1

Table 70 Scoring of varieties on flower damage (average scores)

Variety	Average score
ICEAP 00040	1.5
ICEAP 00053	1.4
Local	1.4
ICP.9145	1.2

Table 71: Question 5.1 Agronomic qualities of varieties and expected yield of observation plots

Variety	Plant stand	Value as wood	Earliness of maturity	Seed size	Expected yield
ICP 9145	**3.6**	**2.8**	3.9	2.4	3.1
ICEAP 00040	3.4	2.7	**4.0**	4.0	**3.9**
ICEAP 00053	**3.6**	2.5	2.8	**4.3**	3.2
Local	2.5	2.2	1.2	3.5	1.8

This question was initially asked to get the perception of farmers about weaknesses and strengths of each variety. From this table it is clearly shown that Local is weak in all qualities when compared to the ICRISAT varieties. ICEAP 00040 scored well with regard to value of stems as wood, earliness of maturity, seed size and expected yield. The closest to this variety is ICP 9145 which also scored highest on plant stand, value of stems as wood and earliness of maturity. ICEAP 00053 scored the highest on seed size and plant stand. According to farmers' scoring, ICEAP 00040 is the best bet in pigeonpeas.

Table 72: Comment on any obvious differences between varieties.

Difference	Frequency
No differences	6
ICEAP 00040 has a higher yield than the rest because it was planted where there was no pigeonpeas last year	2
Varieties have shown differences in their ability to produce and resist wilting	2
ICEAP 00040 makes a lot of branches but ICEAP 00053 is non-branching	1
There are a lot of deaths and poor germination in local	1
There is seed size differences between varieties	1
Poor germination reduced yield in all varieties except in ICEAP 00053	1
ICEAP 00053 had stunted growth compared to the other varieties	1
ICEAP 00040 and ICEAP 00053 have given better yields than local and ICP 9145	1
ICEAP 00040 and ICP 9145 have given better yields than the others	1

Six farmers did not see any differences between these varieties. ICEAP 00040 has been promoted as a high yielding variety. Following this variety are ICEAP 00053 and ICP 9145. It was pointed out that Local suffered more deaths and was the worst hit by poor germination. One farmer pointed out that poor germination reduced yield for all varieties except ICEAP 00053. In general varieties have exhibited differences in yield, seed size and resistance to wilt.

Table 73: Use any of the varieties for green beans or dry beans.

Response	Frequency
Yes	13
No	4

Thirteen farmers used pigeonpeas from their observation plot for green beans. Scores on the taste of these varieties do not show a significant difference. However, it is interesting to note that ICEAP 00040 still leads the other varieties on taste. This reinforces our understanding that the variety is really a best bet on all qualities the farmers look for when selecting varieties. Unfortunately, ICEAP 00053 has not proved to the satisfaction of farmers.

Table 74 Scoring of varieties on taste (average scores)

Variety	Average score
ICEAP 00040	2.5
Local	2.2
ICP 9145	2.1
ICEAP 00053	1.88

Table 75:.Lessons learnt about pigeonpeas from the observation plot.

Lesson	Frequency
Has known new pigeonpea varieties which are high yielding and early maturing	4
Has learnt that different varieties perform differently	3
Planting pigeonpeas on top of the ridge but separate from maize stations	2
Has learnt that it is good to plant several varieties to avert risks	2
Has observed that some varieties are earlier in maturing than others	2
Planting pigeonpeas on top of the ridge and in lower planting densities	2
Has not learnt anything	1
Has learnt to keep varieties separate for assessment on performance	1

Four farmers said that they had learnt to plant pigeonpeas on the top of the ridge in lower densities and separate from the maize planting station. This implies that formerly (before the project) farmers used to plant pigeon peas together with maize. For those who were not mixing the seed, they planted pigeon peas separately but it was planted on the side of the ridge close to the furrow. Farmers are happy that they have been exposed to new varieties which have shown differences in yield and time of maturity. Planting different pigeonpea varieties in one field was seen to be beneficial because one is able to avert risks of drought, excessive rain or pests and diseases. This means that some varieties might prove to be resistant to some of these problems and the farmer could still be able to harvest something. One farmer said that it has been possible to assess these varieties by planting them separate from each other.

Table 76: Comments on any aspect of the trial.

Comment	Frequency
No comment	10
We are grateful for the provision of these new varieties	3
She would like to keep seed for next season	2
All long duration varieties yield better than local and resist wilting	1
With the new varieties we start eating pigeonpeas around May/June	1

Over half the farmer did not make comments. However, those who were willing to comment expressed gratitude to the project for providing additional seed to the farmers to grow under their own management. It was reported that these varieties are high yielding, early maturing and resistant to wilt unlike their local variety. As a result of early maturing in these varieties, farmers nowadays start using pigeonpeas as green beans around the months of May/June. They are keen to keep seed for the coming years.

Farming Systems Integrated Pest Management Project

1999 Main Trial (Bean and Pigeonpea) Monitoring: Round 5, Long and Medium Duration Pigeon Peas (Matapwata EPA only)

By P. Kapulula and J.Lawson-McDowall

Introduction

Main trial farmers in Matapwata had a different package of the extra pigeonpea seed from those of Chiradzulu. Their package comprised of ICEAP 00040, ICEAP 00053, ICP 9145, Chilinga and their local variety. In this package, it is only Chilinga that is considered to be a medium duration cultivar.
In this exercise, like the other pigeonpea monitoring exercises, farmers were asked to score plant stand, value of stems as wood, earliness of maturity, seed size and expected yield. Our scoring scale ranged from 1 (very poor) to 5 (very good) for agronomic qualities and expected yield and 1 (no problem) to 5 (very serious problem) for pests and diseases observed in the plots. Farmers were also asked to comment on any obvious differences spotted between varieties and the possible reasons for these differences. They were further asked to tell us what they had learnt from their observation plots. Only 13 farmers were available and had been interviewed in this exercise.

Table 77: Farmers knowledge on the four varieties

Response	Frequency
Yes	9
No	4

Nine farmers were able to separate the four varieties. Most of these farmers were able to differentiate between varieties by looking at the amount of pods produced per plant. In a way this relates to whether a variety is high yielding or not. The other farmers looked at the shape and vigour of the plant, the size of the pod, the colour of the pods and how each variety suffered or resisted fusarium wilt.

Table 78: Characteristics used in separating the four varieties.

Response	Frequency
Amount of pods per plant	5
Not applicable	4
Plant shape and vigour	1
Pod size	1
Pod colour	1
Extent of wilt	1

All farmers except one, expected low pigeonpea yields because they had experienced some problems. Seven farmers said this loss in yield would be due to low soil fertility in their gardens. Three farmers attributed the low yields to loss of flowers in their pigeonpeas. Two other problems, which have reduced pigeonpea yields, are poor germination and fusarium wilt.

Table 79:.Problems leading to reduced pigeonpea yield.

Response	Frequency
Yes	12
No	1

Table 80:.Important problems leading to loss of yield.

Response	Frequency
Low soil fertility	7
Loss of flowers	3
Wilting	2
Poor germination	2
Not applicable	1

Table 81: Most serious general problem.

Response	Frequency
Low fertility	5
Loss of flowers	4
Poor germination	2
Wilting	1
Not applicable	1

Table 82: Average scores depending on severity of problems.

Variety	Average score
Chilinga	3
ICEAP 00053	2.8
ICP 9145	2.6
ICEAP 00040	2.5
Local	**2.2**

Farmers stressed that low fertility is the major cause for the loss of pigeonpea yield in Nansadi Section of Matapwata Extension Planning Area this year. In addition to low fertility, pigeonpeas lost quite a lot of flowers. Other farmers also observed that poor germination and wilting have contributed to this loss in yield. The reader should be reminded here that when scoring problems and pests, a score of 1 means slight problem while a score of 5 means a very serious problem. Given the information in Table 82 it should therefore be mentioned here that Local had slightly suffered from all these problems while Chilinga had a medium problem.

Table 83: Wilting problem.

Response	Frequency
Yes	3
No	10

Table 84: Average scores depending on severity of wilting.

Variety	Average score
Chilinga	0.38
ICEAP 00053	0.61
ICP 9145	0.46
ICEAP 00040	0.38
Local	0.54

In general wilting was a very trivial problem this season. Only three farmers had spotted it in their fields. The average figures in Table 84 show that it was non-existent.

Table 85: Flower damage.

Response	Frequency
Yes	10
No	3

Ten farmers observed that there had been damage to pigeonpea flowers in their fields. There was only one type of damage and this was loss of the flowers that would bear the pods and consequently the desired grain. This loss was attributed to wind, poor soils and other unknown causes. Chilinga suffered the worst on loss of flowers. There was a slight loss in the other varieties but the most resistant of them all was Local.

Table 86: Nature of damage and cause.

Response	Frequency
Loss of flowers due to wind, poor soil and unknown other causes	10
Not applicable	3

Table 87: Average scores depending on the cause and nature of damage.

Variety	Average score
Chilinga	3.1
ICP 9145	2.1
ICEAP 00053	1.8
ICEAP 00040	1.8
Local	1.6

Table 88: Pod damage.

Response	Frequency
Yes	2
No	11

Table 89: Nature of damage and cause

Response	Frequency
Not applicable	11
Caterpillars feeding on pods	1
Premature drying of pods	1

Table 90: Average scores depending on the cause and nature of damage.

Variety	Average score
Chilinga	0.38
ICP 9145	0.53
ICEAP 00053	0.54
ICEAP 00040	0.61
Local	0.38

From **Table 88**, only 2 farmers observed pod damage on their pigeonpeas. From Table 89, it can be seen that Caterpillars were boring and eating the grains inside the pods. The other problem was wilting of the pods before maturity. But on average as given Table 90 in, the problem of pod damage could be termed non-existent.

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Only 1 farmer had not carried out any operation since maize harvest in Chilinga and the ICRISAT varieties' plots and 2 farmers on plot where the local variety was grown. Eleven farmers had done the first field clearing (kuojeka) operation on the ICRISAT varieties and only 10 on local. One farmer had done mbwera on all the plots.

Table 91: Field operations carried out on the kanthu nkako plots since the maize harvest

Variety → Operation ↓	Chilinga	ICEAP 00040	ICEAP 00053	ICP 9145	Local
No operation	1	1	1	1	2
Kuojeka	11	11	11	11	10
Mbwera	1	1	1	1	1

Table 92: Pigeonpeas growing in the previous season on kanthu nkako plots.

Response	Frequency
Yes	4
No	9

Only 4 farmers had grown their kanthu nkako pigeonpeas on plots previously put to pigeonpeas last season.

Table 93. Expected yield and agronomic qualities of varieties

Variety	Plant stand	Value as firewood	Earliness of maturity	Seed size	Expected yield
ICP 9145	4.3	3.1	4	2.7	3
ICEAP 00040	4.3	3.4	3.2	3.5	3
ICEAP 00053	4.3	**4.1**	3.2	**4.5**	**3.3**
Local	4.3	3.4	1.8	3.8	3.2
Chilinga	**4.5**	2.9	**4.8**	4.2	2.8

No single variety has proved to be good in all aspects that farmers look for when selecting varieties.

- Chilinga scored highest on plant stand and time of maturity
- ICEAP 00053 scored highest on value as firewood, seed size and expected yield
- Local was the lowest on time of maturity and did not emerge as a winner on any aspect or quality

Table 94: Comments on any obvious differences between varieties

Variety → Quality ↓	Chilinga	ICP 9145	ICEAP 00040	ICEAP 00053	Local
High yielding	1	1	3	2	1
Early maturing					
Low yielding			1		

A closer look at the observed differences between the varieties shows that the main aspect on which farmers have seen a difference is yield. ICEAP 00040 is said to have produced the highest yield and the second in order is ICEAP 00053. But if we referred back to **Table 93**, we find out that the highest on yield is ICEAP 00053 next in the order is Local while ICEAP 00040 and ICP 9145 tie at position three. Other important differences observed relate to resistance to wilt, pod colour, seed size and loss of flowers. Four farmers said that they saw no difference between these varieties. It is not known whether all of these varieties performed well or badly.

Table 95: Differences between varieties

Difference	***Frequency***
No difference	4
Difference in podding pattern, ICEAP 00040 and ICEAP 00053 have produced a better yield than the others	2
Difference in resistance to diseases ICEAP 00053 wilts more than the other varieties	1
These varieties have shown differences in pod colour, yield and seed size	1
All the varieties are high yielding	1
ICEAP 00040 has yielded more than the rest of the varieties	1
Chilinga and ICP 9145 have lost more flowers than the rest	1
ICEAP 00040 has produced the poorest yield	1
Local has produced the highest yield followed by ICP 9145 then ICEAP 00040 and the lowest is ICEAP 00053	1

Table 96: Use any of these varieties for green beans or dry beans.

Response	**Frequency**
Yes	11
No	2

Eleven farmers had used some of the varieties for green beans. According to those who had tasted the varieties, ICEAP 00053 and Local are better than the rest but the difference is not so significant. The lowest score on this quality came from ICP 9145.

Table 97: Average scores on taste.

Variety	**Average score on taste**
Chilinga	2.6
ICP 9145	2
ICEAP 00053	**2.7**
ICEAP 00040	2.5
Local	**2.7**

Table 98: Lessons learnt about pigeonpeas from the observation plot.

Response	Frequency
Has learnt nothing	2
Chilinga and ICEAP 00040 are high yielding and early maturing	2
Chilinga is a better variety and the farmer wishes to grow this variety only	1
Doing kuojeka early helps to give better flowering by reducing competition	1
Some varieties produce more yield e.g. ICEAP 00053	1
Chilinga and Local had a better germination than the research varieties	1
Chilinga and ICP 9145 are early maturing	1
It is better to grow several varieties because it gives you a potential for high yields	1
Chilinga and ICEAP 00053 are high yielding	1
ICEAP 00040 and Local are suitable for their soil	1
All varieties have performed poorly	1

Two farmers learnt nothing from their observation plots. Two other farmers learnt that Chilinga and ICEAP 00040 are early maturing and high yielding varieties. One farmer observed that clearing weeds early enough in a pigeonpea field reduces competition for moisture and nutrients between the crop and other growing plants and promotes better flowering. Another farmer observed that growing a number of varieties of the same crop gives one a potential for obtaining a high yield. Chilinga has been spotted as one of the high yielding and early maturing varieties in line with ICEAP 00040 and ICEAP 00053.

Table 99:.Comment on any aspect of the trial.

Response	Frequency
No comment	8
Need more seed for next season	2
Sad to hear that the project is phasing out	1
Would like to make ridges in the plots	1
Chilinga does not do well in their area	1

Most of these farmers had no comments to make. Two farmers would like to be given seed of these varieties for next year. One farmer is disappointed to hear that the project is winding up this season.

Farming Systems Integrated Pest Management Project

1999 Whitegrub Trial Monitoring: Round 1, Germination

By P. Kapulula and J.Lawson-McDowall

Introduction

As part of the trial process this season, the project solicited farmers' preferences regarding contact and monitoring in order to match these with project monitoring and evaluation needs. An agreement was reached that at critical times researchers and farmers would go to the field and look at the trial crops together to map out the treated maize location and to note spatial arrangement and the combination of intercrops. The farmer would be asked to comment on what s/he had observed in the plot. Scoring of maize establishment on both the research and seed dressed observation plot was done on a scale of 1 (very poor) to 5 (very good).

This report summarises farmers' opinions of whitegrub trials immediately at post-germination and their comparisons of the research and the seed dressed observation plots. The main areas on which farmers' assessment was focused are description of planting patterns, crop establishment (emergence and vigour), the lessons they expected to learn from the trial and the observation plots, farmers' understanding of the trial and researcher data collection. Results are presented as summaries under each question.

Results and discussion

Table 100:.Dates of planting seed dressed maize on the observation plot.

Date of planting for seed dressed maize on observation plots	
No date given	1
23/11/98	1
24/11/98	1
26/11/98	1
27/11/98	1
28/11/98	1
30/11/98	1
Total respondents	8

One respondent could not remember the exact date when the observation plot was planted. The other seven respondents had their observation plots planted between the 23rd and 30th November, that is, with the first rains. This means that all plots were planted with the first rains. This question was asked to see how comparable crop results might be in the end.

Table 101: Varieties of treated maize planted and number seeds planted per station.

Treated maize variety	Number of seeds planted per station	Frequency of responses
Local maize	3 or 4	7
MH 18	3 or 4	3
Bantam	3	1
Katswiri Pan	3	1
Total responses		12

Seven of the 12 responses indicate that they treated a local maize variety with gaucho Four people treated hybrid varieties MH 18 and Katswiri Pan while one person treated a composite variety known as Bantam. The planting density was 3 or 4 seeds per planting station.

Table 102: Varieties of untreated maize planted and number seeds planted per station.

Untreated maize variety	Number of seeds per planting station	Frequency of responses
Local	3 or 4	6
Katswiri Pan	3 or 4	3
Bantam	3	1
MH 18	3 or 4	2
Total responses		12

The remaining parts of these fields were also planted with the same varieties of maize seed as the observation plots. The number of maize seeds planted per station is identical to that of treated maize.

Table 103: Planting positions of the seed dressed maize and the reasons for the particular planting patterns observed.

Planting Pattern	Reason for the planting pattern	Frequency of responses
1. One bean station and one pigeon pea station equally spaced between maize stations	To avoid overcrowding crops in the field	2
2. One bean station midway between adjoining maize planting stations	Its our traditional planting pattern	1
	There was inadequate bean seed And to plant more than two bean stations per station would result in poor yield	1
	To provide enough space for maize	1
3. One bean station between maize stations with one pigeon pea station beside the maize station	Maize had not germinated at the time pigeon was planted therefore pigeon pea had to be planted on the sides	1
4. Maize planted as a sole crop at 60 cm apart	There was no bean seed available so space was spared to plant field peas later	1
5. One planting station of soy bean and one cassava cutting planted between maize stations	Because of scarcity of land	1
Total respondents		8

Two farmers adopted planting pattern 1 to avoid overcrowding. Three farmers adopted planting pattern 2 but for three different reasons. The reasons given include: provision of adequate space for maize, lack of adequate bean seed and because this is a traditional way of planting. Others have chosen to plant intensely because they have a problem of land scarcity.

Table 104: Use of any input.

Use of other inputs on the observation plot	Number of responses
No other inputs used	5
Fertiliser	3

Five of the 8 farmers had not used any other input on the observation plots by the time the monitoring team was visiting them. Three of them had applied basal fertiliser received from Starter Pack Scheme or acquired through other means.

Table 105: Problems faced in seed dressing.

Response	Frequency
There was no problem during seed dressing	6
It was easy after the team had explained to us	2

None of the farmers found it difficult to do the seed dressing. The research team had given clear instructions.

Table 106: Maize establishment (emergence and vigour) for treated maize.

Score	Meaning	Frequency
5	Very good	6
4	Good	2
AVERAGE SCORE		**4.75**

On average, all the treated maize emerged well and was seen to be growing vigorously. Farmers gave scores of 4 or 5 to all treated plots.

Table 107: Maize establishment (emergence and vigour) untreated maize.

Score	Meaning	Frequency
5	Very good	4
4	Good	2
3	Medium/average	1
2	Poor	1
AVERAGE SCORE		**4.13**

Six of the 8 respondents reported a generally good emergence of the untreated maize. Comparing results of 3.1.1 and 3.1.2 suggests that treated maize was doing slightly better than the untreated maize.

Table 108: Lessons learnt from planting seed dressed maize.

Lesson	Number of responses
Hopes to learn the effect of seed dressing compared to untreated maize in relation to germination	4
Hopes to learn whether seed dressing helps preventing maize damage from white grubs	3
It would be good to use seed dressing if there was money	1

It is apparent from the responses that all trial farmers understood the purpose of seed dressing i.e. to prevent whitegrub damage. The sentiment expressed by one of them on the economic aspect of the strategy has a strong impact on the potential for adoption of the technologies. Farmers may see that a technology is effective but lack the wherewithal to adopt it.

Question 5.1 Crop Establishment (research plots)

The tables (**Table 110-117**) inserted below illustrate a comparison of farmer scoring of maize establishment with the treatments mounted in each subplot. Crop establishment referred to here mean how well the crop had emerged or germinated and how well it appeared in terms of its vigour, strength

and health of the leaves and stems. Germination percentage was calculated on the basis of the ideal plant population of the net plot of 48 plants per plot.
A germination stand count made at the time of monitoring is put alongside farmers' scores to crosscheck farmers' opinion on the establishment. It will be observed that farmers' average scores in most instances do not match plant germination percentages. With respect to treatments, farmers' scoring suggests that in the plots where there was seed dressing with gaucho, tephrosia incorporation and gaucho treatment during 1997/98, there was on average the best crop emergence and vigour **(4.2).** But according to maize germination stand count assessment made by the technical team the same day, these plots were the next best **(74.3 %)** after the plots which had only seed dressing this season but had neither tephrosia nor gaucho treatment in 1997/98 which had **79.4%.** In terms of farmer scoring these plots have average score of **3.4** on crop establishment.

Table 109: No seed dressing, no tephrosia and no gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data out of 48	Germination percentage (48)
1	4	2	5	34	70.8%
2	4	2	1	33	68.8%
3	3	1	5	36	75%
7	4	1	3	40	83.3%
4	3	2	5	37	77.1%
5	1	2	5	37	77.1%
6	4	1	5	20	41.7%
8	3	2	3	39	81.3%
9	1	2	3	19	39.6%
Average score & %			***3.9***		***68.3%***

Table 110: No seed dressing, no tephrosia but with gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data out of 48	Germination percentage (48)
1	1	1	4	37	77.1%
2	3	2	1	31	64.6%
3	1	1	4	37	77.1%
4	2	1	5	35	72.9%
5	3	2	4	43	89.6%
6	3	1	4	32	66.7%
7	1	2	3	23	47.9%
8	2	2	4	39	81.3%
9	3	2	3	35	72.9%
Average score & %			**3.6**		**72.2%**

Table 111: Seed dressing, tephrosia incorporation and gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data out of 48	Germination percentage (48)
1	2	2	5	37	77.1%
2	2	1	1	22	45.8%
3	4	2	5	37	77.1%
4	4	1	5	40	83.3%
5	4	2	5	38	79.2%
6	2	2	5	40	83.3%
7	3	1	3	31	64.6%
8	1	1	5	41	85.4%
9	4	1	4	35	72.9%
Average score & %			**4.2**		**74.3%**

Table 112 Seed dressing, tephrosia incorporation but without gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data out of 48	Germination percentage (48)
1	3	2	5	39	81.3%
2	1	1	1	33	68.8%
3	2	1	5	32	66.7%
4	1	2	4	24	50%
5	2	2	4	35	72.9%
6	1	1	5	36	75%
7	2	2	3	28	58.3%
8	4	2	4	41	85.4%
9	2	2	3	37	77.1%
Average score & %			**3.8**		**70.6%**

Table 113 Seed dressing, no tephrosia incorporation and gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data out of 48	Germination percentage (48)
1	1	2	5	39	81.3%
2	3	1	1	33	68.8%
3	1	2	3	39	81.3%
4	2	2	5	37	77.1%
5	3	1	2	34	70.8%
6	3	2	5	39	81.3%
7	1	1	3	29	60.4%
8	2	1	5	40	83.3%
9	3	1	3	30	62.5%
Average score & %			**3.6**		**74.1%**

Table 114: Seed dressing, no tephrosia and no gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data out of 48	Germination percentage (48)
1	4	1	4	42	87.5%
2	4	1	1	28	58.3%
3	3	2	4	40	83.3%
4	3	1	5	46	95.8%
5	1	1	1	35	72.9%
6	4	2	5	40	83.3%
7	4	2	3	30	62.5%
8	3	1	5	44	91.7%
9	1	1	3	38	79.2%
Average score & %			**3.4**		**79.4%**

Table 115: No seed dressing, tephrosia incorporation and gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data	Germination percentage (48)
1	2	1	4	40	83.3%
2	2	2	1	27	56.3%
3	4	1	5	26	54.2%
4	4	2	5	36	75%
5	4	1	1	34	70.8%
6	2	1	4	26	54.2%
7	3	2	3	42	87.5%
8	1	2	4	34	70.8%
9	4	1	4	19	39.6%
Average score & %			**3.4**		**65.7%**

Table 116: No seed dressing, tephrosia incorporation and no gaucho treatment in 1997/98

Farmer number	Plot no	Subplot no	Crop Establishment	Germination data out of 48	Germination percentage (48)
1	3	1	3	35	72.9%
2	1	2	1	32	66.7%
3	2	2	4	28	58.3%
4	1	1	4	40	83.3%
5	2	1	2	31	64.6%
6	1	2	5	41	85.4%
7	2	1	3	26	54.2%
8	4	1	4	42	87.5%
9	2	1	2	25	52.1%
Average scores & %			**3.1**		**69.4%**

Table 117: Differences between maize establishment in research and observation plots.

Comparison of establishment	Frequency of responses
Establishment of crops in the observation plots is better than the research plots due to earlier planting by the farmer because the soil was not yet compacted by heavy rains	4
There is no difference in establishment between observation and research plots	2
Where tephrosia was incorporated maize is looking better than other parts of the field	1
I am unable to differentiate the research and observation plot, the observation is located elsewhere	1
Maize in the research plot looks thinner than in the observation plot	1

Question 6.1What do you hope to learn from the research plots?

Table 118: Lessons learnt from the research plots.

Lesson	Frequency of responses
Intercropping pattern of maize, beans and pigeon peas	3
Effect of tephrosia on whitegrubs	2
Does not expect to learn much from maize but beans and pigeon peas	1
The effect of tephrosia on soil fertility	1
Effect of seed dressing to control pests	1
Spacing of ridges and planting stations and its effect on yield	1

Since this is a whitegrub management trial we expected farmers to cite lessons concerning pest management. However only three farmers out of 9 said that they were hoping to learn about whitegrub management. These three farmers were interested to see the effect of tephrosia incorporation and seed dressing with gaucho as treatments against whitegrub damage on maize. The six other responses refer to normal agricultural practices such as intercropping patterns, spacing and soil fertility in relation to expected resulting yield. One would like to know why most of these specialist group farmers are not anticipating that they will learn much about pest management strategies? Question 4.1 demonstrated that most farmers understood the purpose of the trial so the problem is not lack of farmer comprehension. It is more likely that an absence of serious whitegrub damage in previous years means that farmers do not give particular attention to this pest problem. On the other hand, we have consistently found in project work that farmers are very interested in new intercropping and ridge spacing patterns. Such practices are easily available and affordable.

1999 Whitegrub Trial Monitoring: Round 2, Pre-maize harvest

By P. Kapulula and J.Lawson-McDowall

Farming Systems Integrated Pest Management Project
Whitegrub Management Trial
Farmer's Observation Plot Monitoring: Round 2 (Pre-harvest)

Introduction

This exercise was carried out a few days before harvest through individual farm visits. Farmers were asked to score performance of maize on plant survival, plant vigour, expected maize yield (of cobs) on each subplot and severity of whitegrub damage on research, treated maize observation plots and on nearest untreated maize. Scoring on maize performance was done on a scale of 1(very poor) to 5 (very good) while scoring on whitegrub damage was done on a scale of 1 (none) to 5 (severe). In addition to this, farmers were asked to comment on any unusual differences between plots and what they felt they had learnt from both the research and the kanthu nkako seed dressed plots.

Farmer management

Table 119:.Record of first weeding of the observation plot and problems faced

Record of first weeding	Problems with weeding	Frequency of responses
Done completely	No problem	8
Not done	Plot was waterlogged and then abandoned	1

Eight of the 9 farmers weeded their observation plots completely and they encountered no problems during the exercise. Only one farmer was unable to weed her plot due to the waterlogging conditions of the field.

Table 120:Record of banking of the observation plot and problems faced

Record of banking	Problems with banking	Frequency of responses
Done completely	No problems	7
Done partially	A friend disturbed the work and the farmer forgot to go back to finish off	1
Not done	Plot was waterlogged and abandoned	1

Seven farmers managed to bank their observation plots completely without any problems. One farmer did it partially due to a friend's disturbance and did not go back to finish the work. One farmer could not do the banking because the field was waterlogged.

Table 121. Plant survival scores

Score	Meaning	Treated Frequency	Untreated Frequency
2	Poor		1
3	Average	1	2
4	Good	1	4
5	Very good	6	2
Average score		**4.6**	**3.8**

It appears that more of the treated maize survived than the untreated one. The outcome suggests that seed dressing was very effective in guarding against the soil pests.

Table 122: Vigour scores

Score	Meaning	Treated Frequency	Untreated Frequency
2	Poor		2
3	Average		4
4	Good	3	1
5	Very good	5	2
Total respondents		8	9
Average score		**4.6**	**3.3**

Generally the treated maize grew with much vigour and health as compared to the untreated maize. Only 3 people out of 9 scored maize vigour above average while for the treated maize crop vigour in all plots was well above average.

Table 123. Expected yield scores

Score	Meaning	Treated Frequency	Untreated Frequency
2	Poor		1
3	Average	1	4
4	Good	3	1
5	Very good	4	3
Total respondents		8	9
Average score		**4.4**	**3.7**

Seven of the 8 farmers scored maize yield for the treated maize as good while as only 4 farmers scored maize yield from the untreated seed as good. According to the unweighted average score, yield from the treated seed was generally very good.

Table 124. Severity of whitegrub attack

Score	Meaning	Treated	Untreated
		Frequency	**Frequency**
1	None	8	6
2	Slight		2
3	Average		1
Total respondents		**8**	**9**
Average score		**1**	**1.4**

No whitegrub attack was reported on any of the portions where treated maize was planted. Three of the 9 respondents reported slight and average whitegrub damage on portions where untreated maize was planted. This suggests a conclusion in favour of planting seed dressed maize against whitegrub damage.

Table 125: Subplots with the best-expected maize yield.

Which subplots had the best-expected maize yield?	What is the reason for the observed difference	Frequency of responses
Where there was no gaucho in 1997/98, gaucho in 1998/99 and tephrosia incorporated	Tephrosia increased fertility Because of seed dressing and fertiliser	6
Where there was no gaucho in 1997/98, no gaucho in 1998/99 and tephrosia incorporated	Tephrosia was very effective Because of fertiliser	5
Where there was gaucho in 1997/98, no gaucho in 1998/99 and tephrosia incorporated	It was not attacked by whitegrubs	3
Where there was gaucho in 1997/98, gaucho in 1998/99 and no tephrosia incorporated	No explanation	2
Where there was gaucho in 1997/98, gaucho in 1998/99 and tephrosia incorporated	No explanation given There was no damage from whitegrubs	2
Where there was no gaucho in 1997/98, gaucho in 1998/99 and no tephrosia incorporated	I do not know the reason	2
Where there was gaucho in 1997/98, no gaucho in 1998/99 and no tephrosia incorporated	No explanation	1
Where there was no gaucho in 1997/98, no gaucho in 1998/99 and no tephrosia incorporated	I do not know the reason behind this difference	1

The majority of comments (6) point out that farmers expected best maize yield from subplots where there was no gaucho treatment in 1997/98 but there was gaucho treatment in 1998/99 and tephrosia was incorporated. Their reasons for this difference were that the tephrosia improved soil fertility in addition to the fertiliser applied and also because the seed dressing helped to reduce whitegrub damage.

An almost equal number of comments (5) were made in favour of subplots which had neither gaucho treatment in 1997/98 nor in 1998/99 but had tephrosia incorporated in 1998/99. The reasons backing this difference were that the tephrosia incorporated was very effective in, hopefully, increasing soil fertility supplemented by the fertiliser application which was done four weeks after germination. The lowest number of comments (1) were in favour of plots where there was either gaucho in 1997/98 and/or in 1998/99 but there was no tephrosia incorporation in both cases.

It is evident from the reasons offered for the best expected maize yields in these subplots that farmers are applauding the green manure technique using tephrosia as the most effective. It has not been mentioned as a control strategy for whitegrubs but specifically as a soil fertility element in the trials.

Table 126: Differences between expected maize yield on research and farmers own plot and 'reasons for the difference.

Difference	Frequency of responses
There is more maize on the research plots than farmer's observation plot due to poor emergence on farmer's own plot	2
There are no differences	2
There is more maize on the research plots than the observation plot due to application of mankhwala which prevented whitegrub attack	1
There is more maize on the research plots than on the farmer's plot because fertiliser was applied on both sides of the of the planting station	1
There is more maize on the research plots than the observation plots due to good spacing which provided enough space for better plant growth	1
There is more maize on farmer's own plot than the research plots because the farmer planted 4 seeds per station and all survived	1
There is more maize on farmer's own plot than on the research plots due to early planting	1
There is more maize on farmer's own plot than on the research plots due to two fertiliser applications	1

Table 127: Lessons learnt from the research seed dressed plots.

Lesson	Frequency of responses
Tephrosia incorporation is not a hard work if you are doing it for part of the field	3
Intercropping of maize beans and pigeon peas	2
Ridge spacing	2
Seed dressing is the best way of combating whitegrubs using gaucho	2
The method of fertiliser application	2
Maize and pigeon peas have done better because the soil was less waterlogged	1
Making box ridges	1
Maize spacing	1
Early weeding	1
Early banking	1
Avoiding late planting	1
Tephrosia reduces whitegrub damage	1
Tephrosia improves soil fertility and hence increases yield	1

A number of lessons relate to normal farming practices especially spacing of crops and ridges, fertiliser application, time of planting, time of weeding, time of banking and intercropping. Farmers also pointed out four lessons which are very specifically related to treatments. Two people said that seed dressing is actually the best way of combating whitegrubs. It was also noted that tephrosia reduces whitegrub damage and in addition it improves soil fertility thereby increasing yields. One further comment on tephrosia is that the work of incorporation is not strenuous if you are doing to small proportion of the field. This is however implying that it requires more labour although it has been seen as a good strategy for both whitegrubs and soil fertility.

Table 128: Lessons learnt from the kanthu nkako seed dressed plot.

Lesson	Frequency of responses
Seed dressing improves germination	2
Seed dressing suppresses germination	1
Plants looked healthier where seed was treated than where it was not treated	1
Comparison of whitegrub damage on treated and untreated seed	1
Seed dressing is the best way of combating whitegrubs i.e. using mankhwala (gaucho)	1
Whitegrub damage is minimal on older plants	1
Good plant performance is a result of seed dressing and doing field activities on time	1

Two farmers were confident enough to say that they have learnt that seed dressing with gaucho improves seed germination although one of the farmers reported that it suppressed germination in his/her field. In agreement with those two farmers, one more farmer said that seed dressing with gaucho is the best way of combating whitegrubs. It was also observed that plants looked healthier where treated maize was planted than else where.
Another observation showed that plants did not perform well solely because of seed dressing but that timely field management contributed positively towards this result. Lastly it was observed that there is minimal whitegrub attack on older maize plants.

Table 129: Comments on any aspect of the trial.

Comment	Frequency of responses
No comment	2
The research plots were better this year than last year because there was less whitegrub attack	1
Would like to have the research plots extended	1
The farmer intends to continue welcoming more research people in future because she has seen its advantage	1
Their main problem is lack of fertiliser not whitegrubs	1
The research team should try to plant the research plots on time	1
The whitegrubs are a problem at their larvae stage (mphutsi) and are not affected by mankhwala (gaucho)	1
Appreciates the effectiveness of tephrosia and would like to be supplied with seed	1
Tephrosia improves soil fertility but heavy rain have reduced the expected yield	1

Some farmers have appreciated the work of tephrosia incorporation done on the research plots this year. It has been observed that tephrosia is a very good green manure and they would like to be given some seed to plant on their own next season. Some farmers are appreciating the work done in an attempt to control whitegrubs up to the extent that they would like the research plot to be extended while as others consider it a second priority. One comment specifies that whitegrubs are not their main problem. That individual considers fertiliser as the priority problem to be addressed.

It is recorded here that whitegrubs are a problem at their larvae stage and that this year there was less whitegrub attack.

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Farming Systems Integrated Pest Management Project

1999 Striga Trial Monitoring: Round 1, Germination

By P. Kapulula and J.Lawson-McDowall

Introduction

This exercise was done soon after germination of the crops. Research team members visited each farmer at his/her field to see how the crops germinated. The farmer was asked to assess each crop both in the observation and research plots and make comparisons if possible on the obvious differences observed between plots. Farmers were asked to score crop establishment, that is emergence and vigour, on a scale of 1-5 where 1 is very poor and 5 is very good. Several questions were posed to the farmer on what he/she expected to learn from both the research and the observation plots. Some questions were asked in order to know what the farmers' perceptions were on particular treatments.

Table 130: Trap crops planted and number of seeds per station.

Trap Crop	Seeds per station	Remark
Cowpeas	3 or 4	Planted by all the 6 farmers
Tephrosia	3 or 4	Planted by only 2 farmers
Crotalaria ochroleuca		Not yet planted
Crotalaria pallida		Not yet planted
Groundnut	1	Planted by all the 6 farmers
Velvet bean	2 or 3	Planted by only 2 farmers
Soya	2 or 3	Planted by all the 6 farmers

At the time of this monitoring exercise, none of the 6 farmers had planted the two species of crotalaria (large and small) only two farmers had planted tephrosia and an equal number had planted velvet beans. It was noted that farmers were intending to have the crotalaria and velvet bean planted after first weeding in order that it should not be confused with weeds.
On average, 3 or 4 cowpea seeds were planted per station. For those who had their tephrosia planted the density was similar to cowpeas. Two to three seeds were planted per station for Soya beans and for velvet beans for the two farmers who had it planted at the time of monitoring. One seed per station was the planting density adopted for groundnuts for all the farmers.

Table 131: Maize varieties and other crops planted on the observation plots, number of seeds per station and the date.

Crop	Variety		Seeds per station	Date planted
Maize	MH 18	2	3 or 4	28/11/98-01/12/98
	Katswiri Pan	3	3 or 4	
	Local	1	3 or 4	
Pigeon pea	Local	2	3 or 4	28/11/98-01/12/98
	ICP 9145	1	3 or 4	

Three maize varieties were planted on the observation plots for different farmers. Two farmers planted MH 18, three farmers planted Katswiri Pan and only one farmer planted a local variety. None of the farmers planted beans on his/her observation plot. Only three farmers planted pigeon peas on their observation plots, two of them planted a local variety while the other farmer had planted ICP 9145. For both maize and pigeon peas the planting density was 3 or 4 seeds per planting station. These crops were planted between 28 November and 1 December 1998 with the first rains.

Table 132: Maize Spacing

Spacing	Number of farmers
61-70 cm	**3**
51-60 cm	**2**
71-80 cm	**1**

It was interesting to observe that all the six farmers adopted maize spacing, which is closer than the recommended spacing of 90 cm apart. Three farmers planted their maize at 61-70 cm apart. Two farmers adopted even a much closer spacing between 51-60 cm apart. Only one farmer adopted spacing that was wide enough and closer to the recommended 90 cm apart

Table 133: Planting patterns and reasons for adopting them

2.7 Planting Pattern	**Reason for adopting it**	**Total of farmers in favour**
1. One Soya station midway between adjoining maize planting stations	Because of shortage of land	1
	This is our traditional planting pattern/ we are continuing an old practice	1
	Wanted to provide enough space for the crops which spread their branches wide	1
2. One Soya station and one cowpea station between maize stations but cowpea side-planted	Because of shortage of land	1
	Wanted to provide enough space for the crops which spread their branches wide	1
3. One groundnut station and one tephrosia station between maize stations but tephrosia side-planted	Because of shortage of land	1
4. One groundnut station and one pigeon pea station between maize stations but pigeon pea side-planted	Because of shortage of land	1
5. One cowpea station between adjoining maize stations	This is our traditional planting pattern/ we are continuing an old practice	1
6. One groundnut station between adjoining maize stations	Wanted to provide enough space for the crops which spread their branches wide	1
7. One Soya station and one velvet bean station between maize stations but velvet bean side-planted	This is our traditional planting pattern/ we are continuing an old practice	1
8. Each trap crop intercropped with maize separately	Want to see how the trap crop will perform with maize only	1
	This is our traditional planting pattern/ we are continuing an old practice	1

There were a total of eight different planting patterns observed in the farmers' observation plots. Considering the fact that we had only eight respondents in this exercise, it comes clearly that every farmer practised his/ her own planting pattern and some opted for more than planting pattern for their crops.

Decisions for planting positions of these crops were reached after considering the number of crops a farmer had planned to plant and the size of the land that s/he had. If one considers the spacing of maize shown above, it becomes clear that farmers are really adopting different planting positions of their crops due to lack of cultivable land. At least half of the responses have indicated that for some of these planting patterns farmers are unable to tell the reasons why they are practised and they only said that this is a traditional planting pattern

Table 134: Lessons learnt from what the research activities.

Response	Frequency
To observe the effect of crotalaria on soil fertility	1
To assess the benefit of growing all these trap crops	1
Appreciates gaining new seed of cowpea	1
To see how Striga will be controlled by these trap crops	1
To see how tephrosia and groundnuts will help reduce Striga and see how much yield will be obtained from it	1
Experts to find out whether Soya and groundnuts add fertility to the soil	1

Each of these farmers was hoping to learn different things from observing the trap crops grown on their land. Five of these farmers had hoped to learn about how effective the different legumes were in controlling or reducing Striga on their observation plot. One other important aspect mentioned includes the effect of crotalaria, Soya and groundnuts in improving soil fertility. One farmer was only concerned with cowpea seed and wanted to give a word of appreciation to the project for the provision.

Table 135: Differences between maize establishment on research and observation plot.

Response	Frequency
Maize is looking better in farmer's observation plot than in research plot	5
There are no differences	1

It should be pointed out here that because of the amount of work the team had at planting, it was not possible to plant all trial plots immediately after the very first rains. As a result it was farmers' observation plots that were planted earlier enough than the research plots. Consequently, at the time of this monitoring exercise it was clear from the farmers' point of view that their observation plots were far much superior to the research plots. It was only one out of the six farmers who observed that crop establishment in his/her field was similar to the one in the research plots. Maize was unable to germinate well because the soil became had on top forcing the leaves to curl as they came out of the ground.

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Table 136: Lessons learnt from the research plots.

Response	Frequency
To learn about how the various trap crops will affect the emergence and effect of Striga	2
Learn about improving soil fertility using tephrosia	1
Learn about planting crotalaria as a trap crop for Striga and for soil fertility	1
Learn about how pigeon peas will perform against wilting	1
To learn about how pigeon peas and maize will perform in terms of yield	1

Two farmers were interested to learn about what the different trap crops would do to Striga. Two other farmers were keen to learn about the improvement of soil fertility through green manure from tephrosia and crotalaria. The last two farmers wanted to observe the performance of both maize and pigeon peas on yield and fusarium wilt respectively.

Table 137 : Reasons for fertilizing some of the plots.

To see whether fertiliser has an effect on Striga or not	2
To see which treatment is effective in controlling Striga whether it is fertiliser, tephrosia or crotalaria	1
To make comparison between the two portions to see which side yields better than the other	1
To make comparison between fertilised and unfertilised parts in relation to Striga emergence and yield	1
To encourage the growth of Striga	1

It is interesting to hear these facts from our farmers. They were able to give out what they thought research is trying to find out from this treatment. The writer does not know why fertiliser was applied only on some plots not others (the specialist should be invited to comment on this). Two farmers were of the view that fertiliser was included as a treatment in order to see what effect it was going to have on Striga. The other four farmers had individual views on this subject. To them it was a question of finding out which treatment was effective in controlling Striga among fertiliser, tephrosia and crotalaria. This was expected to show up in the emergence of the weed (which portions were going to have more of the weed than the others) but also to see the difference in the amount of maize yield between the fertilised and unfertilised portions.

Table 138: Reasons for incorporating tephrosia on some of the plots.

Response	**Frequency**
To improve/increase/add soil fertility	6

All the farmers were quite aware of the fact that tephrosia is a green manure crop. This would improve the fertility of their soils.

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Table 139: Comment on any aspect of the trial.

Comment	Frequency
No comment	4
Expects to see good results but maize establishment has been disappointing	1
Wants to know why fertiliser will not be applied even on the portions where tephrosia was not incorporated	1

Four farmers did not make any comment at the end of the interview. One farmer was worried about the decision of not applying fertiliser on the portions where no tephrosia was incorporated. This farmer was probably anticipating poor performance of maize from these portions. The other farmer was disappointed by the poor germination of maize that was observed during the first few weeks after planting.

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1999 Striga Trial Monitoring: Round 2, Pre-Maize harvest

By P. Kapulula and J.Lawson-McDowall

Introduction
Monitoring was done just before the maize harvest. This exercise was done in order to get farmers' opinions regarding the planting patterns of the different trap crops they had planted in their observation plots. It was also intended to capture farmers' views on the observed difference of striga emergence on the different plots both on the research and observation plots. Other questions were asked in order to solicit an overall assessment by the farmer regarding the trial this season and the lessons so far learnt from the striga management trial.

Table 140: Planting dates for tephrosia and number of seeds per station.

Seeds per station	Planting date	Frequency
4	After weeding	2
5	After weeding	2
	19.12.98	1
6	After weeding	1

For tephrosia, the number of seeds per station ranged from 4 to 6 and most of the people planted after weeding. Velvet bean was mostly planted at the rate of 2 seeds per planting station and it was planted mostly after the first weeding.

Table 141: Planting dates for velvet bean and number of seeds per station

Seeds per station	Planting date	Frequency
2	After weeding	2
"	After banking	3
"	19.12.98	1

Farmers planted two velvet bean seeds per station. Planting was done either after weeding or after banking.

Table 142: Planting pattern for the two species of crotalaria (*ochroleuca and pallida)* and the reason for the planting pattern.

Planting pattern	Reason	Frequency
Drilled along ridge side and spread the seed	Farmer was told to do it like this by members of the research team	3
	Farmer was told to do it like this but also feels it has the best place for leaf fall	1
	We adopted what the research team did on the research plot	1
	In order that I should not have trouble when weeding	1

The planting pattern for the two species of crotalaria was the same. Farmers drilled along the ridge side and thereafter spread the seed in it. Initially these people were advised to plant it like this by members of the team but three farmers had their other reasons for doing it that way. Since they were told that this was a green manure crop. one farmer thought that planting it like this provides a best place for leaf fall. Another farmer planted it like this so that at weeding it would not be disturbed.

Table 143: Planting pattern of tephrosia and the reason behind it

Planting pattern	Reason	Frequency
One tephrosia planting station between adjacent maize stations but on the side of the ridge beside pigeon peas	So that I could weed and bank without problems	1
	I imitated what the research team had done in the research plots	1
One tephrosia planting station between adjacent maize stations but on the side of the ridge beside a bean station	There was no reason behind adopting this pattern	1
One tephrosia planting station between adjacent maize stations but on the side of the ridge beside a Soya bean station	I imitated what the research team had done in the research plots	1
One tephrosia planting station between adjacent maize stations but on the side of the ridge beside a Soya bean station	To give tephrosia and maize enough space to grow	1

It appears that nearly every farmer planted tephrosia in the same pattern. Differences come in when we consider the crop beside which tephrosia was planted and the reason for planting tephrosia that way. Some of these farmers only imitated the pattern of planting practised in the research plot but could not explain why they thought this was a good idea. Others did it in order to avoid later problems at weeding and to provide ample space for each crop to grow well.

Table 144: Planting pattern of velvet bean and the reason behind it

Planting pattern	Reason	Frequency
Velvet bean is planted like a hedge dividing the field in boxes after each tenth maize planting station	To avoid from spreading all over the field	1
Velvet bean planted on the boundaries of the field one planting station after two maize planting station	To avoid it from pulling most of the maize down	2
Velvet bean planted like a hedge around the field one planting station between adjacent maize stations but skipping one ridge in between	To avoid it from pulling most of the maize down	1
Velvet bean planted like a hedge around the field one planting station between adjacent maize stations after every fifth maize	To avoid it from pulling most of the maize down	1
Velvet bean planted on the boundaries of the field one planting station after two maize planting station	To avoid from spreading all over the field	1

Farmers adopted a wide variety of different planting patterns, based on their knowledge of the growing habits of velvet bean. This shows that although farmers like to plant velvet bean in their gardens they know that its growing habits very much interrupts the growth of maize by pulling the stems down. However, all the farmers tried as much as possible to plant it in a best possible way that could ensure the safety of the growth of maize and other crops by avoiding velvet bean from spreading all over the field.

Table 145: Record of first weeding

Record of first weeding	Problems with weeding	Frequency
Done completely	None	6

There was no problem with weeding. Every farmer managed to do it completely.

Table 146: Record of banking

Record of banking	Problems with banking	Frequency
Done partially	I was not able to do all this work alone	1
Done completely	No problems	3
Done completely	There was inadequate labour to do the work on time	1
Not done at all	Failed because of sickness	1

Unlike first weeding, only three farmers managed to weed their observation plots completely. One farmer completely failed to bank due to sickness. Another farmer managed to do it partially due to inadequate labour.

Table 147: Agronomic qualities of trap crops

Crop	Plant stand	Vigour	Expected yield
Groundnut	**5**	**5**	**4.5**
Soya	**5**	**5**	**4.5**
Velvet bean	4.8	4.7	**4.5**
Cowpeas	4.2	4.7	1.3
Crotalaria ochr	4.2	4.7	
Crotalaria pall	4.2	4.2	
Tephrosia	3	3.2	

The table shows that groundnuts, Soya and velvet bean performed very well according to farmers' assessment on plant vigour, plant stand and the expected yield from these crops. Cowpeas also scored well for growth and plant stand. One of the contributing factors for the poor yield in cowpeas could be the problem of Ootheca, which defoliated the leaves thereby inhibiting photosynthesis. On the inedible trap crops (legumes) tephrosia has the worst performance.

Table 148: Bad effects of a specific trap crop on maize? Explain which and how?

It was only velvet bean that was said to have badly affected the growth of maize by pulling it down. Although we might have expected it to be mentioned by all the farmers, it was only one farmer who cited this effect from velvet bean.

Response	Effect on maize	Frequency
None of them has had a bad effect on the maize	None	5
Yes, there was a bad effect	Velvet bean was pulling the maize down	1

Table 149: Maize crop performance on research plots according to treatments

Treatment	With Fertiliser in 1997/98 and 1998/99		Without Fertiliser in 1997/98 and 1998/99	
	Vigour	Expected yield	Vigour	Expected yield
Cowpeas	4	2.8	3.2	1.8
No legume	3.4	2.5	2.8	2.2
Tephrosia	**4.1**	**4**	**3.9**	**3.5**
Crotalaria	3.9	3.4	3.6	2.7

From the table above, maize performed well on both vigour and the expected maize yield on tephrosia plots according to farmers' observation. This was both with and without fertiliser application in the past two seasons. The next best plots were those without a legume in 1997/98 but with crotalaria in 1998/99 both with and without fertiliser application in the past two seasons.

Table 150: Vigour of the trap crops

Score	Meaning	Cowpeas (freq of plots)	Tephrosia (freq of plots)	Crotalaria (freq of plots)
5	Very good	7	7	9
4	Good	2	3	1
2	medium	1		
Average score		**4.6**	**4.7**	**4.9**

The trap crops well growing healthily and vigorously but the best was crotalaria.

Table 151: Subplots with the best expected maize yield.

Response	Frequency
Tephrosia plots	10
Plot without a trap crop	1

Subplots with tephrosia were expected to produce the best maize yield amongst all the treatments.

Table 152: Difference between expected maize yield on the research and observation plots.

Response	Frequency
There is more maize on the research plot than in my own observation plot because I did not apply fertiliser in the observation plot	3
There is more maize in the research plots than in my own observation plot because of poor performance of the maize variety I planted against rain	2
There is no difference, all have performed poorly because there was too much rain	2
I expect more maize from my observation plot than in the research plot because they delayed banking the research plot after fertiliser application so that it was mainly weeds which benefited from the fertiliser	1

Table 153 continued

There is more maize in the research plot than in my observation plot because of failure to bank on my observation plot	1

Six responses mentioned that there would be more maize in the research plot than the observation plots. The observed differences were due to lack of fertiliser in the observation plot, failure to bank and the type of maize variety planted. Two responses claimed there would be more maize from the observation plot because it was considered to be bigger than the research plot and because the research plot was not well managed, it was not banked on time after fertiliser application. Two responses indicate that there was no difference in the expected maize yield because the plots had equally suffered from excessive rains.

Table 153: Striga infestation on the observation plot as a whole

Response	Frequency
Serious infestation	1
Medium infestation	1
Slight infestation	4

Most farmers reported a slight striga infestation on their fields this year.

Table 154: Striga on trap crops.

Response	Frequency
The least amount of striga was on groundnuts and the most was on Soya	1
The least amount of striga was on Soya and the most was on groundnuts	1
There was no difference in the amount of striga on all trap crops. All of them had less striga	2
The least amount of striga was on crotalaria and tephrosia and the most was on Soya but it died before flowering	1
The least amount of striga on Soya and groundnuts And the most on tephrosia	1

Trap crop	Least amount of striga	Most amount of striga	Equal amounts (less)
Groundnuts	2	1	1
Soya	2	2	1
Tephrosia	1	1	1
Crotalaria	1		1

If we checked closely on the differences in emergence of striga on different trap crops, three responses are that the least amount of striga was found with groundnuts and soya. Two responses (which happen to be the most frequent citation) mention that there was the most amount of striga on soya. Two responses each mention that there was the least amount of striga on crotalaria and tephrosia. One respondent each mention that there was the amount of striga on groundnuts and tephrosia.

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Table 155: Striga emergence on the research plot less(this year and last growing season).

Response	Frequency
Less than last year	5
More than last year	1

All except one respondent observed that striga emergence in all subplots was less than last year. This should be an encouraging observation on the part of our farmers. It shows that our work has been fruitful.

Table 156: Striga on subplots.

Response	Frequency
Striga emergence was equally low in all subplots	3
Least amount of striga emerged where there was crotalaria and the most appeared where there was no trap crop	1
Least amount of striga emerged where there was tephrosia and the most appeared where there was cowpeas	1
Least amount of striga emerged where there was tephrosia and cowpeas and the most appeared where there was crotalaria	1

Trap crop	Least amount of striga	Most amount of striga	Equally less
No trap crop		1	1
Cowpeas	1	1	1
Tephrosia	2		1
Crotalaria	1	1	1

A summary from this table indicates that the least amount of striga emerged where there was tephrosia and the most amount of striga emerged where there was crotalaria, cowpeas and where there was no trap crop.

Table 157: Lessons learnt from the research plots.

Lesson	Frequency
I have seen that tephrosia is improving soil fertility, where it is incorporated maize grows vigorously and it gives big cobs.	3
There is slightly more maize on the research plots this year than last year	1
I have seen that planting these trap crops for some years reduces the amount of striga	1
Fertiliser at 4 weeks is good compared to later application	1
I have learnt to intercrop maize, pigeonpeas and cowpeas	1

Overall lessons learnt by these farmers are that tephrosia improves soil fertility, encourages a vigorous maize growth and promotes the production of big cobs. Planting these trap crops on the same piece of land for a number of years reduces the amount of emerging striga.

Table 158: Lessons learnt from the Kanthu Nkako plots

Lesson	Frequency
Trap crops seem to cause striga to die after emergence so could be good to plant trap crops	1
I learnt nothing	1
I have not seen any effect	1
I will check at harvest	1
It appears that tephrosia and crotalaria improve fertility	1
I have learnt how to plant crotalaria and tephrosia to control striga	1

Two farmers indicated that they learnt nothing from their observation plots. For those who said that they learnt something, it was coming back to the use of tephrosia as a green manure and that the trap crops are causing striga to die after emergence and so are very helpful in the control of striga.

Table 159: Comments on any aspect of the trial.

Response	Frequency
No comment	3
Groundnuts and soya caused early death of emerged striga and tephrosia incorporation had a tremendous effect on research plots	1
I appreciate that at times I was able to join the research team in the field and learnt something	1
There is a bad performance of the trap crops on research plots due to water logging	1

The fact that some trap crops have shown a direct effect on the emerged striga and that tephrosia incorporation has produced a tremendous effect on the research plot keeps on resurfacing. It is clear that these farmers have seen the utility of using tephrosia as a green manure. It is hoped that such green manuring can assist farmers who cannot afford chemical fertilisers.

<u>Farming Systems Integrated Pest Management Project</u>

1999 Termite Trial Monitoring: Round 1, Germination

By P. Kapulula and J.Lawson-McDowall

1.0 Introduction: the Germination Monitoring Exercise
Farmers taking part in the FSIPM Project on-farm trials in 1998-99 were asked to take part in a monitoring exercise just after the emergence of the maize.

2.0 Methodology and Sample
There are twelve farmers in the termite trials with four sub-plots per plot. The farmers were interviewed in the plot field between 15.12.98 -7.1.99. Treatments were not banking to prevent termite damage and seed priming (wetting seeds with water overnight before planting) to advance germination. At this stage of the trial, only one treatment had been applied, seed priming. Banking does not take place until approximately six weeks after planting.

3.0 Results
(Question 1 was concerned with background information while Question 2 mapped the farmer observation plots.)

On half the plots, maize seeds were primed, soaked overnight before planting to advance germination. Farmers were asked how they found this treatment and if there were any problems.

Table 160: Experience of seed priming

3.1 How did you find doing the seed priming?	Total
I had no problems	7
It was easy	5
Total	12

All twelve farmers found seed priming a straightforward procedure.

Question 4 Crop Establishment (Research Plots)

Question 4.1 Crop Establishment (Research Plots)
Each farmer was asked to score the establishment (the emergence and vigour) of the maize on the four research trial plots. Scoring was from 1-5 where 1 is very poor and 5 is very good. The results from the 48 plots have been combined to create an average score for each set of twelve plots with an identical treatment. It should be kept in mind that not-banking is the treatment rather than banking but that at this stage, neither had been done. Farmers are evaluating the impact of seed priming alone.

Table 161: Scores for Crop Establishment

Banking	Seed priming	Establishment
No	Yes	3.3
No	No	3.42
Yes	Yes	**3.5**
Yes	No	**3.5**

The scores were very close, varying by only 0.2 for all plots. One plot with seed priming received 3.3, the lowest score and the other 3.5, the highest joint score. Clearly at this stage, farmers found little to choose between the plots.

Farmers were also asked to comment on any differences between plots. WHERE IS THIS INFORMATION?

Question 4.2
Farmers were asked if they noticed any difference between maize establishment on the research plots and in the rest of the field. If so, they were asked to suggest why this might be so.

Table 162: Differences between maize establishment on the research plots and in the rest of the field.

Comment	Frequency
Slow maize growth in research plot	5
Maize is looking better in the rest of my field than in the research plot	4
There are no differences	2
There is a better germination in my field than in the research plot because I planted soon after the first rains	1
Total	12

Most farmers (10 out of 12) thought that the maize in their own fields was doing better than that in the research plots. Unfortunately farmers were not probed to explain why this was except in one case. The most likely explanation for the other nine is also that the farmer's maize was planted earlier.

Question 5, Farmer Expectations

Question 5.1 What do you hope to learn from these plots?
Question 5 aimed to discover which aspects of the trials farmers thought important.

Table 163: Lessons learnt from the plots.

Comment	Frequency
Crop spacing, ridge spacing and intercropping	7
Spacing of maize, beans, pigeon peas and their density	3
Learn seed priming	1
I would like to learn more about the pests which are damaging the crops especially termites	1
Total	**12**

As we have found elsewhere on the project, farmers are interested in our cultural practices, in this case, crop and ridge spacing and intercropping patterns. Only one farmer expressed interest in learning about the effects of seed priming and one farmer mentioned pests. The open ended nature of this question means that no conclusions may be drawn about what farmers do not mentions.

Question 6 Farmer understanding of trial
In question 6, we asked farmers to explain the purpose of the two treatments in the termite trial to make sure that all participants were clear about what we were doing and why. To reinforce the message, after farmers told us what they thought the trials were to show, team members repeated the reasons behind seed dressing and comparing banking and not banking (Questions 6.3 and 6.5). Question 6.1 was used to review the location of the different treatments in the plot with the farmers and ensure that all plots were correctly labelled.

Question 6.2 What is the reason for seed priming?

Table 164: Reasons for seed priming.

Comment	Total
For the seed to germinate faster than when not primed	11
Does not know	1
Total	12

Eleven out of 12 farmers knew that the reason for seed priming was to encourage germination. This demonstrates that when asked open ended questions, as in Question 5, farmers may not mention the purpose of the trial as perceived by the project but this does not mean that they are unaware of it.

Question 6.4 Why have some of the plots not been banked?

Table 165: Reasons for not banking other polts.

Comment	Frequency
To prevent termites from lodging the maize	8
To see which plots whether banked or unbanked will be affected by termites	2
Farmer does not follow this practice	1
No response recorded	1
Total	12

Ten out of 12 respondents knew that the purpose of not-banking was to prevent termite attack on the maize.

Question 6.6
Farmers were then asked if there was any other comment that they would like to make about the trials in general.

Table 166: Comment on the trials.

Comment	Frequency
No comment	9
Worried about the *Ootheca* problem	1
My field is not susceptible to termites	1
Still learning with research team	1
Total	12

Nine farmers had no other comment to make at this stage. One farmer (Bambo Kawarenga, with an upland field in Kambuwa, Mark) told us that the field in which the plot was located was not susceptible to termites. Fields had been selected on the basis of termite damage in previous trials, however.

Question 7 Explanation of Researcher data collection
Team members explained how project members count live and dead plants to try and determine the cause of death. Where there were other interesting things seen in the plot, such as pest or disease damage, these were pointed out to farmers for their comments.

Table 167: Comments on any other aspects of interest in the plots

Comment	Frequency
No comment	6
No response recorded	1
Thank you for this information	1
Why are you not supplying planting stations that did not germinate?	1
Planting pattern and growing of crops in intercrop	1
System of monitoring by research	1
Labelling will be helpful because she will know where to bank and not	1
Total	12

Six out of 12 farmers had no comment to make at this early stage of the trials.

Farming Systems Integrated Pest Management Project

1999 Termite Trial Monitoring: Round 2, Pre-Maize Harvest

By P. Kapulula and J.Lawson-McDowall

1. Methodology and Sample

There are twelve farmers in the termite trials with four sub-plots per plot. The farmers were interviewed in the plot field between 14.4.99 and 22.4.99, shortly before the maize harvest. The objective of the exercise was that farmers should give their views of the maize crop and the trial structure and performance while crops were still in the field. This timing allowed for exploration of pest and disease damage and direct comparison between the plots.

2. Results

Section 2. Maize Crop Performance

Question 2.1 Score survival, vigour and estimated yield for each plot

Farmers were asked to score each subplot out of five for plant survival, vigour, estimated yield and severity of termite damage. Treatments were randomly allocated different plot numbers and farmers were asked to score each plot by number. Participants were not reminded about the plot treatments although were free to check labels if they wished or were able.

Table 168: Maize crop performance

Banking	Seed priming	Plant survival	Vigour	Yield	Overall average
No	Yes	3.7	3.5	3.6	3.6
No	No	3.6	3.5	3.1	3.4
Yes	Yes	**4**	**3.8**	**4**	**3.9**
Yes	No	**4**	3.4	3.6	3.7
Rest of farmer's field		**4.3**	3.8	3.9	**4**

Differences between the scores across the four research plot types were not great (See Table 168). The highest score was 4 and the lowest 3.1. However, farmers gave the highest score to the plot where there was both banking and seed priming. The second highest score was given to the plot which was banked but where seeds were not primed. The highest overall score of all was given to the farmer's own plots, suggesting that farmers thought that their practice was superior to researcher practice on this occasion.

Table 169. Severity of termite damage

Banking	Seed priming	Termite damage	No termite damage (frequency)
No	Yes	**1.8**	9
No	No	1.4	5
Yes	Yes	1.6	**10**
Yes	No	1.4	8
Rest of farmer's field		**2.7**	5

Farmers were then asked to score their plots for termite damage (see Table 169). Scoring for pest or disease damage was kept on a 1-5 scale in order that practice should be consistent throughout monitoring and evaluation. This means, however, that a score of one is equivalent to no termite damage. Five farmers said that there was no termite damage in their fields. The variation in score is only 0.4 but the plots with both treatments, seed priming and no banking, were considered to have suffered slightly more from termite damage than the others (1.8). Plots with both banking and seed priming received the second highest score (1.6). The rest of the farmer's field appears to have suffered more severely from termite damage than the research plots.

Farmers' comments on the different plot types

a) No banking but seed priming

Table 170: Comments on not banked plots with seed priming

Comment	Frequency
Everything is okay	3
None	3
Too much rain/wind caused lodging of the plants.	1
Poor performance because of bad termite damage.	1
The plot is poor because of no banking and a single fertiliser application.	1
Not asked	*3*
Total	12

This first set of plots received both treatments. The plot was not banked in the hope that this would reduce termite damage and the seed was primed. Three participants said that everything was fine while three had no comment (Table 170). Three farmers were not asked for their comments. Two of the remaining three farmers complained of lodging of plants by termites or bad weather and the third told us that the poor crop was due to the absence of banking and the fact that fertiliser had only been applied once.

b) No banking and no seed priming

Table 171: Comments on not banked plots with no seed priming

Comment	Frequency
None	3
Everything is okay	2
Will harvest same as plot no.1 (banking and no seed priming)	1
Low yield will be obtained	1
Germination was very poor	1
Wilting of the maize due to **mbozi** (grubs or millipedes)	1
Not asked	*3*
Total	12

This set of plots had one treatment: not banking against termite damage. Three farmers had no comment (Table 171).. Two said that everything was fine while three other farmers said that they thought the yield would be low. Two specified the reasons for this: poor germination and damage from **mbozi** (grubs or possibly millipedes).

c) Banking and seed priming

Table 172. Comments on banked plots with seed priming

Comment	Frequency
Everything is okay	4
Some plants died at 6 inches because they were cut by **mbozi** (Yellow Millepede) below the soil	1
Poor performance, bad termite damage.	1
Wilting of the maize **mbozi**	1
Not asked	*3*
Total	12

These plots received one treatment, the seed priming Four farmers said that all was well (Table 172).. Two had germination or wilting problems connected to **mbozi** damage. One farmer had serious termite damage.

d) Banking and no seed priming

Table 173: Comments on banked plots with no seed priming

Comment	Frequency
None	3
Good compared to other plots.	1
Germination was very poor	1
Good performance due to banking but not the best because of single fertilizer application.	1
Not asked	*2*
Total	12

This set of plots received no treatment. It is interesting that unlike other plot sets, few farmers remarked that the plots were 'ok' (Table 173).

e) Rest of farmer's field

Table 174: Comment on rest of farmer's field

Comment	Frequency
Poor perfomance, bad termite damage.	4
Too much rain/wind caused lodging of the plants.	2
Good compared to other plots.	1
Faced no termite damage this year than last year	1
Not asked	*3*
Total	12

Four respondents told us that the rest of their field did badly due to termite damage (Table 174). Two others had serious lodging due to rain and wind.

Question 2.2.and 2.3 Which plots have the best expected maize yield? What is the reason for the observed difference between expected yields mentioned in 2.2?

Participants were asked which plots they expected to produce the best maize yield. They were then asked to explain why this was the case. Some farmers selected more than one plot. The results are presented by plot type.

Table 175. Summary of results by plot type: best maize yield

Banking	Seed treatment	Expecting best yield
0	1	4
0	0	2
1	1	6
1	0	6

In Table 175 above, the results by plot type are summarised. Clearly, farmers preferred the plots which were banked whether or not the seed was dressed. The plots where there was no banking but the seed was dressed was chosen by four farmers while the plots with no banking or seed priming fared worst.

The results with farmers' explanations are presented below.

a) No banking but seed priming

Table 176. Best maize yield – plots without banking with seed priming

Plot number	Banking	Seed priming	2.3 What do you think is the reason for the observed difference between expected yields mentioned in 2.1?
2	0	1	Plot 2 was weeded first (by one day) and then the rains came. This meant that the weeds regerminated in the other plots.
4	0	1	Farmer thinks fertilizer was only on 3 and 4 so less termite damage
1	0	1	Not sure of the reason
2	0	1	There was very poor emergence in plot 1.

Four farmers selected the plots with both treatments, no banking and seed priming as promising the best maize yield (Table 176). Unfortunately, there is no consensus on why this might be. One farmer attributed the higher yield to slightly earlier weeding. Another, mistakenly, blamed poor performance elsewhere on termite attack due to the non-application of fertiliser.

b) No banking and no seed priming

Table 177. Best maize yield – not banked plots with no seed priming

Plot number	Banking	Seed priming	2.3 What do you think is the reason for the observed difference between expected yields mentioned in 2.1?
3	0	0	Plot 3 germinated well and it had less termite damage
3	0	0	There was very poor emergence in plot 1.

Only two farmers chose plots with no banking and no seed priming as promising the best yield (see Table 177). This suggests that not banking against termite attack was not a useful treatment in the absence of termite damage. One respondent selected the plot for the absence of termite damage and good germination. The other was comparing the plot with poor emergence elsewhere in trial plots.

c) Banking and seed priming

Table 178. Best maize yield - banked plots with seed priming

Plot number	Banking	Seed priming	2.3 What do you think is the reason for the observed difference between expected yields mentioned in 2.1?
3	1	1	Plot 1 and 3 were banked so did better than 2 and 4. Banking strengthens the plant roots
1	1	1	Plot 1 seeds were soaked (priming) that's why the germination was better than the rest. The seeds germinated very well and fast.
3	1	1	Weeded and banked in plots 3 and 4 and not in 1 and 2.
1	1	1	Not sure of the reason
1	1	1	We did not bank plot 3 and 4 that is why the maize has performed more poorly than plot 1 and plot 2.
4	1	1	There was very poor emergence in plot 1.

Six farmers chose the plots with banking and seed priming as likely to have the greatest yield (see Table 178). Three farmers specified that banking was the reason these plots had done well. A fourth mentioned seed priming. It is likely that in the absence of substantial termite attack, banking would prevent lodging.

d) Banking and no seed priming

Table 179. Best maize yield - banked plots with no seed priming

Plot number	Banking	Seed priming	2.3 What do you think is the reason for the observed difference between expected yields mentioned in 2.1?
3	1	0	Farmer thinks fertilizer was only on 3 and 4 so less termite damage
1	1	0	Plot 1 and 3 were banked so did better than 2 and 4. Banking strengthens the plant roots
4	1	0	Weeded and banked in plots 3 and 4 and not in 1 and 2.
3	1	0	There was good germination but this plot was also banked.
2	1	0	We did not bank plot 3 and 4 that is why they have performed poorer than plot 1 and plot 2.
1	1	0	Better germination, banking and no **mbozi** (grub and caterpillar damage) unlike other plots

Six farmers also chose the plots with banking but no seed priming as best for yield (see Table 179). Four farmers stressed that banking the plots had made the difference. One mentioned good germination due to the absence of termite attack. A sixth wrongly thought variations in plot performances could be explained by the non-application of fertiliser.

Question 2.4 **Are there any differences between the expected maize yields on the research plots and the farmer's own fields? If so, what is the cause of this difference?**

Table 180. More maize in the farmer's field because.....

Explanation	Frequency
Farmer applied fertiliser twice (basal and top dressings)	3
Research team planted later so plots have less harvest.	3
More termite damage on research plots	1
Low fertility on the research plots	1
Farmer carried out all the required management practices like weeding and banking while only two research plots were banked	1
Total	9

Nine farmers thought that the maize in their own fields had done better than that in the research plots (Table 180). Three farmers said that this was because they had applied fertiliser twice rather than once. Three farmers pointed out that they had planted their maize earlier.

Table 181. More maize in the research plots because....

Explanation	Frequency
More fertiliser applied	2
Don't know	1
Total	3

Three farmers thought that the research plot maize was better than their own (Table 181). Two attributed this to a lack of fertiliser on their fields.

Question 2.5 **Have you taken any action to reduce termite damage in the field where the research plots are situated? If so, what was that?**

Table 182. Action against termites

Action	Frequency
No action has been taken.	6
They planted Nkhadze in the borders	2
No termite damage this year	2
Used to bank late (weeds waist high). This year she banked early when weeds were small.	1
Followed the example of not banking in research plots and did not bank own field where there were termites.	1
Total	12

This question aimed to find out if any indigenous pest management techniques had been practised this year (Table 182). Eight farmers had taken no action against termites. Two farmers had planted the Nkhadze tree which is believed to prevent termite damage.

Question 2.6 **What treatments are present on each plot?**
Farmers were asked to describe which treatments were present on each plot. The results are presented by plot type. Overall, four farmers banked all rather than two of their plots, one farmer banked the wrong plots while seven banked the plots that were supposed to be banked.

a) Not banking but seed priming

Table 183. Farmer perceptions of plot treatments (no banking but seed priming)

Farmer	Plot No.	Banking 1998/99 (proposed)	Banking 1998/99 (actual)	Banking 1998/99 (farmer's perception)	Seed priming 1998/99 (actual)	Seed priming 1998/99 (farmer's perception)
Malita Sapuwa	2	0	0	0	1	0
Linily Matekesa	4	0	1	1	1	0
Lucy Magreen	2	0	0	0	1	0
Kasimu Sapanga	2	0	0	0	1	0
Mai Jana	1	0	1	1	1	0
Mai Kwizombe	4	0	1	1	1	0
Bambo Basikolo	2	0	0	0	1	0
Bambo Chikoti.	1	0	0	0	1	0
Bambo Kawerenga	4	0	1	0	1	0
Bambo Kamoto	4	0	0	0	1	0
Bambo Mafaiti	3	0	0	0	1	0
Mai Kusala	2	0	0	0	1	1

In this plot set, four plots were banked where no banking was the required treatment. One farmer thought a plot not banked that had been banked (Table 183). No farmers mentioned seed priming.

b) No banking and no seed priming

Table 184. Farmer perceptions of plot treatments (no banking and no seed priming)

Farmer	Plot No.	Banking 1998/99 (proposed)	Banking 1998/99 (actual)	Banking 1998/99 (farmer's perception)	Seed priming 1998/99 (actual)	Seed priming 1998/99 (farmer's perception)
Malita Sapuwa	4	0	1	1	0	0
Linily Matekesa	2	0	1	0	0	0
Lucy Magreen	4	0	0	0	0	0
Kasimu Sapanga	3	0	0	0	0	0
Mai Jana	3	0	1	1	0	0
Mai Kwizombe	3	0	1	0	0	1
Bambo Basikolo	1	0	0	0	0	0
Bambo Chikoti	2	0	0	0	0	0
Bambo Kawerenga	3	0	1	0	0	0
Bambo Kamoto	3	0	0	0	0	0
Bambo Mafaiti	2	0	0	0	0	0
Mai Kusala	3	0	0	1	0	0

Five plots were wrongly banked in this set. Two farmers thought plots were not banked when they although they had not. Otherwise, farmers said there was no seed priming.

c) Banking and seed priming

Table 185. Farmer perceptions of plot treatments (banking and seed priming)

Farmer	Plot No.	Banking 1998/99 (proposed)	Banking 1998/99 (actual)	Banking 1998/99 (farmer's perception)	Seed priming 1998/99 (actual)	Seed priming 1998/99 (farmer's perception)
Malita Sapuwa	1	1	0	0	1	0
Linily Matekesa	1	1	1	1	1	0
Lucy Magreen	3	1	1	1	1	0
Kasimu Sapanga	4	1	1	1	1	0
Mai Jana	2	1	1	0	1	0
Mai Kwizombe	1	1	1	1	1	1
Bambo Basikolo	3	1	1	1	1	0
Bambo Chikoti	4	1	1	1	1	0
Bambo Kawerenga	1	1	1	1	1	0
Bambo Kamoto	1	1	1	1	1	0
Bambo Mafaiti	4	1	1	1	1	0
Mai Kusala	4	1	1	1	1	1

One plot in this set was wrongly banked (Table 185). One farmer thought a plot was not banked when it had been banked. Although all the plots had primed seeds, only two farmers mentioned this.

d) Banking and no seed priming

Table 186. Farmer perceptions of plot treatments (banking and no seed priming)

Farmer	Plot No.	Banking 1998/99 (proposed)	Banking 1998/99 (actual)	Banking 1998/99 (farmer's perception)	Seed priming 1998/99 (actual)	Seed priming 1998/99 (farmer's perception)
Malita Sapuwa	3	1	1	1	0	0
Linily Matekesa	3	1	1	0	0	0
Lucy Magreen	1	1	1	1	0	0
Kasimu Sapanga	1	1	1	1	0	0
Mai Jana	4	1	1	0	0	0
Mai Kwizombe	2	1	1	0	0	0
Bambo Basikolo	4	1	1	1	0	0
Bambo Chikoti	3	1	1	1	0	0
Bambo Kawerenga	2	1	1	1	0	0
Bambo Kamoto	2	1	1	1	0	0
Bambo Mafaiti	1	1	1	1	0	0
Mai Kusala	1	1	1	0	0	0

In this set, all the banking was done correctly but four farmers thought plots were not banked when they had been banked (Table 186). There was no seed priming and farmers did not mention seed priming.

Question 2.7 **If the banking or seed priming has been assigned to plots other than the ones indicated in the treatment structure, what do you think is the reason for this?**

Table 187. Reasons for altering treatment on plots

Difference	Reason	Frequency
Banked all 4 plots	Banking is good because it prevents plant deaths and helps cob formation	1
Banked all 4 plots	Banking is good because it prevents plant deaths and helps cob formation (and because the farmer was late and the rains were heavy – TR)	1
Banked wrong plots	Banked two plots to compare termite lodging banked/unbanked	1
Did *kusenda* to all plots	Heavy rains meant kukwezera would have resulted in rapid regrowth of weeds	1
Banked all 4 plots	Question not asked, farmer confused	1
	Not applicable	7
	Total	12

Only four of the five farmers who could have been asked this question gave responses (Table 187). The information here has been cross checked against a study of the farmers participating in the termite trials conducted by the socio-economic section of the FSIPM Project, 'Termites Revisited' (TR). Where farmers banked (or carried out *kusenda*), they did this because in their judgement, this was the best farming practice for the plot in the circumstances, in particular heavy rain or the fact that the farmer was late in banking or second weeding.

Discussion of 2.6 and 2.7

Three farmers had banked all their plots, two deliberately, one by mistake (we think) one farmer had used a technique called *kusenda* and one farmer had banked the wrong two plots in error. Work by the socio-economic team, 'Termites Revisited' suggests that one of the all-banking farmers and the farmer who did *kusenda* were rejecting a trial design that might reduce their yield (Orr, Mwale and Saiti, 1999). In the absence of more serious termite damage, banking the plots would result in higher yields.

More surprising is that farmers should make mistakes about whether or not plots had been banked. The most likely explanation for this is that a different member of the family had carried out the work or that it was hard to compare between the plots with fully grown maize obscuring the view.

There was a universal lack of awareness or comment on seed priming. Although at first sight, farmers appear to have correctly indicated that there was no seed priming on the plots where there was no seed priming, this result is undermined because no one mentioned seed priming where seeds had been soaked. Why should this be so? Further investigation of farmers' perceptions of these techniques is necessary but it may be that soaking seeds is a normal practice and so not thought worth specifying. If this were the case, however, it seems probable that farmers would have commented more on the absence of seed priming. It is possible that the effect of seed priming is so small that farmers do not think it worth referring to.

Question 3.1 **What have you learnt from these research plots this year?**

Table 188. Learning from research plots

Comment	Frequency
Maize spacing at 90 cm	9
Ridge spacing	2
Weeding prevents termites	2
To bank early even if the weeds are small to avoid lodging	1
Learnt that termites reduce yield	1
Learnt about not banking to avoid termites	1
Use of fertilizer	1
Timing of weeding and banking	1
3 maize plants per station.	1
Effect of banking versus kukwezera has not been seen since there were no termites this year on research plots.	1
Has learnt the pattern of intercropping of different crops like:pigeonpeas, beans and maize.	1
Total	20

The results here fit with findings from other survey work (see, for example, Lawson McDowall et. al., 1999). Maize spacing at 90cm and ridge spacing have drawn most interest from farmers who normally plant their maize more closely than this (Table 188). Ridge spacing is also of interest since project ridges tend to be larger than farmer's own. Three farmers in total mention termite prevention but two see weeding rather than the avoidance of banking as the strategy.

Question 3.2 **Can you comment on any aspect of the trial?**

Table 189. Comments on trials

Comment	Total
Appreciates research work.	5
Asked if we would take the maize after harvest?	1
Asked why we seed primed	1
Feels he has learnt something (but does not specify what)	1
No comment	*5*
Total	13

Most comments were complimentary, that the farmers appreciated the work of the project (Table 189).

References

LAWSON-MCDOWALL, J., et.al., (1999) Great Suspicions and Lesser Expectations: an investigation into farmer perceptions of the Farming Systems Integrated Pest Management Project. FSIPM Project Mimeo, May

ORR, A., MWALE, B. AND SAITI, D. (1999) Termites Revisited. FSIPM Project Mimeo, March.

Matapwata and Chiradzulu Farmers: Long duration Pigeon pea monitoring pre-harvest

By Eviness Simkoza.

Introduction

The following long duration pigeon peas varieties were used in the monitoring exercise: ICEAP 00040, ICEAP 00053, ICP 9145 and the local variety. In this exercise, farmers were asked to score plant stand, value of stems as wood, earliness of maturity, seed size and expected yield. Scoring scale ranged from 1 (very poor) to 5 (very good) for agronomic qualities and expected yield. Farmers were also asked to comment on any obvious differences spotted between varieties and the possible reasons for these differences. They were further asked to tell us what they had learnt from their observation plots. Only 33 farmers were interviewed in this exercise.

Results

Question 2.1 Performance of Research Plots: expected yield and agronomic qualities of varieties.

Table 1. Average scores for long duration pigeon peas pre-harvest

	ICP 9145	ICEAP 00040	ICEAP 00053	LOCAL
Plant stand	3.12	**3.85**	3.42	3.64
Firewood value	2.64	**3.48**	3.06	3.15
Early maturity	**4.52**	4.21	3.33	2.03
Seed size	2.78	4.13	**4.41**	4
Expected yield	3.24	4	3.06	2.88
Overall average	**3.26**	**3.93**	**3.46**	**3.14**

Overall ranking:

ICEAP 00040
ICEAP 00053
ICP 9145
LOCAL

Farmers comments

- ICEAP 00040 proves to be the best. From the table above, it is coming the first on plant stand, firewood value and excepted yield hence a higher average score.
- Local variety is matures very late and its excepted yield is very low. This variety is not liked by many farmers nowadays with the recent introductions of the hybrid varieties by FSIPM.

Question 2.2 Differences between varieties on research plots

Table 2: Farmer responses on the differences between variety performance on the research plots.

Agronomic quality	Particular comment	ICP 9145	Local	ICEAP 00040	ICEAP 00053	*Total per comment*	Sub-totals
Yield	Good stand	1		2		*3*	
	Good pod formation			2	1	*3*	
	High yield	3	2	8	1	*14*	
	Good tree formation	2		2	3	*7*	
	Low yield		2		2	*4*	
	Small stems	1			1	*2*	**33**
Adverse conditions	Surviving waterlogging		1			*1*	
	Not surviving waterlogging				1	*1*	
	Surviving weediness		1			*1*	**3**
Seed size	Big			1	1	*2*	
	Medium				1	*1*	
	Small	3				*3*	**6**
Problems	Flower loss	1			1	*2*	
	Wilt susceptibility		1		2	*3*	
	Wilt resistance	1	1	1		*3*	
	Crumbly tips				1	*1*	**9**
Maturity	Early	5		5	2	*12*	
	Late		4		2	*6*	**18**
Taste	Good		1	1	1	*3*	
	Nice smell	1				*1*	**4**

In agriculture, many farmers would like to grow varieties which are able to give more yield in a short period of time. This statement in the table is supported by frequencies of 33 and 18 respectively. ICP 9145 and ICEAP 00040 matures very early and are good at yielding. These two varieties should be recommended to be grown by farmers. Growing these varieties in prevalent favourable conditions, farmers can realise more produce in a short period.

All varieties in Table 2 above resist wilts and they are able to grow well in water logging conditions except ICEAP 00053. The yield realised form this variety is relatively not very high, this is shown in the table with a frequency of 1. The variety is good at tree formation and it can be used for firewood.

Out of all the agronomic aspects outlined above, the local variety does not qualify to be the best because it matures very late and its yield is considerably low. There is need to encourage farmers to use the new introduced varieties.

General Comment

A desirable variety of pigeonpeas should be able to possess atleast three quarters of the above agronomic qualities. The farmers lamented that the project should give them enough seed for their own fields to plant hence increasing its availability and use.

Question 2.3. Did any of the varieties perform differently on the research plots compared to the same variety on the farmer's observation plots? If so, how and what do you think is the reason for this?.

Table 3: Farmer responses on the differences between variety performance on research plots and on the farmer's observation plots.

Response	Frequency	Sub-total
• **No difference**	15	15
• **Pigeon peas did better in the Research Plot because**		
-Don't know why	4	
-Fertiliser was applied	2	
Better management, ridge and plant spacing.	2	
-intercropping pattern		
-Wind on Observation plot caused flower loss	1	9
• **Pigeon peas did better in the Observation Plot because**		
-The Research Plot was in the dambo	1	
-Research plot was waterlogged due to blocks and big ridges	1	
-The soil in the Observation plot is more fertile	1	
-Don't know why	4	7
-Can't compare because in the observation plot varieties were all mixed up	1	1

Nine farmers said that pigeonpeas had performed better in the research plot. Four farmers failed to come up with reasons for their decision. Two said that on the research plots, fertiliser was applied and better management was followed unlike in their fields. Another pair commented that on the research plot pigeonpeas was intercropped with other crops. One had to say that on the observation plot there was flower loss due to wind.

Fifteen farmers were not able to differentiate the performance between the two plots.

Seven individuals said that the crop did better on the observation plots rather than on the research plots. The contributing factors include: fertility of the observation plots rather than on the research plots and the research plots were prone to waterlogged conditions because they were located in the dambo. Four people were unable to give reason for the fact. On the other hand, one was not able to compare because in the observation plot varieties were all mixed up.

Question 3.1. Farmer Learning 'What do you think you have learned about pigeon peas from the research plots?

Table 4: Lessons learnt about pigeon peas from the research plots.

Response	Frequency	Category
• Better spacing of planting stations	8	Cultural
• Learning about new high yielding varieties	8	Varieties
• Top planting of pigeon peas	5	Cultural
• New ridge spacing	4	Cultural
• New ridge sizes	3	Cultural
• The intercropping of maize, beans and pigeon peas is good	3	Cultural
• Finding early maturing varieties	2	Early maturing
• Early weeding and banking is beneficial	2	Cultural
• Have seen how variable yield can be between varieties	2	Varieties
• Planting several varieties avoids risk, get some harvest	2	Cultural

In this research, farmers have learnt about names of new early maturing varieties, their performance as well as the cultural practices that have to be practised in the course of farming.

Eight farmers said that they have learnt about better spacing of planting stations. This means that in the past they were planting the crop without following the recommended spacing.

From Table 4, 8 farmers learnt about new early maturing varieties and their cultural practices to be followed for superior performance. Three farmers learnt to plant the crop on top of the ridge rather than on the sides, the practice they were using in the past before the establishment of the project.

Most of the farmers had the idea that there is no difference between yields when using different varieties. With the presence of the project, they have learnt that yield varies from variety to variety. It is very important to plant different varieties because in times of unfavourable conditions you may be able to realise harvest to the resistant ones.

Mangunda Farmers: Long duration and medium term duration Pigeon pea monitoring pre-harvest

By Eviness Simkoza.

Introduction

The following pigeon peas varieties were used in the monitoring exercise: ICEAP 00040, ICEAP 00068, ICEAP 00073, ICEAP 00053, ICP 9145, ICP 6927, Chilinga and the local variety, (both long and medium types). The crop was grown both as an intercrop and as a sole crop. In this exercise, farmers were asked to score plant stand, value of stems as wood, earliness of maturity, seed size and expected yield. Scoring scale ranged from 1 (very poor) to 5 (very good) for agronomic qualities and expected yield. Farmers were also asked to comment on any obvious differences spotted between varieties and the possible reasons for these differences. They were further asked to tell us what they had learnt from their observation plots. Only 5 farmers took part in the trials, all were interviewed.

Results

Question 2.1 Performance of Research Plots: expected yield and agronomic qualities of varieties.

Table 1:Performance of research plots(excepted yield and agronomic qualities of varieties

Farmer's Scores – Medium duration varieties (intercrop and sole stand)						
Variety	**Plant Stand**	**Value as firewood**	**Earliness of Maturity**	**Seed size**	**Expected yield**	**Total**
CHILINGA	4	**4.6**	**4.8**	4	**2.8**	**4.04**
ICEAP 00068	4.2	3.8	4.6	3	2.2	3.56
ICEAP 00073	**4.4**	3.8	**4.8**	2.6	2.2	3.56
ICP 6927	3.8	3.6	**4.8**	3	2.2	3.48

NOTE: In each column, figures written in bold means superior performance.

Chilinga had the highest score of 4.04, this means that it is the best variety because on average it's performance outweighs the other varieties. ICEAP 00068 and ICEAP 00073 have similar performance shown by the same score of 3.56. On the other hand, ICP 6927 performed poorly compared to the other varieties but is known to have the tendency of maturing early.

Table 2: Mangunda farmer's scores for long duration pigeon peas pre-harvest.

Farmer's Scores - Long duration varieties (intercrop and sole stand)						
Variety	**Plant Stand**	**Value as firewood**	**Earliness of Maturity**	**Seed size**	**Expected yield**	**Total**
ICEAP 00040	**4.6**	**4.5**	4	4.6	**3.8**	**4.3**
ICEAP 00053	3.5	3.5	3.2	**5**	2	3.44
ICP 9145	**4.6**	4	**4.2**	2.4	3.6	3.76

NOTE: In each column, figures written in bold means superior performance.

ICEAP 00040 is best at giving high yields; superior value of firewood and its plant stand does not become influenced by external factors. ICP 9145 as a medium variety of pigeon peas matures early and has got good plant stand as compared to a scenario where it is grown as a long duration variety. ICEAP 00053 had least scores meaning that it did not perform well on average despite having big sizes of seed.

Table 3 : Mangunda farmer's scores for pigeon peas, in sole and intercrop stands.

Agronomic Quality	Duration	Pigeonpea Variety	Intercropped plots	Sole crop	Overall average
Plant stand	Long	ICP 9145	**4.6**	**4.6**	**4.6**
	Long	ICEAP 00040	**4.6**	**4.6**	**4.6**
	Long	ICEAP 00053	3.6	3.4	3.5
Firewood	Long	ICP 9145	3.8	4.2	4
	Long	ICEAP 00040	4.4	**4.6**	4.5
	Long	ICEAP 00053	3.4	3.6	3.5
Earliness of maturity	Long	ICP 9145	4.2	**4.2**	4.2
	Long	ICEAP 00040	4	4	4
	Long	ICEAP 00053	3.2	3.2	3.2
Seed size	Long	ICP 9145	2.4	2.4	2.4
	Long	ICEAP 00040	4.6	4.6	4.6
	Long	ICEAP 00053	**5**	**5**	**5**
Expected yield	Long	ICP 9145	3.6	3.6	3.6
	Long	ICEAP 00040	**3.8**	**3.8**	**3.8**
	Long	ICEAP 00053	2	2	2

The results show that earliness of maturity, seed size and expected yield of the three pigeonpeas varieties plus plant stand of ICP 9145 and ICEAP 00040 are not become affected when grown as a sole crop or as an intercrop. On the other hand, the value of the crop as firewood is greatly affected when grown under two different growing patterns.

Question 2.2

'Can you see any obvious differences between varieties on the research plots or compared to the farmer's local? If so, what is the difference and what do you think is the reason for this?

Three of the five farmers said that the research varieties had performed better than any local that they had grown had. This difference was attributed to the characteristics of the research varieties such as, wilt resistance, vigorous plant growth, toleration of weeds and particularly, early maturity. Two farmers said that their local variety had outperformed the research varieties but that they did not know why.

Question 2.3

Did any of the varieties perform differently on the intercropped research plots compared to the same varieties on the sole cropped plots? If so, how and what do you think is the reason for this?

Three farmers said that the pigeon peas had performed better in the sole crop plots. Two of the farmers said they had noticed how tall and strong the plants grew in the sole plants. One said that this was because there was more disease in the intercropped plots but that this was because last year she had grown pigeon peas in this plot so there might be more wilt in the soil than in the sole plot. Another commented that there was more disease in the intercrop plot. Two farmers said that they thought that the intercrop plots pigeon peas did better but one said that this had come as a surprise because the sole crop looked more vigorous.

Question 3

What do you think you have learnt about pigeon peas from the research plots?

Two farmers said again that they now thought that sole cropping pigeon peas was better than Intercropping. Two other farmers said that they had learnt how much better for yield the new varieties were than their local varieties, although one of these farmers said that he did not like Chilinga. The fifth farmer reported that he had learnt how to do kuwojeka (early land preparation involving burying residues to allow decomposition) and now appreciated how the leaves fell in the furrow and created new biomass.

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

QUICK QUESTIONNAIRE ON COWPEAS

Edited by

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Results of Quick Questionnaire on Cowpeas [nseula/khobwe]

Sixteen farmers: 6 men and 10 women. responded to this questionnaire in preparation for the FSIPM Striga Consultation Meeting to be held on 6.10.97. Questions were asked by Mr C. Chanika. Mr E. Shaba Mr T. Maulana and Mr W. Fero.

Summary of findings

- Nearly all farmers grew nseula: three farmers did not but because they were either away at planting time or had no seed
- Khobwe does not appear to suit this area [what about Chiradzulu?]
- Seeds seem to be in short supply. only one farmer had enough from own production to replant. others had to buy.
- Only one variety of nseula is common. Two farmers had heard of another variety. one had tried it.
- Nseula can be eaten in a variety of ways: the leaves and peas can be eaten fresh. very early in the cropping season: or. where farmers have enough peas. they dry them for relish and for pounding to add to maize or market the surplus
- Nseula is valued primarily as an early maturing food crop. one farmer called it 'famine relief'; one farmer said it was high yielding and another commented that it does not need fertiliser
- Nseula is a cash crop if there is a surplus
- Most farmers found nseula an easy crop to grow which does not scramble too much: however. it cannot be disturbed too much by weeding and banding/banking because this can damage the plants and it does not favour being planted where there are high density plant populations
- Five farmers mentioned pest damage as a problem for cowpeas
- Nseula is commonly intercropped with maize and beans and with pigeon peas by some farmers.

Suggestions for follow up

How do different legumes compare? e.g. Mucuna [velvet beans] Nkhungudzu [another legume grown locally] Perhaps some farmer ranking would be a useful exercise?

Name	Nseula grown this year? When last grown?	Khobwe - grown this year or when?	Seed availability/ New varieties	Used for	Advantages	Disadvantages	How easy to grow?	What are they intercropped with?
Mai Mazinga ES	Yes but harvest failed because of insects	Do not grow because does not suit soil, no pods develop	Market Nseula wa nchima is a new variety	Relish - green leaves [Makaka] Sale	high yielding	Insect damage	Easy to grow, interplant with maize grow with chimbamba or kaulesi - has never grown climbing beans	maize or any other crop
Bambo Wilson ES	No was away this year grew in 1994	No was away this year Grew in 1994	Market Has heard of new seeds but never tried	Relish - leaves and peas Porridge [mixed with maize flour] Seeds		Diseases	Is quick maturing - more so than pigeon peas	maize, pigeon pea, pumpkin
Bambo Chigomire ES	Yes but nseula failed [dried] due to lack of rains	No never grows because does not suit soil	Market Never heard of new varieties	Relish when fresh [makaka] Relish as dried pea Can sell when have good harvest	Quick maturing Does not need fertiliser	Insect damage Have to buy seeds	Easy because can sideplant with maize [Has never grown climbing beans because cannot be a relay crop]	maize
Mai Elizabeth [Marichi cluster] WKF	Yes	No never grow because give no yield	Bought	Food good for eating boiled makata	Matures early		Easy to grow but must bank ridges early to avoid breaking the plants	Maize, beans and pigeon peas
Mai Muthowa WKF	Yes	No Does not do well in this area	Bought	Food and cash if sufficient yield Nice to eat while green - makata		Insects [aphids] cause curling of leaves Podding was poor this year	Easy to grow because does not scramble much	Maize and beans

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Name	Nseula grown this year? When last grown?	Khobwe - grown this year or when?	Seed availability	Used for	Advantages	Disadvantages	How easy to grow?	What are they intercropped with?
Dyson Simeon WKF	Yes	No Does not give any yield	Bought	Food	Early maturing		Easy	Maize and beans
Bambo Situma WKF	No Had no seed Grew 1994-5	No Does not give any yield	Bought	Food Cash if sufficient yield mostly eaten green [makata]	Early maturing	If plants are grown close, they do not give a good yield	Not easy because weeding and banding must be done early to avoid breaking plants	Maize only
Mai Nasiyani THH	Yes Every year	No Has never seen it grown around here	Market	Food, especially green leafy vegetable	Early maturing so good food	Cannot grow in the field with high populations of other plants		Beans, maize, pigeon peas
Mai Kazembe THH	Yes Every year	No Doesn't suit soil around here	Market	Food	Early maturing		Grown on the side of the ridge and beans then go on top	Maize, beans and pigeon peas
Mai Gomani THH	Yes Every year	No Doesn't suit soil around here	Either storage of own seed or from market, only one variety	Food Cash	Early maturing		Easy because can grow with maizee	Maize and other beans beside
Mai Kusala THH	Yes Every year	No, only yields vegetatively because of the soil	Stores the seed, sometimes purchases from the market	Food Cash	Early maturing - can use for food when other crops are not ready		It is easy to grow like other beans, does not scramble through crops	Maize and other beans
Mai Nantchengwa THH	Yes Last season as well	No, does not grow well because it is too cool here	Market Only knows old variety	Food	Early maturing so can eat when other crops are not yet matured	Lack of seed??	Easy to grow because you harvest before each and every crop	Good with Kaulesi, Chimbamba, maize - has never tried with pigeon peas
Bambo ? CSMC	Yes	No No podding, does not know why	Lack of own, stored seed	Food, not usually enough to sell	Famine relief	Last year production was low due to pest attack and prolonged rains	Grow for 'famine relief' - this year local and ICP9145 pigeon peas flowered but poor podding] Sideplant	Intercropped with Chinganga [this year]

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Name	Nseula grown this year? When last grown?	Khobwe - grown this year or when?	Seed availability	Used for	Advantages	Disadvantages	How easy to grow?	What are they intercropped with?
Bambo Milani CSMC	Yes	No Sandy soil is unsuitable	Can find at market No seed because had small production due to pest attack [Wants black gram to be reintroduced]	Food Cash	Early maturing [famine relief]	This year attacked by long white pests unknown to the farmer	Easy because matures early so very good if rains stop before they should	Chimanga - beans
Mai Kalonga CSMC	No Because went away to work, grew 2 years ago	No Khobwe requires more seed	Market No new varieties	Seed Food -Relish [pea and leaves] -Phalala - added to maize	'Fungo'??? Early maturing		Easy and useful because early maturing	Maize, pumpkins, pigeon peas

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QUESTION	ANSWER	NUMBER
Have you grown <u>nseula</u> this year? **If not, when did you last grow it and why did you not grow it this year?**	yes	12
	no	3
	been away	2
	no seed	1
Have you grown <u>khobwe</u> this year? **If not, why not?**	No [Only 1 farmer said that he had grown Khobwe, in 1994]	14
	No yield/podding	7
	Soil unsuitable	5
	Area unsuitable	2
	Climate too cool	1
How is the seed availability? Are there any new varieties? [Sudan 5] n b not clear whether 'market' and 'bought' are same thing or not - might buy from fellow villagers? Market seems more likely	Market	10
	Bought	4
	Own seed	3
	New varieties?	1
What are <u>nseula or khobwe</u> mostly used for? [Food, cash or both?]	Food	15
	Cash [if surplus]	7
	Seed	1
	n b nseula can be eaten as relish or in nsima -green leaves [<u>makaka</u>] -fresh peas -dried peas -dried peas ground up [<u>phalala</u>] and added to maize flour	
Why do people like or dislike <u>nseula or khobwe</u>? what virtues or disadvantages do they have as a crop? *Advantages*	Early maturing crop [famine relief]	12
	High yielding	1
	Does not need fertiliser	1
Disadvantages	Insects/pests	5
	Diseases	1
	Curling of leaves	1
	Cannot grow where there is high/dense plant population	2
	Have to buy seeds	1
	Lack of seed	1
	Damaged by rains [this year]	1
How easy are they to grow e.g. compared to pigeon peas [khobwe scramble through crops and affect, e.g., what kinds of beans can be grown, do have to grow climbing beans] What problems do they have?	Easy to grow	11
	because harvest before other crops	1
	Difficult because plant fragility means must plant and bank ridges early	2
	Sideplanting	2
What is nseula intercropped with?	Readily intercropped with maize	12
	beans	10
	pigeon peas	3
	pumpkin	1

1.10.97

Quick Questionnaire on Cowpeas [nseula/khobwe]

Name	
Background info [to be filled in later if necessary]	

- Have you grown nseula this year?

If not, when did you last grow it and why did you not grow it this year?

Have you grown khobwe this year?

If not, when did you last grow it and why did you not grow it this year?

- How is the seed availability? Are there any new varieties? [e.g. Sudan 5]

- What are nseula or khobwe mostly used for? [Food, cash or both?]

- Why do people like or dislike nseula or khobwe? what virtues or disadvantages do they have as crops?

- How easy are they to grow e.g. compared to pigeon peas [e.g. khobwe scramble through crops and affect. e.g.. what kinds of beans can be grown. do have to grow climbing beans] What problems cowpeas have?

- What are nseula or khobwe intercropped with?

Use of Sevin (Carbaryl) by farmers in Chiwinja village against Black Maize Beetle (Matono)

J.M. Ritchie
October 1997

In April 1996 the IPM team visited Chitera Central EPA which is situated on the south side of the Chitera dambo directly south of Lidala and Chiwinja villages which are in Lirangwe EPA. The FA for Chitera Central. Mrs Sinyangwe (married to the Veterinary Assistant). showed us specimens of the Black Maize Beetle (matono) which is the most serious pest of maize in the area. With Mrs Sinyangwe we interviewed Village Headman Kawawa and elicited the following details: The dambo was mostly grazed commons originally but this is now dcreasing due to land pressure. In 1994/95 and 95/96 there was serious matono attack on maize and farmers had to plant up to four times. Planting began around 15 Nov 1995 and damage was seen after 10-15 days. The problem began around 1980 and fluctuates from year to year. Damage is at the root collar with the plant being severed just below the soil surface and incidence can reach 100%. In 1995/96 two plantings were completely destroyed and the MP for Chiradzulu West raised the matter in Parliament. Sorghum and finger millet were also hit at about 1 foot high. 150 households were affected in the village and 3 villages were affected with a total area lost of about 150 ha. Bvumbwe supplied some chemicals (this was said to be "Sumithidin") in January 1995 for spraying young plants and part of the third planting survived the attack but was flooded out while young. Earlier information (29/3/96) from Matapwata EPA HQ indicated that Sumithion had been applied to the planting station. presumably as a drench.

In June 1996 Mr Kadalinga FA for Lirangwe accompanied the team on a reconnaissance visit to several vilages in his section. including Lidala and Chiwinja and mentioned that the Chitera dambo had come into cultivation after the drought of 1949. Sowing of maize could be occur five times due to matono damage.

On Thursday 15 August 1996 in Chiwinja Village interviews were held to ask about use of Sevin as a maize seed dressing. First informant was Mai Nankonya who obtained knowledge of Sevin for seed dressing from her brother-in-law who was using it for cotton pests. He suggested it might help against Matono and she tried it for the first time in 1993/94 season using one packet to a whole garden. The method was as follows: one basket (lichero) of seed of local maize was soaked overnight at home and taken to the field where it was mixed with 1 packet of Sevin (cost 14 Kwacha). A lichero is a flat dished basket about 15 inches in diameter. In 1994/95 she repeated the treatment with MH18 (cost now K 18 for one packet of Sevin). However waterlogging in the dambo meant that attack was low and she had 10 x 90Kg bags of maize yield which was less than the previous year. Dead beetles were seen after treatment and neighbours crops were severely damaged. In 1995/96 she planted late waiting for the soil to be moist but there was too much waterlogging and the yield was only one 90Kg bag. She used ADMARC seed (treated) plus Sevin.

The second interview was with Mai Malonda. Bambo Mombezi and Mai Mpoya. **The details of this interview need to be confirmed in relation to familiar relationships among participants and which participants actually used Sevin. The measurements are judged accurate**. Mai Mpoya is the elder sister of Mai Mombezi. Mai Nankonya is Bambo Mombezi's daughter. Mai Malonda (?) had bought a packet of Sevin 85 S (85g) from ADMARC. The Mombezi family learnt about Sevin from Mai Malonda who has told some others as well but Mai Mpoya was the first to try Sevin. A packet of Sevin was shown to us which had instructions on it for spraying at a dilution of 85g to 13.6 litres of water. The husband of one of the ladies present (?Bambo Mombezi) bought Sevin in 94/95 and her daughter bought it in 1995/96 from ADMARC at Lunzu Trading Centre (1 packet cost c K20 in 95/96). The method was as described above with the seed soaked overnight then drained and c1.7 packets of Sevin (we saw the remainder) mixed with 1.5 Chidebe of seed. The remaining insecticide was used against ants. In 1994/95 local maize on the cob filled the nkhokhwe but in 95/96 waterlogging reduced the yield to less than 1 bag. She would continue using it. Mrs Mpoya mentioned that an acquaintance (Mai Daniel). a relative of Bambo Mwachande (who walked the village transect with the FSIPM team) had bought Sevin adulterated with maize meal from Mbulumbuzi market in 1994/95.

The team attempted to find out how big an area was treated with how much Sevin. Mai Mpoya could not say how big her field was but Mai Malonda pointed out that it was the same size as her field. This was then paced out and mapped and estimated at 0.4 ha. The pail (chidebe) was estimated at 15 Kg.

1.5 pails therefore is 22.5 Kg of seed. This appears inadequate for a good stand on 0.4 ha (would need about 30 Kg) but is of the right order of magnitude at least. 1.75 packets of Sevin is about 150g. This gives a figure of 7g of Sevin to 1 Kg of seed. This estimate formed the basis for the Project's use of Sevin as a maize seed dressing in 1996/97 season.

Members of this same group of farmers were also active in growing soya beans in 1995/96. How this technology reached them and was spread might also be worth studying. It appears to have been encouraged by favourable buying price from NGOs and may have lapsed once the market price fell back when the NGOs pulled out.

sevin1.doc

A Socio-economic Perspective on Weeds and Weed Management at FSIPM Research Sites, 1996/97.

Alastair Orr, Paul Jere, and Alex Kiloko.

6 October 1997.

Abstract

Eleusine indica, *Bidens pilosa*, and *Panicum maximum* were identified by farmers as the three most common weeds. Seventy-one percent of the area planted to maize was fully weeded at first weeding, 24 % was fully weeded at second weeding, and 42 % was fully banked. Matapwata EPA had a slower start to second weeding, and a higher proportion of fields were partly weeded at second weeding and partly banked. Fewer female-headed households fully weeded at first weeding, but a higher proportion banked their maize. Farmers ranked *Striga asiatica* as the second most important pest of maize but only 9 % of the cultivated area was reported to contain 'a lot' of *Striga*. Incidence of *Striga* was higher on upland and hillslope fields and on fields which were not weeded or only partly weeded at second weeding. Limited farmer knowledge of the biology of *Striga* reduced effective participation in the evaluation of on-farm trials.

Introduction

The FSIPM Project has classed weeds as a pest of its three target foodcrops of maize, beans, and pigeonpea. From an economic perspective, farmers' existing weed management practices are assumed to be rational, and reflect an efficient allocation of the household's labour resources. Differences in weed management between regions or households are determined both by supply factors (labour) and demand factors (weediness, and expected yield loss from weeds). Thus, labour demand for weeding may compete with labour requirements for other IPM pest management strategies.

So far, socio-economic research on weeds has been diagnostic rather than problem specific. Consequently, the data poses more questions than it answers. Section 1 of this report analyses weeds and weed management, while Section 2 focusses on *Striga asiatica.* The main findings are then summarised and we suggest possible research topics for the 1997/98 season.

The data

FSIPM socioeconomic data on weeds derives primarily from a formal baseline survey at FSIPM research sites in Matapwata and Mombezi EPAs during the 1996/97 crop season. The sample size was 120 households, stratified by participation on FSIPM on-farm trials (60 participating, 60 non-participating households), by sex of household head (60 male-headed, 60 female-headed), and by location (58 from Matapwata, 64 from Mombezi). Survey work was conducted in two rounds using a structured questionnaire. Additional information on farmers' perceptions of *Striga* was obtained from participatory evaluation of on-farm trials (Jere, 1997).

1. Weeds and weed management

What are the major weeds ?

Information on the distribution of weeds relies on farmers' perceptions, not field measurements. Farmers were asked to name the three most common weeds in their gardens, and rank them in order of importance, with the most numerous species ranked first. Results are shown in Table 1, with weeds listed according to the number of farmers reporting a particular weed. Weighting the responses by the rank assigned to each slightly altered the order of this listing in some cases.

Farmers identified 31 "common" weeds, 26 of which we have identified as separate species. Only 10 weeds were reported as "common" by 10 farmers or more, and only three weeds were identified as "common" by 40 farmers or more (one-third of the sample). Despite the large number of weeds reported, therefore, the number of truly "common" weeds is small.

It is instructive to compare this listing with that by the Soil Pests Project, based on the mean number of each weed species per 1 m^2 quadrat during the 1991/92 crop year (SPP, 1993: 228-230, Table 135). Surveys were conducted in Mombezi and Matapwata EPAs in two rounds, corresponding to the sprouting and vegetative stage of maize. The two surveys identified 23 and 34 weed species in Matapwata and Mombezi EPAs, respectively. Table 2 shows that only two weed species (*Eleusine indica* and *Bidens pilosa*) were common to both surveys.

What weeding practices do farmers use ?

Weeding practices differed significantly between EPAs. Average household labour resources (measured as the number of workers in each household, weighted by age and sex) were significantly higher in Mombezi than in Matapwata. Households in Mombezi has more adults than their counterparts in Matapwata. There are a number of possible explanations for this difference (more non-resident adults in Matapwata, a higher birth rate among Muslims, etc) which we have not had sufficient time to explore. The point is, however, that households in Matapwata have less household labour available for weeding and banking, and have adjusted to this in several ways.

- Participation rates were generally higher in Matapwata, significantly so for first weeding. In other words, a higher proportion of household members participated in field activities. They may also have worked longer and harder, though we have no information about this.

- Households in Matapwata focused their efforts on first weeding rather than on second weeding and banking. Almost all the area planted to maize in Matapwata received a first weeding, but nearly half was not weeded at second weeding and only one quarter was fully banked.

On the demand side, weed management practices may be influenced by the type of weed species or the density of weeds, which in turn may be determined by physical factors (soils, landtype), fertiliser use, and tillage practices. In the Shire Highlands, the local practice of *mbwera* (drawing soil away from the ridge to create a flat bed for planting relay beans) may also discourage farmers from banking maize. Table 5 shows, however, that the area planted to maize which was used for *mbwera* did not differ significantly between the two EPAs in either 1995/96 or 1996/97. Similarly, there was no significant difference in the treatment of maize residues on either *mbwera* or non-*mbwera* fields. Most ridges were made in the dry season rather than immediately after harvest, with few farmers preparing land at first rains. Only a small prportion of area planted to maize was re-ridged before planting.

Weeding practices also differed between households headed by men and those headed by women (Table 4). FHHs (including both *de jure* and *de facto* households) had significantly fewer workers than those headed by men. The number of persons (weighted by age and sex) who participated in major field operations (land preparation, weeding) was also lower among these households.

- Participation rates for the same operations were higher for land preparation, planting, and first weeding.

- FHHs weeded their fields less thoroughly, both at first and second weeding. Significantly more FHHs banked their gardens, however. There was no significant difference in the area planted to maize left unweeded.

Timely weeding is particularly important in the Blantyre Shire Highlands because of the high number of weed species (SPP, 1993: 220). DAR's Annual Guide to Agricultural Production does not specify the optimal period for first and second weeding. Research evidence indicates, however, that a critical period of competition is between 10-30 days after emergence.

Figure 1 shows that four weeks after planting, weeding had started on only 50 % of the area planted to maize. By five weeks after planting, the proportion had risen to 85 % . It is possible that the late start to first weeding may have reduced the area which which received a second weeding or banking, since farmers may have felt this was not worthwhile. Second weeding had started on 80 % of the area planted to maize by eight weeks after planting.

The slow start to first weeding was due partly to heavy rains after planting which encouraged weed growth and reduced the benefits from early weeding. Rainfall data from Matambo estate (Mombesi EPA) show that December rainfall totalled 325 mm, compared to an average of 174 mm in the preceding three years. Rainfall in January totalled 544 mm, compared to an average of 279 mm in the preceding three years. Continuous, intensive rains were cited by the MOAI Crop Estimates as one of the main causes for low yields in BLADD in 1996/97.

Timing of planting and start of first weeding did not differ noticeably between EPAs, but second weeding started earlier in Mombezi than in Matapwata (Figure 2). By seven weeks after planting, second weeding had started on 63 % of the area planted to maize in Mombesi compared to 23 % in Matapwata.. By contrast, time of planting, and timing of first and second weeding did not differ markedly between female- and male-headed households (Figure 3).

What determines farmers' choice of weed management strategy ?

Farmers' choice of weed management practices is determined by a large number of variables operating simultaneously. Regression analysis was used to identify important variables determining farmers' decisions for first weeding and banking. The estimating equations are underspecified, because of the difficulty of measuring all the likely independent variables (eg. weediness, expected yields, etc). Specification error results in biased estimates of the parameters of the included variables. Two models were specified to identify determinants of thoroughness of first weeding, and thoroughness of banking. Since the dependent variable was dichotomous (0,1), a logistic function was used to obtain maximum likelihood estimates of the specified relationship and asymptotically efficient parameter estimates to which tests of significance could be applied.

Full weeding at first weeding

The dependent variable was the dummy variable MZFWEED1, with 1 = full weeding and 0 otherwise.

The farmer's decision to fully weed at first weeding was specified to depend on eight independent variables (Table 6). The Chi-square goodness-of-fit statistic showed that the model fitted the data with significance at Prob. >.0001 and that the specification explained 84 % of the observed variation in full weeding of maize fields. Five of the estimated coefficients were statistically significant at the 10 % level or better.

The FHH variable showed a negative sign, perhaps reflecting lower supply of labour among female-headed households. PRFWEED was negatively associated with full weeding, which was unexpected, but which may be due to the higher participation rates found among female-headed households. The TOTN coefficient was positive, implying that the likelihood of first weeding was higher on fields with higher fertiliser rates. W1HIRE was also positive, with hired labour facilitating fuller weeding. Finally, the dummy variable for the CHITERA dambo was negative because farmers were prevented from weeding by excessive flooding.

The MZAREA, W1WK, and W1TIME variables were not statistically significant, indicating that the total area under maize, the date of first weeding, and the time required for first weeding were not detemining factors after controlling for other variables.

Banking of maize

The dependent variable was the dummy BKDONE, with 1= banking, and 0 otherwise.

The farmer's decision to bank maize was specified to depend on 10 independent variables (Table 7). The Chi-square goodness-of-fit statistic showed that the model fitted the data with significance at Prob. >.0028 and that the specification explained 75 % of the observed variation in banking maize. Seven of the estimated coefficients were statistically significant at the 10 % level or better.

The dummy variable for CHITERA dambo displayed a negative sign, since farmers had abandoned their fields due to flooding. The MZAREA variable was negative. Farmers with larger areas planted to maize may face labour constraints in banking. The TERMITE variable was negative, since farmers believe banking encourages this pest. As expected, the TOTN sign was positive: fields with higher fertiliser rates are more likely to be banked. The sign of the WDWK3 variable was positive, indicating that speed of first weeding influenced farmers' decision to bank. The EPA dummy was positive, even after controlling for the Chitera dambo. Finally, the sign on the TMBWERA variable was positive, suggesting that this cultivation practice was compatible with banking maize.

The FHH, RGANYU, and TOTWORK variables were not statistically significant. The RGANYU variable had the expected negative sign.

2. *Striga asiatica*

The baseline survey results show that *Striga* was ranked second as a pest of maize but Table 8 shows that the incidence was surprisingly low in the fields of the sample households. There was lower reported incidence of *Striga* in the two EPAs (36.76% of the area cultivated) but there were no significant differences between the two EPAs as well as among the four villages. 'A lot' of striga was reported was reported in only 8.6% of the cultivated area. These low incidences though posing potential threat for the few infested fields can make it difficult for farmers to experience and appreciate the damaging effects of striga and this can limit their perceptions and practice of control strategies. These results would also cause problems in identifying really infested fields to mark out trial plots so that the effect of various strategies can be clearly assessed.

Striga incidence by landtype

Table 9 shows that the *Striga* reported was mostly in upland fields (36.7 % of upland and 35.3% of hillslope fields) as opposed to dambo fields. There was a significant positive correlation between land type and *Striga* incidence, with *Striga* associated with upland fields (Table10). These upland fields with some *Striga* had mostly sandy loam soils with very few incidences of *Striga* on clay loam or clay soils. These sandy loam soils are very prone to heavy cultivation and leaching or depletion of nutrients so that they can easily become infertile and associated with *Striga* infestations.

Field management

One of the most important field management techniques for weed management is weeding. In most fields weeding is done twice and this can help reduce *Striga* incidence as a planned strategy or as a coincidence. A lot of people consider first weeding as necessary. As such, most of the fields for the sample households (49.3%) were fully weeded and very few were not weeded. Table 11 shows that for the fields where *Striga* was reported there was no significant differences on whether the field was fully, partly or not weeded. Table 13 also shows that the correlation between *Striga* incidence and the proportion of maize fully weeded at first weeding (MZFW1PER) was not statistically significant.

For second weeding, it was found that more of the fields with reported *Striga* were either partly or not weeded (Table 12). The issue of not weeding or partly weeding during second weeding could be a reflection of the farmers' perceptions of the performance of their maize crop. For the fields with low fertility and no fertiliser application coupled with heavy rains this year, the maize crop performed poorly so that some farmers abandoned their fields. Some of these fields could contain *Striga* either in large or small quantities. Other reasons for not doing second weeding include labour shortage and the impending process of *mbwera* for relay cropping. There was also a significant and positive correlation between second weeding and the incidence of *Striga* (Table 13).

Control methods

For the farmers who reported *Striga* in their fields, the most common method of control was to intensify weeding of their maize fields (59.6%) while some hand picked the flowering *Striga* (40.4%) [Table 14]. Some of these farmers were more careful that they removed the *Striga* from their fields (19.3%) after weeding but there was no reported incidence of burning the removed *Striga*.

One interesting result was that some farmers (10.5%) reported using velvet beans (*mucuna spp.*) as an intercrop to reduce *Striga* incidence in their fields. Most of them did not know how this worked but they had noticed a decrease of *Striga* after planting velvet beans for some years. Some farmers reported using other crops (e.g. groundnuts) planted after maize. These are likely to be working as trap crops for *Striga.* Quite a few farmers related the incidence of *Striga* with declining soil fertility so that they considered fertiliser use, adding manure and incorporating residues as control methods for *Striga.* However, the remainder did nothing to control *Striga* apart from the normal weeding practices. This might be due to lack of knowledge and understanding of the *Striga* presence, effects and control measures.

Farmers need to be sensitized on how *Striga* is related to soil fertility. Farmer evaluation of the FSIPM *Striga* trials showed that farmers had difficulty understanding the strategies which have indirect effects on *Striga*, such as the use of.soya as a trap crop, and fertiliser and *Tephrosia* to improve soil fertility (Jere, 1997). Unless farmers understand the mechanisms and effect of *Striga*, it will be difficult for them to implement many control strategies against it.

Conclusions

Weeds and weed management

- Only two of the five most weeds identified as 'most common' by farmers at FSIPM researh sites appeared in the top five common weeds identified by the Soil Pests Project survey of 1991/92. Physical measurements of weed species at FSIPM sites may be required to resolve this anomaly.

- Seventy-one percent of the area planted to maize was fully weeded at first weeding, 24 % was fully weeded at second weeding, and 42 % was fully banked. Unusually heavy rainfall in the survey year reduced average maize yields by encouraging weed growth. The relatively low proportion of full second weeding and full banking may reflect farmers' perception of small expected benefits from additional weeding.

- Significant differences in weed management practices were found between FSIPM research sites, with a higher proportion of maize fields partly weeded at second weeding and partly banked in Matapwata EPA. This did not reflect differences in tillage practices. The amount of household labour available for weeding was significantly lower in Matapwata, however. This implies that in Matapwata there is (1) greater competition from weeds, resulting in lower average maize yields; and (2) greater reluctance to adopt IPM strategies which make additional demands on household labour, particularly within 2-3 weeks of planting.

- Weed management practices also differed significantly between male- and female-headed households. Fewer female-headed households fully weeded at first weeding, but a significantly higher proportion banked their maize.

- Timing of the start of first weeding was similar in both Matapwata and Mombezi EPAs but the start of second weeding was later in Matapwata, where second weeding and banking were also less thorough than in Mombezi.

- Multivariate analysis illustrated the complexity of farmers' weed management decisions. Significant variables at first weeding included labour supply and nitrogen rate, and farm size, nitrogen rate, and risk of termite attack for banking.

Striga asiatica

- Although *Striga* was ranked as the second most important pest of maize, only 9 % of the cultivated area was reported to contain 'a lot' of *Striga.* Incidence was significantly higher on upland and hillslope fields.

- Incidence of *Striga* was significantly higher on fields which were not weeded or only partly weeded at second weeding. Low expected yields on these fields might explain why farmers were reluctant to weed these fields fully.

- Intensified weeding and hand-pulling were the most common control methods but some farmers also used trap crops (velvet beans, groundnuts).

Suggested research needs

- Differences in weed management practices warrant further research, particularly in Matapwata where practices appear sub-optimal. It is recommended that socio-economic research on weeds focus on farmers' weed management decisions.The difficulty of measuring all the variables which affect these decisions limits the scope for multivariate analysis. A more approppriate analytical tool is the hierarchical decision-tree, with a sample of 30-40 households. This quantitative approach could be supplemented by fine-grained anthropological case-studies of selected households with different weeding practices, to monitor allocation of labour. The study would also require physical measurements of weed density and effects of weed competition on maize yields to assist determine the economic costs and benefits of alternative weed management strategies.

- On-farm research to develop interventions for *Striga* requires a different approach from that of conventional on-farm trials. Farmers' knowledge of the biology of *Striga* is limited, making it difficult for them to understand the rationale of some interventions (eg. trap crops); they also have difficulty understanding the purpose of interventions which reduce *Striga* indirectly by improving soil fertility, such as *Tephrosia*; and they are easily discouraged by interventions which do not promise visible results in one or two seasons. Consequently, on-farm trials for *Striga* require greater investment in farmer training if they are to fully participate in the design and evaluation of interventions. Farmers' knowledge of *Striga* requires further research so that appropriate messages and control methods can be introduced. Farmers also need to be informed of what crops they can grow to reduce *Striga* incidence. Finally, farmers need to be sensitized on how *Striga* is related to soil fertility.

References

P. Jere (1997). Farmer Evaluation of On-Farm Trials. Mimeo.

Soil Pests Project (1993). Relative importance of different insect pests, plant diseases and weed species affecting farmers' crops in southern Malawi. Report No. 3. October. Mimeo.

Table 1. Farmers' ranking of common weeds, FSIPM research sites, 1996/97.

(n=120 households)

No.	Name of weed (Latin, Chichewa)	Farmers reporting	First rank	Second rank	Third rank	Weighted rank[a]
1	*Biden pilosa* (Chisoso)	46	14	21	10	27.5
2	*Eleusine indica* (Chigombe)	45	22	12	11	31.7
3	*Panicum maximum* (Nsothe)	42	14	18	8	25.7
4	*Cynodon dactylon* (Kapinga)	28	9	14	5	17.7
5	*Unidentified* (Likakazi)	21	9	6	5	13.7
6	*Tribulus terrestris* (Ntcheso)	21	14	4	3	17.0
7	*Leersia hexandra* (Nakache)	18	9	5	4	12.8
8	*Galinsonga parviflora* (Mamuna aligone)	16	6	7	3	10.5
9	*Striga asiatica* (Kaufiti)	15	2	3	10	6.8
10	*Commelina bengalensis* (Kholowani)	12	7	5	0	9.5
11	*Ageratum conyzoides* (Ntawetawe)	5	1	2	1	2.3
12	*Imperata cylindrica* (Nasongole)	4	0	1	3	1.5
13	*Trichodesma zeylanicum* (Chilungumwamba)	3	0	1	2	0.8
14	*Unidentified* (Ndeka)	3	1	2	0	1.5
15	*Cyperus rotundus* (Dawe)	3	2	0	1	2.3
16	*Unidentified* (Gonaphili)	3	2	0	1	2.3
17	*Rhychelytrum ropens* (Chirere)	2	0	1	0	0.5
18	*Acanthospermum hispidum* (Masakambwa)	1	1	0	0	1.0
19	*Unidentified* (Njapani)	1	0	0	1	0.3
20	*Unidentified* (Gwadamumvetse)	1	1	1	0	1.0
21	*Unidentified* (Mupoloni)	1	0	0	1	0.3
22	*Unidentified* (Senche lomwe)	1	0	0	1	0.3
23	*Nicandra physalodes* (Chamasala)	1	0	0	1	0.3
24	*Cyperus esculentus* (Mululu)	1	1	0	0	1.0
25	*Alectra vogelii* (kaufiti wakulu)	1	0	1	0	0.5
26	*Unidentified* (Namasakatha)	1	0	1	0	0.5
27	*Unidentified* (Zonde)	1	1	0	0	1.0
28	*Unidentified* (Stamba olimba)	1	0	1	0	0.5
29	*Unidentified* (Moleni)	1	1	0	0	1.0
30	*Unidentified* (Uwe matemba)	1	0	0	1	0.3
31	*Urrachora mocambisensis*	1	1	0	0	1.0

[a] first rank=1.0; second rank=0.5; third rank=0.3.

Table 2: Five most common weeds identified by FSIPM baseline and Soil Pests Survey.

No.	Baseline Survey, 1996/97	Soil Pests Survey, 1991/92	
			Mean no/ m^2.
1	*Eleusine indica*	*Commelina benghalensis*	42
2	*Bidens pilosa*	*Bidens pilosa*	38
3	*Panicum maximum*	*Eleusine indica*	29
4	*Cynodon dactylon*	*Digitaris barbonica*	26
5	*Tribulis terrestris*	*Rhychelytrum repens*	23

Source: Soil Pests Project, (1993): 228-230, Table 135.

Table 3: Weed management practices among sample households, by EPA, FSIPM research sites, 1996/97.

No.	Variable	Matapwata (n = 60)	Mombezi (n = 60)	Sig.-level [a]
1	Total workers (no)	2.62	3.44	-2.83 *
2	- adult male	1.24	1.71	-2.05 *
3	- adult female	1.19	1.52	-2.45 *
4	- child	0.19	0.21	-0.31
	Labour use (no)			
5	- land preparation	2.13	2.39	-1.17
6	-planting	2.14	2.43	-1.33
7	-first weeding	2.19	2.40	-0.98
8	-second weeding/banking	1.74	2.41	-2.31 *
	Participation rates (%)			
9	- land preparation	92.97	82.49	1.53
10	- planting	92.31	85.54	1.00
11	- first weeding	95.19	83.25	1.82 *
12	- second weeding/banking	83.21	81.48	0.29
	First weeding (% area planted to maize)			
13	- fully weeded	79.63	61.00	2.429
14	- partly weeded	17.46	16.49	0.035
15	- no weeding	2.90	22.51	5.252 *
	Second weeding (% area planted to maize)			
16	- fully weeded	16.49	31.46	1.562
17	-partly weeded	34.47	6.80	7.311
18	- no weeding	49.03	61.74	0.700
	Banking (% area planted to maize)			
19	- fully banked	25.65	59.69	7.929 *
20	-partly banked	49.51	15.16	8.901 *
21	-no banking	24.84	25.15	0.053

[a] * indicates significant differences between groups (10% or better), by Chi-square or t-test

Table 4. Labour supply and use among sample households, by sex of household head, FSIPM research sites, 1996/97.

No.	Variable	Female-headed household (n = 60)	Male-headed household (n = 60)	Sig. -level [a]
1	Total workers (no)	2.47	2.96	-1.99 *
2	- adult male	1.08	1.88	-3.62 *
3	- adult female	1.52	1.20	2.33 *
4	- child	0.23	0.17	1.02
	Labour use (no)			
5	- land preparation	2.18	2.36	-0.82
6	-planting	2.15	2.43	-1.30
7	-first weeding	2.15	2.45	-1.39
8	-second weeding/banking	1.99	2.42	-1.53
	Participation rates (%)			
9	- land preparation	93.56	81.54	1.77 *
10	- planting	92.25	83.57	1.02
11	- first weeding	93.81	84.24	1.45
12	- second weeding/banking	82.11	81.97	0.03
	First weeding (% area planted to maize)			
13	- fully weeded	60.85	76.35	-2.17 *
14	- partly weeded	29.77	9.11	3.37 *
15	- no weeding	9.37	14.53	-1.05
	Second weeding (% area planted to maize)			
16	- fully weeded	18.63	31.47	-1.83 *
17	-partly weeded	21.42	18.36	1.04
18	- no weeding	59.95	56.87	-0.54
	Banking (% area planted to maize)			
19	- fully banked	39.69	44.04	-0.54
20	-partly banked	42.05	25.17	2.23 *
21	-no banking	18.25	30.78	-1.87 *

[a] * indicates significant differences between groups (10% or better), by Chi-square or t-test

Table 5. Tillage practices on area planted to maize, by EPA, FSIPM research sites 1996/97.

No.	Variable	Matapwata (n=60)	Mombesi (n=60)	Sig.-level
	Area of *mbwera* in 1996/97 (ha)			
1	- Yes	17.45	13.35	
2	- No	21.07	21.41	0.130 ns
	Area of *mbwera* in 1995/96 (ha)			
3	- Yes	12.14	10.93	
4	- No	28.44	24.51	0.026 ns
	Treatment of maize/weed residues on *mbwera* gardens (ha)			
5	- burned	2.18	1.20	
6	- fuel	0.70	0.00	
7	-laid in furrow	0.00	0.00	
8	- incorporated	9.33	9.73	0.925 ns
	Treatment of maize/weed residues on non-*mbwera* gardens (ha)			
9	- laid in furrow	0.00	0.59	
10	- carried off field	2.80	0.42	
11	- burned	1.36	1.91	
12	- buried after harvest (Jun-Jul)	11.88	14.88	
13	- buried later in season (Aug-Oct)	12.58	6.34	
14	- other	0.00	0.18	4.698 ns
	Time of ridging (ha)			
15	- after harvest (Jun-Jul)	6.41	4.68	
16	- in dry season (Aug-Oct)	27.39	31.18	
17	- at first rains	1.63	3.04	
18	- other	0.55	1.57	1.172 ns
	Ridges rebuilt before planting (ha)			
19	- Yes	0.94	5.18	
20	- No	39.53	30.97	2.290 ns

Notes:
ns = not significant by Chi-square test at 0.05 level

Table 6. Logit estimates of determinants of thoroughness of first weeding of maize, FSIPM research sites, 1996/97.

Variable	Coefficient	S.E.	Exp(B)	Sig. -level
Constant	3.9975	1.1795		.0007
FHH	-1.4363	0.4626	0.2378	.0019
MZAREA	0.4321	0.5157	1.5405	.4021
PRFWEED	-0.0175	0.0102	0.9827	.0854
TOTN	0.0462	0.0231	1.0473	.0453
W1WK	-0.2700	0.1811	0.7634	.1361
W1TIME	0.0036	0.0201	1.0036	.8584
W1HIRE	1.2089	0.6752	3.3496	.0734
CHITERA	-1.5102	0.5687	0.2209	.0079
- 2 Log of likelihood function, constant only: 194.366				
- 2 Log of likelihood function: 158.177				
Chi-square goodness-of-fit (d.f.=8) 36.189 (p >=.0001)				
Percent of cases predicted correctly: 85.99				
n = 207 plots				

Definitions:

FHH	Dummy for female-headed household (1=Yes, 0 otherwise)
MZAREA	Total area planted to maize by household (ha)
PRFWEED	Household labour participation rate for first weeding (%)
TOTN	Total nitrogen applied to plot (kg/N/ha)
W1WK	Date of first weeding (weeks after planting)
W1TIME	Duration of first weeding (days)
W1HIRE	Dummy for hired labour used for first weeding (1=Yes, 0 otherwise)
CHITERA	Dummy for Chitera dambo (1=Yes, 0 otherwise)

Table 7. Logit estimates of determinants of banking maize, FSIPM research sites, 1996/97.

Variable	Coefficient	S.E.	Exp(B)	Sig. -level
Constant	-0.3613	0.7107		.6112
CHITERA	-1.2854	0.5016	0.2765	.0104
FHH	0.3936	0.3419	1.4824	.2497
MZAREA	-0.8618	0.3756	0.4224	.0218
RGANYU	-0.1037	0.3557	0.9015	.7707
TERMITES	-1.2627	0.5519	0.2829	.0221
TOTN	0.0299	0.0169	1.0304	.0761
WDWK3	1.7925	0.7172	6.0047	.0126
TOTWORK	-0.1159	0.0938	0.8906	.2166
EPA	1.0029	0.4065	2.7260	.0136
TMBWERA	0.6650	0.3555	1.9444	.0614
- 2 Log of likelihood function, constant only: 275.862				
- 2 Log of likelihood function: 249.091				
Chi-square goodness-of-fit (d.f.=8) 26.771 (p >=.0028)				
Percent of cases predicted correctly: 75.11				
n = 221 plots				

Definitions

CHITERA	Dummy for Chitera dambo (1=Yes, 0 otherwise)
FHH	Dummy for female-headed household (1=Yes, 0 otherwise)
MZAREA	Total area planted to maize by household (ha)
RGANYU	Dummy for household participation in ganyu labour (Yes=1, 0 otherwise)
TERMITES	Dummy for farmer perceiving termites as major pest of maize (1=Yes, 0 otherwise)
TOTN	Total nitrogen applied (kg/N/ha)
WDWK3	Proportion of maize area weeded within three weeks of planting (%)
TOTWORK	Household labour, weighted by age and sex (no.)
EPA	Dummy for EPA (1=Matapwata, 2=Mombezi)
TMBWERA	Dummy for *mbwera* done in this plot in 1996/97 season (1=Yes, 0 otherwise)

Table 8. Farmers' reporting of the distribution of *Striga asiatica* at FSIPM research sites, 1996/97

No.	Variable	Area (ha)	Proportion of area cultivated (%)	Sig.-level [a]
	Striga reported present			
1	Total	29.66	36.76	
2	- Matapwata EPA	14.31	35.55	0.000 ns
3	- Mombezi EPA	15.35	37.97	
	Villages			
4	- Kambua	7.39	34.13	
5	- Magomero	6.92	37.20	
6	- Chiwinja	6.45	32.80	
7	- Lidala	8.90	42.85	0.529 ns
8	"None"	51.02 (0.33)[b]	63.98	
9	"Very little"	15.35 (0.36)	19.25	
10	"A little"	6.51 (0.43)	8.16	
11	"A lot"	6.86 (0.40)	8.60	0.68 ns
	"A lot" of *Striga* reported		(% of *Striga* area)	
12	- Matapwata EPA	2.02	14.12	
13	- Mombezi EPA	4.84	31.53	0.474 ns
14	- Kambua	1.33	18.00	
15	- Magomero	0.69	9.97	
16	- Chiwinja	2.67	41.40	
17	- Lidala	2.17	24.38	2.002 ns

[a] Chi-square values, significance level at p > .05

[b] ( ) mean area in hectares

Table 9. *Striga* incidence by landtype, FSIPM research sites, 1996/97

(number of fields)

Land type	No *Striga*	'Very little'	'A little'	' A lot'	Total with *Striga*
Dambo	50	11	2	2	15 (23.1)
Upland	93	29	12	13	54 (36.7)
Hilly	11	3	1	2	6 (35.3)
Total	154	43	15	17	75 (34.5)

Notes: figures in brackets are percentages
Chi-square = 8.4 significant (p> 0.05)

Table 10. *Striga* incidence by first weeding at FSIPM research sites, 1996/97.

(number of fields)

First weeding done	No *Striga*	'Very little' *Striga*	'A little' *Striga*	'A lot' of *Striga*	Total with *Striga*
Partly	26	8	1	2	14 (29.7)
Fully	113	30	13	13	56 (33.1)
None	16	5	1	2	8 (33.3)
Total	155	43	15	17	75 (34.5)

Notes: figures in brackets are percentages
Chi-square = 11.52, not significant

Table 11. *Striga* incidence by second weeding at FSIPM research sites, 1996/97

(number of fields)

Second weeding	No *Striga*	'Very little' *Striga*	'A little' *Striga*	'A lot' of *Striga*	Total with *Striga*
Partly	29	8	2	4	14 (32..6)
Fully	44	12	4	2	18 (29.0)
No	82	23	9	11	43 (34.4)
Total	155	43	15	17	75 (34.5)

Notes: figures in brackets are percentages
Chi-square = 80.04, significant at p >0.05

Table 12. Correlation coefficients for incidence of *Striga asiatica* and selected farm- and plot-level variables, FSIPM research sites, 1996-97.

No.	Variable	Correlation coefficient	Prob.-value (2-tailed) [a]	Prob.-value (1-tailed) [a]
	Farm-level: STSCORE1			
1	FSIZE	-.1432	.119	.059
2	FHH	.-.0461	.617	.309
3	FPCAP	-.1940	.034	**.017**
4	FERT3YR	-.0275	.766	.383
5	EPACODE	.0675	.464	.232
6	MZFPER	.0755	.412	.206
7	MZFW1PER	.1459	.112	**.056**
8	MZFW2PER	-.1542	**.093**	**.046**
9	MZNW1PER	-.0022	.981	.491
10	MZNW2PER	.1368	.136	**.068**
	Plot-level: STRIGA			
11	LANDTYPE	.1282	**.051**	**.026**
12	SLOPE	.0748	.256	.128
13	KATONDO	-.0406	.538	.269
14	LOKUDA	.0074	.910	.455
15	LACHENGA	-.0201	.760	.380
16	MAKANDE	-.0664	.314	.157
17	FERT	-.0214	.746	.373
18	MANURE	.0241	.715	.357
19	TOTN	.0631	.339	.169
20	TOTP	-.1066	.105	**.053**
21	TMBWERA	-.0885	.190	**.095**
22	LMBWERA	.0171	.798	.399
23	COWPEAS	.1071	.158	**.079**

[a] bold type = significant at 10% level or above

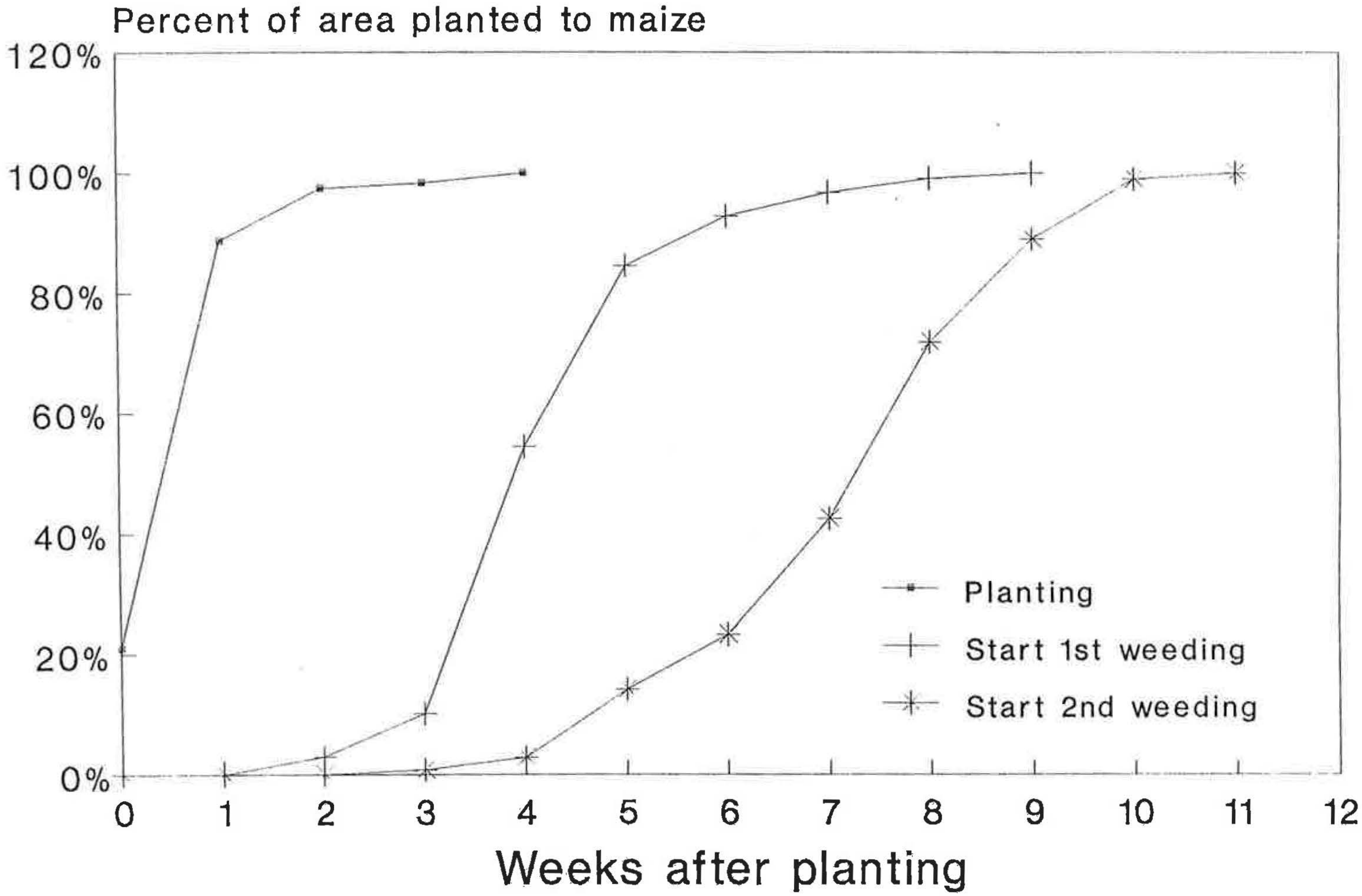
Table 13. Farmers' control methods for *Striga*, FSIPM research sites, 1996/97.

Control strategy	Households using * (%)
Extra hoeing	59.6
Hand pulling	40.4
Removing from field	19.3
Intercropping with velvet beans	10.5
Incorporating crop residues	5.3
Adding manure	3.5
Adding fertiliser	3.5
Using other trap crops	3.5

Sample size (n) = 57

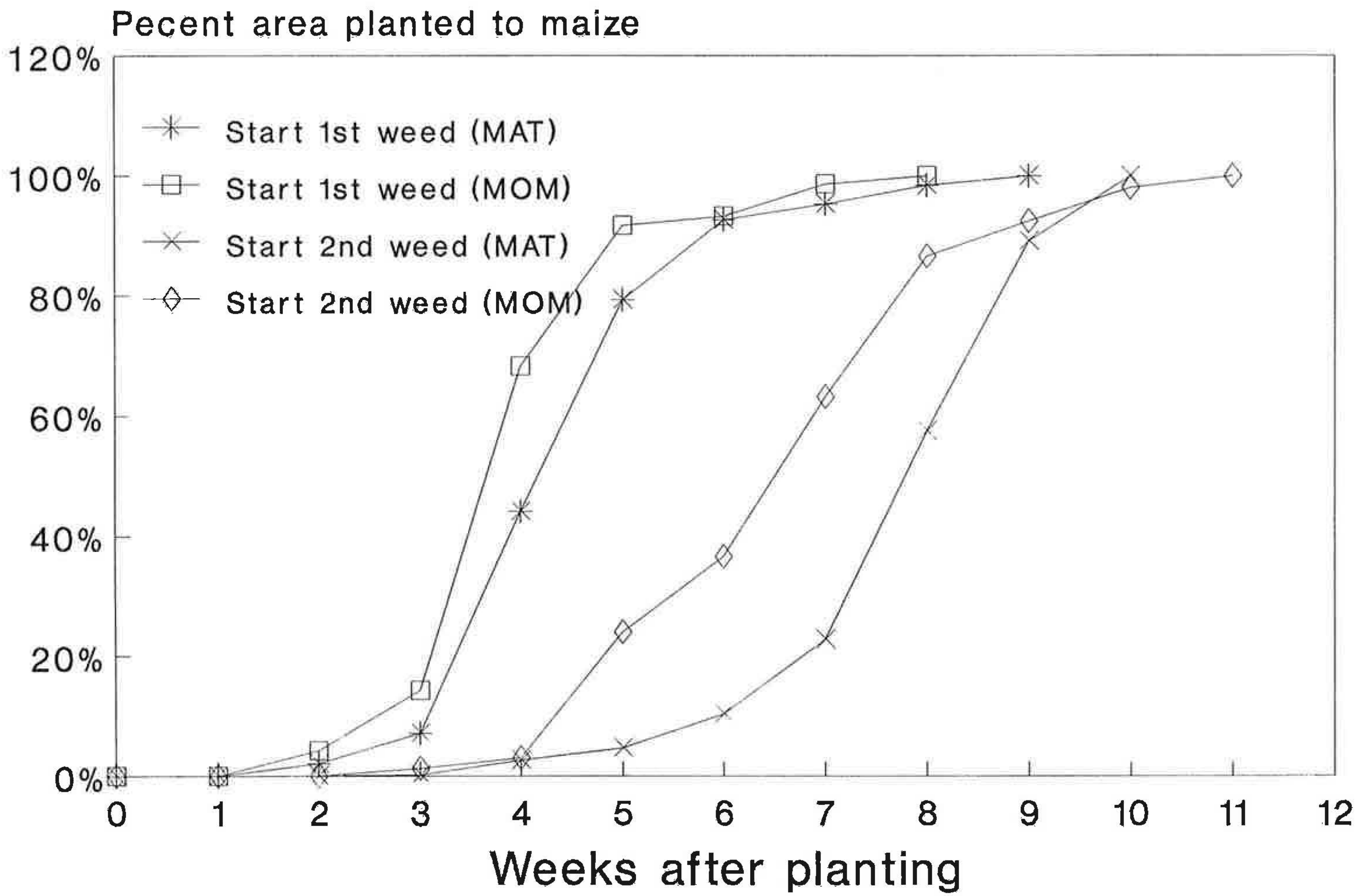
* some farmers used more than one strategy

Timing of first and second weeding
FSIPM research sites, 1996/97



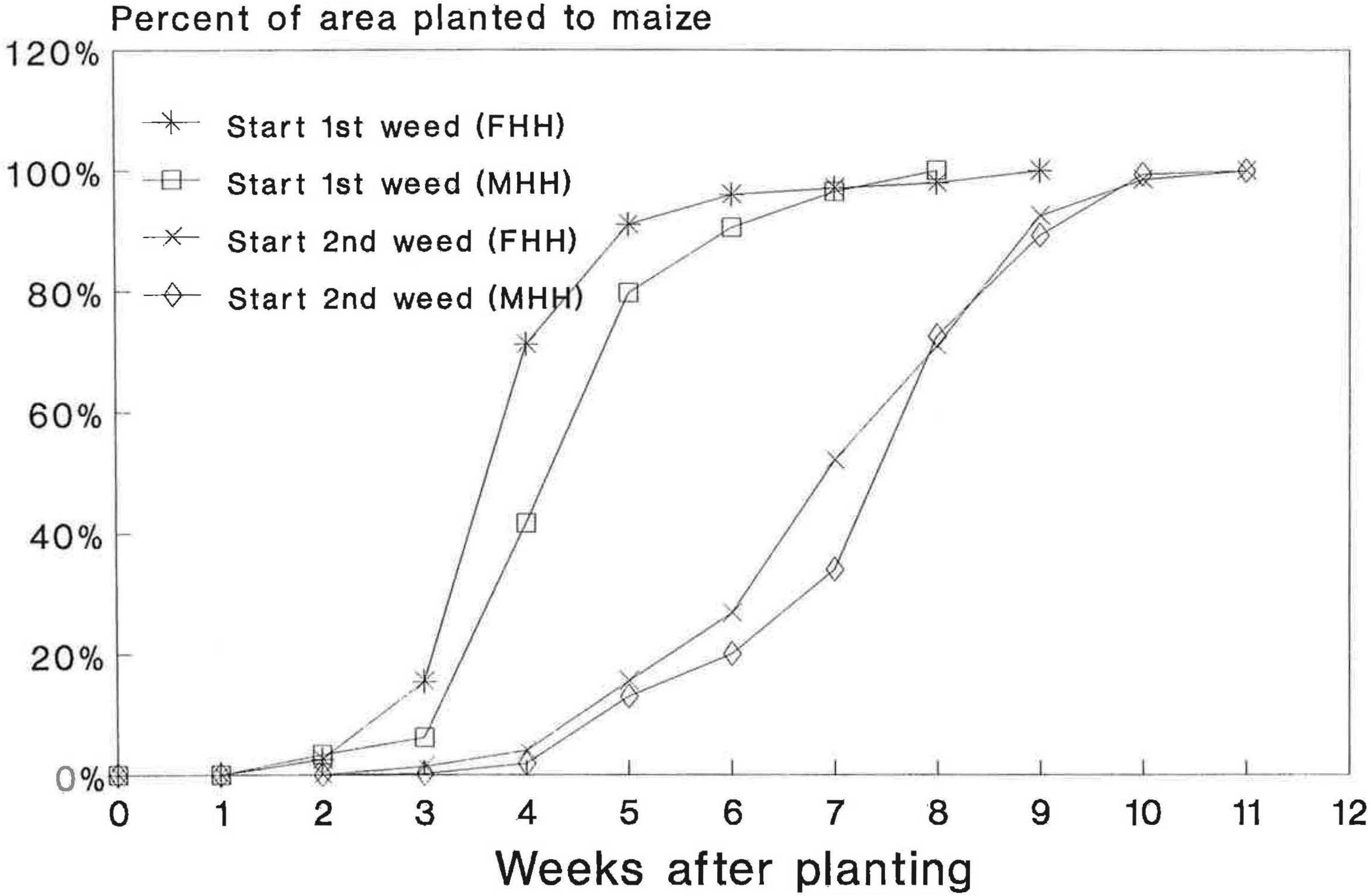
Source: FSIPM Baseline Survey, 1996/97

Timing of first and second weeding by EPA



Source: FSIPM Baseline Survey, 1996/97.

Timing of first and second weeding by sex of household head



Source: FSIPM Baseline Survey, 1996/97

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

Farmers' tillage practices in relation to green manuring with *Tephrosia vogelii* and *Crotalaria juncea*

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Abstract

Farmers' tillage practices are an integral part of soil fertility management. Interviews with key informants in Mombezi and Matapwata EPAs, Blantyre Shire Highlands RDP, identified seven specific tillage practices which were closely linked to cropping patterns and timing. Where maize is intercropped with beans and/or pigeonpea, weeds and crop residues are incorporated (*kuwojeka*) and left to decompose before final ridging (*kuwunga*). Farmers may also lay crop residues in the furrow without incorporating them (*kukhwaza* or *kusosa*). Certain crop residues (sorghum, pigeonpea, tobacco, sometimes velvet bean and dolichos beans) are not incorporated. From September onwards weeds and crop residues are generally burned (*kukhusa*) since farmers believe insufficient time remains for decomposition. Where maize is relay cropped with beans, field peas, or sweet potato, ridges are scraped clean (*kukwezera*) and weeds and residues heaped together and burned. Labour requirements for stripping *Tephrosia* leaves on OFT plots averaged 90 hrs/ha in 1997/98. Net benefits from *Tephrosia* – fertiliser in 1997/98 averaged 10,774 MK/ha compared to 6,929 MK/ha with fertiliser alone. No net benefits are expected from incorporating *Tephrosia* in 1997/98 because of very low biomass production. To maximise biomass production, *Crotalaria* should be harvested in May and *Tephrosia* just before the rains. To synchronise with farmers' tillage practices, however, we suggest that *Crotalaria* is incorporated with other crop/weed residues during *kuwojeka* in May-August and that *Tephrosia* is incorporated at final ridging (*kuwunga*) between September-November. Expanding green manure treatments to all OFTs in 1998/99 will allow farmers to compare different harvesting dates for green manures and a more accurate estimate of potential biomass production.

1.0 Introduction

Land preparation is a central point of coordination for several crop operations in smallholder agriculture. Tillage involves the integration of soil fertility management, weed management, choice of cropping pattern, and allocation of household labour. Field trials in 1997/98 with the leguminous green manures *Tephrosia vogelii* (fishbean) and *Crotalaria juncea* (sunnhemp) have highlighted the need to understand farmer tillage practices in order to evaluate how best to incorporate the use of green manure species into existing farming systems (Riches, 1997). The current recommendation on the time of harvesting for green manure crops is based on maximising potential biomass (MAFE, 1998). This may not be the optimum time from the farmer's point of view, however, if it does not coincide with the incorporation of other crop residues or if it requires added labour when households are already working against time to complete land preparation before the rains.

The objectives of this report are to : (1) identify the range of land preparation practices used by farmers in these villages; (2) relate these practices to farmers' cropping patterns; and (3) explore the factors determining the most appropriate time of harvesting for *Tephrosia* and *Crotalaria* as undersown green manure crops.

2.0 Methods

Tillage practices

The FSIPM Project operates in four villages in Matapwata and Mombezi EPAs in Blantyre Shire Highlands RDP. Information on farmer practices for land preparation was gathered through conversations with 12 key informants. Informants were purposively selected for their skills as farmers and as communicators. Informants were drawn from each of the five cluster groups which represent the main types of farm household at the FSIPM research sites (Table 1). Conversations with informants were structured around a simple checklist (Appendix 1). Each interview lasted roughly one-and-a-half hours. Interviews were made between 6 - 15 July, 1998 when land preparation had just begun.

Labour requirements

Interviews were made on 15 and 17 July with farmers growing *Tephrosia* in order to obtain their views on the optimum time for harvesting and to measure labour requirements for stripping *Tephrosia* leaves. Of six OFTs where *Tephrosia* was undersown with maize in 1997/98, only three produced enough biomass to make measuring labour requirements worthwhile. Each plot was divided into four subplots, giving a total of 12 observations. The protocols of the OFT required that *Tephrosia* plants were uprooted from the side of the ridge and leaves stripped off by hand and weighed before being scattered in the plot. Labour requirements were measured only for stripping leaves. Times were measured with a watch for a net plot size of 3.6 m^2. Times per unit area were converted to a hectare basis and weighted according to the type of labour used (1.0, male; 0.8, female; 0.5, child).

Partial budget analysis

A partial budget analysis was made for undersowing *Tephrosia* with hybrid maize (MH18) in the 1996/97 season in Matapwata EPA. Maize was planted at 90 cm spacing and intercropped with pigeonpea (ICP 9145) planted on the side of the ridge. *Tephrosia* was planted at 4 seeds per station on one side of the ridge at 45 cm intervals alternating with pigeonpea. At flowering the heads of *Tephrosia* were removed and thrown into the furrow to prevent nitrogen being concentrated in seed production. In October 1997 the *Tephrosia* was uprooted, stems removed, and stripped leaves incorporated along with other crop residues as part of *kuwojeka* (Ritchie, 1997). The same protocols were followed in the 1997/98 season except that plots were fertilised at 30 kg N/ha (Ritchie, 1997). The maize crop was harvested in March 1998. Prices refer to the 1997/98 season except for *Tephrosia* inputs (labour, seed) which refer to 1996/97.

Crotalaria

Crotalaria juncea was grown in an observation trial on five fields in Mombezi EPA (Chanika, 1998). A plot of six ridges 90 cm apart and 5.4 m long was marked on five fields where farmers had already planted maize. *Crotalaria* seed was drilled on one side of the ridge at 1.8 g per 5.4 m ridge (0.72g/100 seed). The seed was placed in the drill and partly covered. During second weeding, the side of the ridge where *Crotalaria* had been drilled was handweeded while the other side was banked. *Croaelaria* was harvested in mid-May and incorporated as part of *kuwojeka.*

3.0 Tillage practices

Seven major tillage practices were identified (Table 2). The number and variety of practices reflects the complexity of a smallholder maize cultivation in the Shire Highlands, where intercrops and relay-crops are widely grown. Four major groups of practices may be distinguished:

- *Kuwojeka + kuwunga* and *Kukhwaza* or *kusosa + kuwunga*

The distinctive feature of these tillage practices is that crop residues and weeds are not burned but used to maintain soil fertility. Both sets of practices involve a process of two stages. In *kuwojeka,* farmers incorporate crop residues in a shallow soil covering to help decomposition. Where there are few weeds or residue, they are left to decompose without any soil covering (*kuhkwaza* or *kusosa*). (Weeds and residues may also be laid in the furrow at time of final ridging, if farmers have been too late to do *kuwojeka*). The second stage of final ridging (*kuwunga*) ideally occurs some time after incorporation. *Kuwojeka* is regarded as the ideal practice because the crop residues and weeds improves soil fertility by providing 'manure' (*manuwa*) for maize. It is also impractical to make final ridges without *kuwojeka* because there are so many weeds that it is difficult to cover them with soil. On the hard clay soils (*makande*) of the Chitera dambo, it was difficult to do *kuwojeka* and many waited for the first rains to soften the soil before ridging. Others did *kuwojeka* and final ridging at the same time before the soil became to hard to work.

- *Kukwazira or Kukhusa + kuwunga*

The distinctive feature of these tillage practices is that crop residues and weeds are burned. Farmers regard this as a waste of resources and burn weeds and crop residues only under certain conditions. Burning is used when fields are too bushy for weeds to be incorporated easily with *kuwojeka*. This usually happens when the field was fallowed, or not banked in the previous season. On hill fields, farmers may also collect tall and bushy weeds for burning as a way of clearing the field, before proceeding to do *kuwojeka* with smaller weeds. The main reason for burning, however, was lack of sufficient time for weeds and residues to decompose if farmers used *kuwojeka*. Burning is usually done just before or at the same time as final ridging. Ashes may or may not be spread over the field. *Kukhusa* is also used in tobacco fields, after tobacco stalks have been uprooted, because incorporation of residues is believed to encourage whitegrubs.

- *Kukwezera*

This tillage practice is used where farmers relay crop maize with beans or fieldpeas, or where they grow sweet potato after maize. In both cases, no new furrow is created but the ridges from the relay crop or sweet potato crop are maintained for the next season's maize crop. No incorporation of weeds or residues is thought necessary because weeding for the relay and sweet potato crops means there are very few weeds.

1. *Relay-cropping* (***mbwera***)

In relay-cropping, leaves are stripped from the growing maize and laid in the furrow before being covered with soil scraped from the adjacent ridges. This creates a flat planting bed for beans and/or field peas. After planting in March, the crop is normally weeded once before harvesting in June or July. After harvest of the relay-crops, soil is scraped from the old ridges onto the planting bed to create a new ridge for planting maize the following season.

2. *Sweet potato*

Where sweet potato is grown after maize farmers make new broad ridges in the furrow between the old maize ridges. Maize stalks are incorporated into this new ridge. Sweet potato is normally weeded once and earthed up once to cover exposed tubers. Earthing-up of sweet potato is also known as *kukwezera*. After the harvest of sweet potato the old ridges are simply repaired ready for planting maize.

Variations were noted with (1) one farmer in Mombezi EPA, who preferred to make new ridges for maize (*kuwunga*) rather than maintain the old ridges (*kukwezera*) because the hard clay soil in the Chitera dambo required loosening for maize to grow well and (2) another farmer who said it was necessary to make new ridges if the sweet potato ridges had been badly broken up during harvesting.

- *Kutipula*

Kutipula describes the tillage practice used in *dimba* gardens where crops are planted on flat beds rather than ridges. It is also used to describe the practice of using a hoe to remove noxious weeds which farmers wish to extirpate from their fields, and which are not incorporated with other weeds during *kuwojeka*. Examples given of these noxious weeds included ***kapinga*** (*Cynodon dactylon*), ***likakazi*** (*Leersia hexandra*), ***nakache*** (unidentified), ***chilungumwamba*** (*Trichodesma zeylanicum*) and ***senjere*** (elephant grass). The normal practice is to burn these weeds after drying them out. Farmers without sufficient time for *kutipula* simply incorporate them with other weeds, however.

4.0 Timing of tillage practices

Table 3 shows the timing of tillage practices in relation to other crop management operations for four major cropping patterns. These have been classified using the following notation: a " - " means followed by; " + " means row intercropped; " / " means relay-planted; and " , " means either, or.

- *Maize + beans + pigeonpea*

Maize intercropped with beans and/or pigeonpea is a common cropping pattern in both EPAs but particularly in Mombezi where there is insufficient rainfall for relay cropping on upland fields. The most important tillage practice in this cropping pattern is *kuwojeka + kuwunga. Kuwojeka* normally starts in June or July, several months after the harvest of maize. The deadline for finishing *kuwojeka* varied. Maize is planted with the first rains, generally around the last week of November. To allow sufficient time for weeds and residues to decompose before planting, some farmers believed that *kuwojeka* had to be finished by August, while others believed it could still be done in September. Generally, when *kuwojeka* was done in September farmers were careful to remove residues such as large maize stalks which might not decompose in time. Termites are an important means of decomposing residues. Most farmers burned crop residues from September onwards. Final ridging (*kuwunga*) started in late July and continued until just before planting. Most farmers staggered land preparation, completing one field before moving on to the next, perhaps ridging one field in the morning and doing *kuwojeka* in another in the afternoon. This meant that on some fields there was little gap between *kuwojeka* and *kuwunga.* One month was reported as the ideal interval between these operations.

The timing of *kuwojeka* is important in view of claims that the practice of incorporating maize stover immobilises N and contributes to low maize yields (Carr, 1998). This is certainly true if maize is incorporated soon before the planting rains or if there is insufficient moisture for residues to decompose. Farmers are well aware, however, of the need to complete *kuwojeka* before the end of August and allow approximately three months for residues to decompose before planting maize. Decomposition of residues in the Shire Highlands is accelerated by light rains (*chiperoni*) between June-October. While farmers in drier areas such as the central region usually burn crop residues and weeds, farmers in the Shire Highlands have discovered by trial and error that timely *kuwojeka* is beneficial to maize.

Pigeonpea and cassava

Final ridging usually starts before these two intercrops are harvested. Cassava is normally grown on border ridges or ridges separating 'boxes' of different crops in a single field. Cassava ridges are left alone during *kuwojeka* but are usually harvested before final ridging (*kuwunga*) to avoid damaging the tubers. Freshly-planted cassava is often observed on the borders of fields which have just received a final ridging.

Tillage practices with pigeonpea are interesting because farmers harvest long-duration varieties (130 days >) in September/October, when *Tephrosia* may also be ready for harvesting. Pigeonpea is normally grown in scattered plantings, allowing farmers to do *kuwojeka* and start *kuwunga* before harvesting pigeonpea without damaging the plants. Where pigeonpea is grown in dense stands (in our OFTs, for example) it is more difficult to do *kuwojeka* or start *kuwunga* without damaging the pigeonpea roots and losing grain yield. For this reason, one farmer waited for the harvest of local pigeonpea in September before starting to ridge. Pigeonpea stems were usually left in the field as long as possible after harvesting to maximise leaf litter which was incorporated at final ridging or at first weeding.

- *Maize + beans + pigeonpea/beans, field peas*

Maize intercropped with beans and/or pigeonpea, and relay cropped with beans or fieldpeas is common in Matapwata EPA and in the Chitera dambo in Mombezi EPA. The relay crop is normally planted in March after the harvest of the bean intercrop. Since it is grown as a pure stand the relay crop produces more than the row intercrop and is usually grown for sale. Because of poor yields in recent years, fieldpeas have replaced beans as an *mbwera* crop in many fields. Fieldpeas or beans may be harvested green in May. *Kukwezera* begins soon after final harvest in June..

Opinions varied on whether it was feasible to grow pigeonpea as an intercrop and relay-crop with beans or fieldpeas. Some farmers avoided combining the two because pigeonpea shaded out *mbwera* crops or because *mbwera* crops disturbed the roots of pigeonpea. Others said it was unavoidable because of land shortage or that pigeonpea was too tall to shade out the *mbwera* crops. Relay cropping in fields where pigeonpea has been intercropped with maize may also increase water stress both on pigeonpea and relay crops, although farmers did not mention this as a reason for avpoiding relay cropping in fields already planted with pigeonpea.

- *Maize - sweet potato + field peas*

Sweet potato has become increasingly popular both as a substitute for unfertilised maize or grown in rotation with maize. In Mombezi EPA, farmers in the Chitera dambo also plant sweet potato after maize, with field peas planted on one side of the ridge or on both sides of the ridge if they have enough seed. (A second crop of fieldpeas may be planted in pure stand after the first, with the harvest kept for seed rather than sale since prices have dropped by this time). Harvesting of sweet potato begins in late June and may extend until August. *Kukwezera* begins after harvesting.

- *Tobacco + pigeonpea, beans*

Burley tobacco is widely grown in Mombezi EPA. Although the recommendation is to grow tobacco as a pure stand most farmers intercrop with beans, pigeonpea, sweet potato, or groundnuts. After tobacco is harvested in March, stalks are not uprooted immediately but may be left until just before final ridging. Once uprooted they are either burned in the field or taken home for fuel. The normal tillage practice in tobacco fields is to burn residues (*kukhusa*). *Kuwojeka* was said to encourage whitegrubs (*mbozi*). After burning, fields are ridged in preparation for maize.

Competing activities

In theory, farmers could start *kuwojeka* immediately after the harvest of maize in April. Although farmers regarded early incorporation of weeds and crop residues as the best farming practice, however, they did not always give *kuwojeka* top priority. During our field visits we observed a large number of competing activities which delayed land preparation. These included: food processing (making flour from cassava and sorghum); marketing (particularly shelled fieldpeas, a major cash crop in this area, and sugarcane); and building (making bricks, cutting bluegum poles; cutting thatching grass and re-thatching roofs). *Dimba* crop operations also peak in this period. Daily watering of cabbage and tomato is required in September and October for farmers wishing to sell in December or January, when top prices are paid. Women also use the months after the maize harvest for petty trading (*geni*) in maize flour. Two key informants - both female heads of household - also emphasised the need for rest after the maize harvest.

5.0 Treatment of crop residues

Table 4 shows treatment of crop residues for four major cropping patterns. Maize leaves are incorporated in all maize-based cropping patterns, with incorporation for relay crops taking place in March before planting . Maize stalks from *mbwera* fields are removed and used for fuel, either by the household or by others who see them as a free good. Residues from the bean intercrop may be incorporated since the crop is usually harvested directly in the field without removing stems. Relay crops (beans, fieldpeas) may be harvested green in May. Stalks from these plants are left to dry in the field. Plants which are being kept for seed are harvested dry in June. At final harvest all residues from relay crops are usually removed from the field, however. Even when not removed they cannot be incorporated since the same ridges are simply repaired (*kukwezera*) to use for maize. Pigeonpea stems are used for fuel but leaves are incorporated. Pigeonpea sheds leaves continuously, hence most leaves are incorporated at *kuwojeka* or *kuwunga*, with the remainder incorporated at first weeding. Since incorporation occurs when leaves are already dry they have a low N content. Certain crop residues were never incorporated. These included pigeonpea and tobacco stems (used for fuel), and sorghum stems (take too long to decompose). Other residues were sometimes incorporated. These included the stems of velvet bean (take too long to decompose)and dolichos bean (very large stems, used for fuel). The reluctance by some farmers to incorporate velvet bean was interesting in view of its potential importance as a green manure crop. Some farmers also said that they avoided incorporating maize stalks from tall varieties (eg. Masika) in dambo fields where there were not enough termites to break down stover.

6.0 Green manure crops

Tephrosia undersown with maize was identified as an appropriate green manure crop for smallholders in Blantyre Shire Highlands RDP (Ritchie *et. al.*, 1997). *Tephrosia* can be sown directly from seed, it is stock-resistant, and has traditional uses as a fish poison and an insecticide. Its slow growth habit reduces competition with maize for light, water, and plant nutrients, and later harvesting increases the synchrony of nitrogen release from green manure biomass and the uptake of nitrogen by maize. Disadavantages compared to other leguminous green manure crops like *Mucuna* and *Crotalaria* include slower production of biomass (Kumwenda and Gilbert, 1998), reduced competition with weeds and shading out late weed growth, and dependence on high rainfall to reach the target biomass of 2,000 kg/ha (Gilbert, 1998). In addition, *Tephrosia* is a host to the root-knot nematode *Meloidogyne incognita* which also attacks pigeonpea and may have the potential to cause breakdown in *Fusarium* wilt resistance of ICP 9145.

*6.1 Labour requirements for stripping*Tephrosia *leaves*

Table 5 shows that mean labour requirements were 110 hours/ha (weighted) and 117 hours/ha (unweighted). In view of the high variation around the mean, the weighted median figure of 90 hours/ha was used in the economic analysis. This is close to the figure for pruning of 78 hours/ha (13 days @ 6 hours/day) used in the economic analysis by the MAFE Project (Hayes, 1998). Land preparation on light soils is estimated to require 390 manhours/ha (170 manhours/ha for *kuwojeka* and 200 manhours/ha for *kuwunga*) [Werner, 1987]. Thus, harvesting *Tephrosia* increases the total labour requirement for land preparation to 460 manhours/ha, an increase of 23 %.

6.2 Partial budget analysis

Results show that net benefits on fertilised plots where *Tephrosia* was incorporated were higher than on plots which had received only fertiliser (Table 6). Adjusted maize yields were over 1300 kg/ha higher on plots where *Tephrosia* was incorporated. Dry biomass production in 1996/97 averaged 1628 kg/ha, equivalent to 24 kg/ha N. Although this was lower than the 'target' biomass of 2,000 kg/ha required to produce the equivalent of 30 kg N/ha (Gilbert, 1998a) the effect on yields was dramatic. Gross benefits exclude the value of fuelwood which averaged 6 t/ha (minus 12 % moisture). Assuming a value of 0.5 MK/kg (half the retail price at Bvumbwe market) gives additional gross benefits of 3,000 MK/ha. More information is needed on the quality of *Tephrosia* as fuel and labour requirements for collecting fuelwood in order to determine net benefits, however.

Results from regional OFTs also showed a weak positive link between quantity of *Tephrosia* biomass at incorporation in 1996/97 and average maize yields in 1997/98 (Gilbert, 1998a). Results for this OFT at Bvumbwe show that biomass production of 1-9 - 2.2 mt/ha gave no increase in the yield of the subsequent maize crop compared to the control (Gilbert, 1998b). The yield increase in maize obtained from our OFT may have been due to the fact that *Tephrosia* was applied in combination with inorganic fertiliser, thereby reducing competition for N between microbes and the maize plant.

In 1997/98, production of dry *Tephrosia* biomass on FSIPM *Striga* plots averaged only 123 kg/ha. This may have been due to low rainfall at this site in April (15 mm compared to 121 mm in 1996/97) and very low soil fertility on these plots. Thus, no net benefits are expected from incorporation of *Tephrosia* in the 1998/99 season. By contrast, the faster-growing *Crotalaria* avoided this end of season dry spell.

6.3 Optimum time for green manure harvesting

Table 7 illustrates the timing of harvesting of *Tephrosia* and *Crotalaria* in relation to maize and farmers' tillage practices.

Tephrosia is undersown at maize planting. Biomass production may continue until final land preparation in November. Harvesting may take place between August-November. MAFE recommends that *Tephrosia* is harvested just before the start of the rains and laid in the furrow without incorporation. After sundrying for a few days, the leaves are shaken off and the stems removed for fuel. MAFE also recommends not to incorporate *Tephrosia* because this is labour-intensive and produces little additional yield benefit (MAFE, 1998). Incorporation is likely to be beneficial, however (1) in wetter areas of the country where moisture allows decomposition, (2) when incorporation is made earlier to allow leaves to decompose, and (3) where leaves are incorporated while green to avoid loss to N.

Harvesting *Tephrosia* just before the rains may prove difficult for farmers. Firstly, there is considerable variation in the onset of the planting rains. Average dates are 20 November (Kamphonji estate) and 27 November (Chiradzulu), with standard deviations of 12-18 days, respectively (Mpata, nd). Secondly, harvesting at this time requires additional labour when farmers are working against time to complete final ridging. Early harvesting in July and August fits best with farmers' existing practice of incorporating crops residues and weeds (*kuwojeka)* and spreads labour requirements. But incorporating *Tephrosia* at *kuwojeka* reduces total biomass production and uptake of green manure N by maize since some N may be lost due to leaching if heavy rain storms occur at the beginning of the season well before the maize is planted. Harvesting at final ridging (*kuwunga*) will increase biomass production and the increase of N uptake by maize. Final ridging may begin as early as August but where *Tephrosia* is grown it may be delayed until November to maximise biomass production.

Since only three farmers harvested any *Tephrosia* from FSIPM Striga plots in 1997/98, farmers' opinions on time of harvesting were not properly sampled. The general opinion was that it was easier to harvest at *kuwojeka* because (1) leaves were incorporated with other residues; (2) uprooting *Tephrosia* damaged the ridges; (3) there was no time for stripping leaves at final ridging; and (4) leaves required time to decompose.

Crotalaria is planted after first weeding. Biomass accumulates rapidly until April-May when the plant seeds and dies back. Dry matter biomass is thus constant between May-November. Harvesting of the FSIPM observation trial took place in May since delayed harvesting risks N being mobilised for seed production. Thus, incorporation of *Crotalaria* took place earlier than farmers' normal timing for the start of *kuwojeka* in July. Competition with other crop operations is limited at this period. Despite quicker biomass production than *Tephrosia*, the need for early harvesting may reduce the uptake of green manure N by the subsequent maize crop if early heavy rain storms lead to leaching.

The text table summarises the pros and cons of harvesting *Tephrosia* and *Crotalaria* at three different periods. Unfortunately, we do not yet know enough about the relationship between time of incorporation of green manure biomass and nitrogen uptake by maize to evaluate these trade-offs in a systematic way. Given the variations in *Tephrosia* biomass observed in FSIPM OFTs, however, recommendations on time of harvesting should perhaps be conditional on biomass production. The lower the production of biomass, the later the time of harvesting to maximise uptake of green manure N. *Tephrosia* could be harvested at flower bud stage to maximise biomass production and minimise N loss due to seed formation.

From the above scenario we suggest that *Crotalaria* is best incorporated during *kuwojeka* in May-June period together with the rest of the crop/weed residues. *Tephrosia* could be incorporated at the time that final ridging (*kuwunga*) is taking place. Since *Tephrosia* leaves and tender stems are still green at the time of incorporation, decomposition could be expected to occur before the planting rains.

Green manure crop	Time of harvesting in relation to tillage	Advantages	Disadvantages
Crotalaria/ Tephrosia	*Kuwojeka* (July-August)	• Spreads labour requirements • Farmers traditionally incorporate other crop residues and weeds at this time	• Reduced *Tephrosia* biomass • Reduced uptake of green manure N by maize • Stock eat *Crotalaria*
Tephrosia	*Kuwunga* (August-November)	• Increased *Tephrosia* biomass • Increased uptake of green manure N by maize	• Adds to labour requirements at final ridging • Possible conflict with farmer perceptions about time required for decomposition of residues
Tephrosia	*Kuwunga* ('Just before rains' ie. late November)	• Increased *Tephrosia* biomass • Increased uptake of green manure N by maize	• Variable start to planting rains • Adds to labour requirements at final ridging and possibly planting

7.0 Conclusions

The variety of farmers' tillage practices makes it difficult to generalise about the feasability of undersowing maize with *Tephrosia* or *Crotalaria.* Although maize dominates the farming system, the picture is complicated by the existence of several intercrops, relay crops and double-cropping of maize with sweet potato.

Undersowing green manures where maize is single or intercropped fits better with existing tillage practices. However, farmers' practice of incorporating crop residues and weeds before final ridging may conflict with the optimum time for harvesting green manures. No information is available about appropriateness of green manure crops where maize is grown with relay crops or where maize is double-cropped. Tillage practices for these cropping patterns differ from that of single or intercropped maize. Where sweet potato is grown after maize, new ridges are made for planting and maize stover incorporated. Benefits from incorporation of green manure crops thus accrue to the sweet potato crop and not to the maize planted in the following season. (Residues from sweet potato are usually fed to livestock and may thus eventually return to the soil through application of animal manure). Where relay crops are grown, farmers break the maize ridge to build a planting ridge in the furrow. Maize leaves are stripped and incorporated before the relay crop is planted. Since farmers continue to grow pigeonpea in fields with relay crops, it would be possible to grow green manure crops in this situation. But farmers grow only scattered plantings of pigeonpea to avoid shading out the relay crop and biomass production is low.

The trade-offs between time of harvesting and uptake of green manure N require further investigation. Despite being more suited to higher rainfall areas such as the Shire Highlands, biomass production from *Tephrosia* on FSIPM plots was close to the target biomass of 2,000 kg/ha in 1996/97 but failed in the 1997/98. This variability reflected: (1) *Tephrosia*'s vulnerability to low rainfall to end-season and perhaps also to mid-season dry spells (2) the low fertility of the *Striga* plots where *Tephrosia* was grown. Even where the target biomass is achieved, however, the low uptake of green manure N by maize means that the effect on maize yields will be gradual. The appropriate time of harvesting *Tephrosia* will depend on biomass production. On infertile soils where biomass production is low, it will be necessary to delay harvesting to increase N uptake from green manures by maize.

Tephrosia will depend on biomass production. On infertile soils where biomass production is low, it will be necessary to delay harvesting to increase N uptake from green manures by maize.

Green manure OFTs in 1998/99

So far, the FSIPM Project has used green manure crops as a pest management strategy for *Striga*. Soil sample analysis showed low organic matter content, N, and P on all OFT plots, however. The decision was then made to fertilise all OFT plots at the rate of 50 kg N/ha in the 1997/98 season. Anticipated price increases following devaluation will further reduce access to inorganic fertiliser by resource-poor farmers, however. Consequently, there is an urgent need to expand the use of green manure crops to complement inorganic fertiliser on all FSIPM trials in the 1998/99 season. This is necessary not only to ensure reasonable maize yields but to provide a more accurate estimate of biomass production from green manure crops and their fit into the existing farming system.

Formal experiments on time of harvesting green manure crops are being conducted by MAFE. The objective of the FSIPM green manure OFTs should be to demonstrate the concept to farmers and allow farmers to explore different management options. The design of the OFT should therefore be made with farmers. The following may be negotiable: (1) choice of green manure crop, either *Tephrosia* or *Crotalaria*; and (2) time of harvesting and incorporation. Since farmers are not familiar with this technology, plant density, location of planting station, and time of planting may be determined by researchers. Researchers may monitor growth of biomass (stand counts), measure biomass production (weight and moisture content); and question farmers about their choice of crop and management practices. Comparisons can then be made between different groups of farmers. One group might choose to incorporate at *kuwojeka* (spreading labour requirements) while another group might incorporate at final ridging or even just before the rains to maximise uptake of green manure N. Both groups could then compare results in terms of maize crop performance and yields the following season.

Abbreviations

ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
EPA	Extension Planning Area
FA	Field Assistant
FSIPM	Farming Systems Integrated Pest Management
IITA	International Institute of Tropical Agriculture
IPM	Integrated Pest Management
MAFE	Malawi Agro-Forestry Extension Project
MOALD	Ministry of Agriculture and Livestock Development
N	Nitrogen
NGO	Non-Government Organisation
OFT	On-farm trial
RDP	Rural Development Project

References

C. S. M. Chanika (1998). *Crotalaria juncea* (sunnhemp) obsevation plots in Mombezi Extension Planning Area, 1998. FSIPM Project, Mimeo.

S. Carr (1998). Soil Degradation in Malawi. Talk to Wildlife Society of Malawi, Blantyre, 14 July.

R. Gilbert (1998a). 'Growth characteristics and N balance of maize-green manure intercropping systems in Malawi'. Pp. 217-224 in Annual Research Project Report for the 1997/98 Season, Cereals Commodity Group. Vol. 1. Ministry of Agriculture and Irrigation, Department of Agricultural Research.

R. Gilbert (1998b). Personal communication.

I. Hayes (1998). Personal commmunication.

J. D. T. Kumwenda and R. Gilbert (1998). 'Legume biomass production and maize yield response in legume manure rotations in Malawi'. Pp. 148-160 in Annual Research Project Report for the 1997/98 Season, Cereals Commodity Group. Vol. 1. Ministry of Agriculture and Irrigation, Department of Agricultural Research.

Malawi Agro-Forestry Project [MAFE] (1998). Undersowing *Tephrosia Vogelii* with Crops in Malawi. Leflet Series No. 1. April.

S. B. Mpata (nd). Date of Planting Rains, Variability and Probabilities in Malawi. Meteorological Services, Chileka. Mimeo, 18 pp.

A. Orr and P. Jere (1998). Identifying smallholder target groups for IPM in southern Malawi. Farming Systems Integrated Pest Management Project, Bvumbwe Research Station. February. Mimeo, 19 pp.

C. R. Riches (1997). Visit to FSIPM Project, Malawi, March 6-16, 1998. Mimeo.

J. M. Ritchie, A. Orr, and P. Jere eds. (1997). Integrating Soil Fertility with IPM for Smallholders in Southern Malawi. Summary Report of a Consultation Meeting, 19 June 1997. FSIPM Project. Mimeo.

J. M. Ritchie (1997). Proposals for On-farm pest management field trials, 1997-98 season. FSIPM Project. Mimeo.

J. Werner (1987). Labour requirement and distribution for smallholder crops. Adaptive Research Section, Liwonde Agricultural Development Division. Mimeo, 44 pp.

Table 1. Key informants on land preparation, FSIPM survey sites.

No.	Persons interviewed	Cluster [a]	Description
1	Mai Muthowa	Stable female-headed	Elderly. *De facto* female-headed because of shiftless husband
2	Tereza Luwera	Stable female-headed	*De facto* female-headed. Husband businessman, possibly polygamist. Employs two permanant labourers; field in Chitera dambo
3	Bambo Chimwaza + wife	Stable male-headed	Field in Chitera dambo
4	Bambo Sitima + wife	Stable male-headed	Party chairman
5	Fraser Mazinga	*Dimba*	Village chief; *dimba* grower
6	Bambo Nangwale	*Dimba*	*Dimba* grower
7	Bambo Baluti + wife	*Dimba*	Two *dimba* gardens, one in distant Goliati
8	Dorothy Ayimu	Burley	Widowed. Burley grower
9	Bambo Bitoni	Burley	Burley grower; large family; field in Chitera dambo
10	Mai Beni	Vulnerable	Elderly widow; lives with unmarried son and daughter; one hillslope and one upland field
11	Daina Chilinkhonde	Vulnerable	Elderly, divorced. Lives with small son. Field in Chitera dambo
12	Mai Kainga	Vulnerable	Elderly couple; mentally handicapped son; young children. Field in Chitera dambo

Notes

[a] Orr and Jere (1998).

Table 2. Farmers' land preparation practices, FSIPM survey sites.

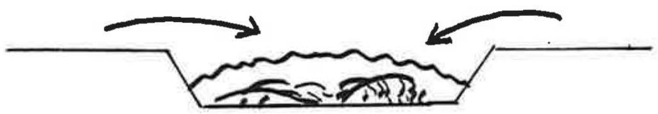
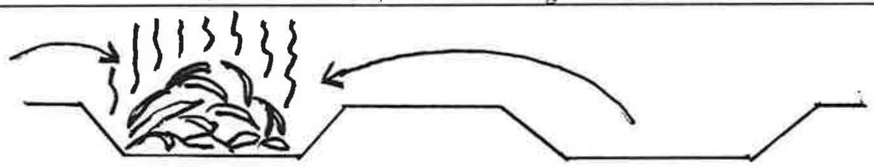
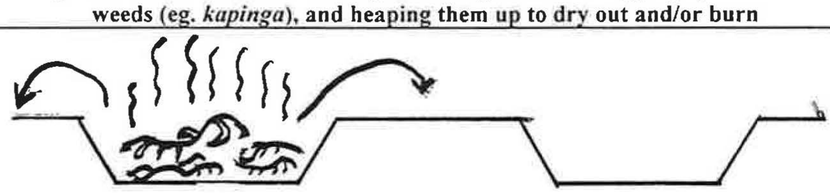
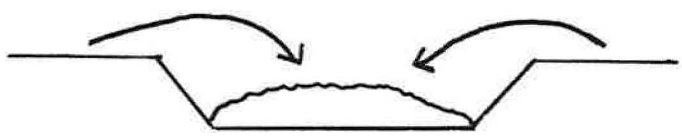
No.	Name	Description
1	*Kuwojeka*	 Using a hoe to scrape together crop residues and weeds from adjoining ridges, laying them in the furrow, and covering with soil to help decomposition
2	*Kukhwaza* or *kusosa*	 Using a hoe to scrape together crop residues and weeds from adjoining ridges, laying them in the furrow, but not covering them with soil
3	*Kukwazira, kukhwaza,* or *kupala*	 Weeding by using a hoe to scrape crop residues and weeds from the sides of the ridge and heaping them up to dry out and/or burn
4	*Kukwezera*	 Using a hoe to maintain old ridges after *mbwera* crops or sweet potato
5	*Kutipula*	 Using a hoe to make beds for sowing *dimba* vegetables, or digging up troublesome weeds (eg. *kapinga*), and heaping them up to dry out and/or burn
6	*Kukhusa*	 Using a hoe to scrape weeds and crop residues and heaping them up to burn, then spreading ash
7	*Kuwunga*	 Using a hoe to make a new ridge in the old furrow by removing soil from the sides of two old ridges

Table 3. Approximate timing of crop management activities for land preparation, by cropping pattern, FSIPM survey sites.

Month	Crop management activity	Maize + beans + pigeonpea	Maize + beans + pigeonpea/ beans, field peas [a]	Maize - sweet potato + fieldpeas	Tobacco + pigeonpea, beans
Mar	Harvest bean intercrop				
"	Plant relay crops				
"	Harvest tobacco				
Apr	Harvest maize				
"	Weed relay crops				
"	Weed sweet potato				
May	Start harvest green beans				
"	Start harvest green field peas				
June	Do *kutipula* for weeds				
"	Start *kuwojeka*				
"	Do *kukhusa* for certain crop residues				
"	Harvest dry beans				
"	Harvest sweet potato				
July	Start *kukwezera*				
"	Finish *kuwojeka*				
	Start harvest pigeonpea				
"	Start *kuwunga* on *kuwojeka* fields				
Aug	Finish harvest pigeonpea				
"	Uproot tobacco stalks				
Sep	Start *kukhusa*				
Oct	Finish *kukhusa*				
"	Finish *kuwunga*				
"	Finish *kukwezera*				
"	Remove pigeonpea stems				
Nov	Plant maize and intercrops				
"	Transplant tobacco				

a " - " means followed by; " + "means row intercropped; " / "means relay-planted; and " , " means either, or.

Table 4. Incorporation of crop residues, by cropping pattern, FSIPM survey sites.[a]

Crop residue	Maize + beans + pigeonpea	Maize + beans + pigeonpea/ beans, field peas [a]	Maize - sweet potato + fieldpeas	Tobacco + pigeonpea, beans
Maize leaves	Y	Y	Y	-
Maize stalks	Y	N	N	-
Intercrop bean stems	Y	Y	N	Y
Relay bean stems	-	N	-	-
Field pea stems	N	N	N	-
Pigeonpea stems	N	N	N	N
Pigeonpea leaves	Y	Y	Y	Y
Sorghum stalks	N	N	N	N
Sorghum leaves	N	N	N	N
Cowpea stems	Y/N	Y/N	Y/N	-
Cowpea leaves	N	N	N	-
Velvet bean stems	Y/N	Y/N	Y/N	-
Velvet bean leaves	N	N	N	-
Tobacco stems	-	-	-	N
Tobacco leaves	-	-	-	N
Sweet potato leaves	-	-	N	-
Cassava stems	N	N	N	N
Cassava leaves	N	N	N	N
Dolichus bean stems	Y/N	Y/N	Y/N	-

[a] Y = Yes, N = No, Y/N = varies, - not grown.

Table 5. Labour requirements for stripping *Tephrosia* leaves, Matapwata, 1997/98.

(hours/ha)

Variable	Unweighted	Weighted
Mean	116.83	110.42
Median	90.00	90.00
St. dev	98.23	82.91
Maximum	386.00	322.00
Minimum	39.00	39.000

Source: FSIPM Survey. Note: n = 12 observations, 3 farmers.

Table 6. Partial budget, maize undersown with *Tephrosia vogelii*, OFT plots, 1997/98.

No.	Description	Units	Maize + fertiliser +*Tephrosia*	Maize + fertiliser
I.	GROSS BENEFITS	Unit	Level	Level
	Maize seed yield	kg/ha	4294	2665
	Adjusted maize seed yield [a]	kg/ha	3435	2132
	Effective price to farmer [b]	MK/kg	3.25	3.25
	Total gross benefits	MK/ha	11164	6929
II.	VARIABLE COSTS	Unit	Level	Level
	(a) Material costs			
	Tephrosia seed	kg/ha	6	-
	Cost of seed in 1996/97 [c]	MK/kg	25	-
	Total cost of *Tephrosia* seed	MK/ha	150	-
	(b) Labour costs			
	planting *Tephrosia* [d]	manhours/ha	30	-
	stripping *Tephrosia* leaves [d]	manhours/ha	90	-
	Cost of labour [e]	MK/hr	2	-
	Total labour costs	MK/ha	240	-
	Total costs that vary [(a) + (b)]	MK/ha	390	-
III.	NET BENEFITS	MK/ha	10774	6929

Notes to Table 6.

a Adjusted downwards by 20 %
b ADMARC producer price 1997/98
c MAFE (1998), p. 4.
d Own stopwatch estimates
e Wage for *gwazu* (task, 4-5 hours) on Kamphonji Estate was 9 Mk for male adult labour in 1996/7.

Table 7. **Timing of harvesting of green manure crops in relation to maize and tillage practices, Blantyre Shire Highlands**

Maize crop activity	Planting	First weeding	Second weeding		Harvesting			*Kuwojeka*	*Kuwojeka* + *Kuwunga*	*Kukhusa* + *Kuwunga*	*Kukhusa* + *Kuwunga*	*Kukhusa* + *Kuwunga*
Maize + undersown *Tephrosia*												Maximum biomass (dry matter)
Maize + undersown *Crotalaria*						Maximum biomass (dry matter)						
Assumed potential uptake of green manure N by maize								*Crotalaria*			*Tephrosia*	
Month	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov

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Appendix 1. Checklist of questions for key informants

1. Kuwojeka

Optimum time, and latest date ?
Any difference between dambo and upland fields ?
What is the purpose of *kuwojeka* ?
What do you think happens to crop residues ?
Why not burn crop residues ?
What happens when field is very weedy (eg. after fallowing) ?

2. Other tillage practices (eg. *kukhusa*)

When do you start *kukhusa* and when finish ?
Why burn and not use *kuwojeka* ?

3. *Mbwera*

Is *kwojeka* possible with *mbwera* ?
Why not ?
Do you weed after sowing the *mbwera* crop ?

4. Pigeonpea

When is it harvested in relation to *kuwojeka* ?
When harvested in rtelation to *kuwunga* ?
Grow pigeonpea with *mbwera* or not ?

5. Other crops

What tillage is done with sweet potato after maize ?
With tobacco ?
With groundnuts ?

6. What do you do with these crop residues ?

Sorghum
Maize
Beans
Fieldpeas
Cassava
Tobacco
Velvet bean
Pigeonpea

7. Could *kuwojeka* be done earlier than June ? (eg. immediately after maize harvest).

8. What activities compete with land preparation ?

9. *Tephrosia*

What is the purpose of incorporating *Tephrosia* ?
When is the best time for incorporation?
Why ?

TERMITES REVISITED

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25 March 1999

Summary

We interviewed the 11 farmers participating in the termite trial in 1998/99 about their control strategies for termites. A wide range of strategies was uncovered. We contrast the concept of strategy-as-a-plan and strategy-as-a-pattern. Research recommendations and on-farm trials view pest management strategy as a plan, laid down in advance. Farmers' pest management strategies resembled patterns that are not determined in advance, synthesise information about different events, and leave room for improvised 'performances'. Five participating farmers did not do kukwezera *on their research plots. Their experience illustrates the limitations of strategy-as-a-plan, and of* kukwezera *as a control strategy for termites under certain field conditions.*

Introduction

Farmers identified termites as the most important field pest of maize after whitegrubs and *Striga asiatica* (Orr *et. al.*, 1997). Information about termites was collected in diagnostic surveys before the 1996/97 season. Results showed few farmer-developed control strategies for termites and other field pests. Killing the termite queen was the only control strategy for termites mentioned by farmers. Over time, however, our eyes have been opened to a range of farmer-developed strategies for pests that were missed during the diagnostic phase. There was an effective control strategy for termites, for example, in *kukwezera*, a weeding technique that kept weeds away from the maize roots. Why did we not discover this and other strategies earlier ?

Possibly PRA techniques were not used correctly and insufficient time allowed for discussion with farmers of what the results actually meant. The team was small, and had to cover four villages in two different areas. There was pressure to complete the diagnostic phase quickly to allow the design of on-farm trials (OFTs) before the start of the season. The fad for PRA also meant that techniques were used uncritically without understanding their limitations. In particular, PRA failed to capture the individualistic and opportunist nature of farmer decision-making. Farming in a rainfed maize-based system is a 'performance' where farmers are continually adapting to circumstances as they change (Richards, 1989). Group dynamics tend to suppress solo performances in favour of a synchronised 'chorus line' of mutually agreed responses. Some strategies may seem too obvious to mention while farmers may be reluctant to divulge strategies that are different or unusual. Variations between seasons and fields make generalisations difficult.

We decided to revisit the major pest problems to get a deeper understanding of farmers' control strategies. This information will form part of an economic evaluation of OFTs. Specifically, we wanted to know: (1) which termites damaged maize; (2) whether farmers used a threshold damage level before taking action; (3) what control strategies they used and in what circumstances; and (4) the weeding technique actually used in the OFT as an alternative to banking.

Methods

All 11 farmers participating in the 1998/99 OFT for termites were interviewed. Farmers were purposively selected for this OFT because of high crop losses from termites in the 1997/98 or 1996/97 seasons. Interviews were conducted in March when termite damage was clearly visible. Samples of five termite species were used to help identification. A short checklist was used to structure the discussion. followed by an inspection of termite damage and farmers' control measures in the OFT plots and the surrounding field. Farmers were also asked to demonstrate the weeding techniques they used in termite fields.

Types of termites

Field surveys in 1991/92 identified 24 species of termites from nine *genera* in farmers' fields in southern Malawi (Logan *et. al.*. 1993). The technical team provided samples of five species. Most farmers recognised four species and provided local names:

Termite species	***Recognised ?***	***Chichewa name***
Macrotermes	Yes	*chiswe chapa chulu*
Pseudocanthotrmes militaris	Yes	*chiswe chaching'ono*
Odontotermes	Yes	*chiswe cha micholo*
Microtermes sp. A	Yes	*chiswe cha ngawere*
Microtermes sp. B	No	na.

Damage to maize

As shown below. not all termite species were equally damaging to maize.

Termite species	***Type of damage reported by farmers***
Macrotermes	Severe damage: cuts stalks. eats grains: eats stover.
Pseudocanthotermes militaris	Eats fallen cobs. thatch roofs. weeds. damages house.
Odontotermes	Eats roots slowly: soil on maize stalk: damages house
Microtermes sp. A	Not usually damaging: eats leaves. fallen cobs:

Farmers identified *Macrotermes* (*chiswe chapa chulu*) as the most severe termite pest of maize because it severed the stalk and caused lodging. Damage from *Odontotermes* (*chiswe cha micholo*). and *Pseudocanthotermes militaris* (*chiswe chaching'ono*) was seen as less severe because they ate only maize leaves. or cobs from maize that had already been lodged by *Macrotermes*.

Failure to distinguish between termite species may lead to OFTs being wrongly sited. Farmers who report 'termites' in their fields may be referring to non-damaging species. One trial that we inspected (Kawarenga) showed no damage by *Macrotermes* but several holes by *Odontotermes*. *Odontotermes are* relatively harmless. yet this plot had a high share of plant deaths from termites in 1997/98. Unlike *Macrotermes*. *Odontotermes* are mobile and the position of nests varies from year to year.

Frequency of damage

Seven farmers had one or more active termite mounds on their fields. Most mounds had been in existence for as long as farmers could remember and their fields had a history of termite damage. Three farmers reported damage from mounds not located on their own fields. Surprisingly, one farmer (Basikolo) reported no history of termite damage on his fields. Heavy damage (19 % of plants attacked at harvest) occurred on a field that the family rented in 1996/97, but this field has now reverted to the original owner. No damage was recorded in the OFT on the family's fields in 1997/98. This OFT may have been wrongly sited, therefore.

Several farmers said that damage was worse than last year but could not always explain why. Generally, farmers believe that damage is more severe in dry years than in a year when rainfall is normally distributed. One said that damage had been particularly bad in a dry year (1984/85) when termites were visible before banking. Surprisingly, however, most farmers reported worse damage this year than last year, despite heavier rainfall. One farmer believed that damage was less this year because more alates (flying ants) had left the mound. Part of his thinking was that termites left the mound with the alates, at a time when termites had not yet actively started to damage maize. Two farmers (Kamoto and Kusala) believed that damage was *higher* in years when alates left the mound.

Timing of damage

Termites become visible at the start of the rains as alates left the mound. Farmers said that in dry years termite damage is visible before banking whereas in wet years damage only becomes visible when the maize is already drying. Most damage became visible at maize tasselling stage, however, when farmers had already finished banking.

Damage levels

A central feature of IPM is the concept of a damage 'threshold' at which it becomes economic to introduce control measures. We tried asking farmers: 'What level of damage do you think is serious/not serious?' Some could not answer this question. Others said that for them even one lodged plant, or enough cobs to provide one meal, constituted 'serious' damage. Still others went on a general impression of the number of lodged plants. One said he looked for at least 10 plants lodged in a small area. Another said 10 plants did not constitute serious damage but 150 plants did. For some farmers, therefore, the concept of a threshold for termites may be academic. Farmers who see one lodged plant or see termites in the field assume that more damage is imminent and quickly take preventative action before the economic threshold is crossed. They don't wait. Our overall impression, however, was that farmers had no 'rule of thumb' but that their threshold was intuitive.

A contrast is often drawn between scientific knowledge and farmers' knowledge, which is informal, not easily formalised or codified. Farmers are not the only decision-makers who rely primarily on intuition, however. A management specialist watched how five successful chief executives made business decisions (Handy, 1995: 47). In most of the decision processes observed there was no 'diagnosis stage' - chief executives preferred to jump straight to the solution - and most decisions were not based on explicit analysis but on intuition and judgement. Is this so very different from the way farmers make decisions about pest management?

Control strategies

Farmers used a variety of control strategies. Several of these only came to light when we looked in farmers' own fields surrounding the OFT.

1. Keep weeds away from the planting station

The underlying principle is to prevent termites feeding on the roots of the maize plant by ensuring that weeds are not heaped or buried close to the planting station. 'Banking' maize.

where earth is dug from the furrow and deposited on the ridge, smothering weeds beneath a deep layer of soil, provides food for termites and gives them easy access to the maize roots. Avoiding banking maize is therefore seen as an effective control strategy for termites. Similar techniques exist in other areas: for example, the *kaselera* technique developed by farmers in Katuli EPA, Machinga district (Logan *et. al.*, 1993). Where termite damage is severe, as in the Shire Valley, farmers rarely bank their fields at second weeding (Soil Pests Project, 1992: 29).

Farmers sometimes used the same name for different techniques. To ensure that we knew which technique they meant we either visited the field with them to check on the type of weeding given or asked them to demonstrate the technique for us. We found several variants:

Kukwezera

The farmer stands in the furrow and uses a hoe to scrape earth upward towards the ridge while avoiding heaping soil around the base of the maize plants in the planting station. Weeds are either covered lightly with soil or laid in the furrow to dry. Weeds are never laid on top of the ridge. The action is then repeated from the other side of the ridge.

Kupala

The farmer stands in the furrow and uses a hoe to scrape weeds from the side of the ridge, which are then left to dry in the furrow. Weeds are not deposited on the top of the ridge. Soil clear of weeds is heaped close to the planting station to prevent lodging. The action is then repeated from the other side of the ridge.

Kufukulira

Kufukalira represents a clever adaptation of *kukwezera*. Maize is banked as usual but once a maize plant has been lodged by termites soil is scooped out from that planting station to protect the remaining two or three plants. *Kufukalira* avoids the disadvantages associated with *kukwezera* but is reported to be labour-intensive. We found this technique in only one field (Supuwa) and the farmer claimed not to have used it before. A suggestive example of farmer experimentation, illustrating the way in which farmers might adapt an IPM recommendation.

2. Salvage

Collecting cobs

Not all maize lodged by termites is irretrievably lost. Between 60-70 % of farmers in the Blantyre Shire Highlands in 1991/92 saved most of the yield 'lost' to termites by salvaging fallen cobs (Soil Pests Project, 1993: 39). The economic value of salvage depends on the precise timing of termite damage, however. Farmers distinguished four stages in plant growth when termites damaged maize:

- *chili ndimpeni* or *chimanga chikuphatika ana*, when the young pointed cob has just started to form;
- *chili ndimikuta*, when cobs are bigger and grain formation has begun;
- *chimanga chachiwisi*, or green maize; and
- *chimanga chikuuma*, when maize is drying.

Termite damage to maize in the first stage of plant growth is a total loss and damaged plants are left in the furrow. Damage in the second stage is usually a total loss but some farmers reported collecting cobs to feed to goats. Maize attacked by termites at the green maize stage when some grains are edible is salvaged, taken home, and eaten. Maize damaged during drying is brought home, shelled, dried, and milled to prepare *masalanga* or *matindili* (flour made from maize harvested before fully dried). One farmer (Sapanga) said that he had already collected 100 kg of maize from a field in this way and he estimated that he would shortly salvage another 75 kg.

Tying

Some farmers prefer not to collect fallen cobs but to stand lodged plants upright, either by sticking the stalks back in the planting station (*kuzika*) or by tying the leaves to living plants (*kuyumika*). This allows the maize to dry fully before harvesting. This technique is not used for green maize but for maize that is already partly dry. Farmers who did not use this method objected that tied stalks might lodge again if there was more damage or said that they needed the maize to eat.

3. Plant cactus (*nkhadze*)

Cactus (*Euphorbia tirucalli*) is a traditional method of termite control. Cuttings may be planted at the corners of fields, or close to the termite mound, or in parts of the field where termite damage has occurred. Two or three years are required before the plant is sufficiently grown to be effective as a control. According to one farmer (Kusala), after planting cactus the field should not be banked for a few years. Banking may then start again in a section of the field to check for the presence of termites. If no termites are seen, the field may be banked as before. Latex from the plant is toxic to humans and children are warned not to play near it. According to farmers it emits a smell which cannot be detected by humans but which is fatal to termites. Most of the farmers who had planted cactus had not noticed any reduction in damage as a result of this control strategy. A large number had tried it, however.

4. Bank early

One farmer (Magreen) theorised that early banking might reduce termite damage because there would be less weed biomass buried in the soil to support termites. She wanted to experiment with this control strategy next season. Bambo Kamoto also believed that early banking discouraged termites.

5. Wait for rain

One farmer (Kamoto) told us that she stopped banking if saw termites in her field. Rather than switch to *kukwezera* immediately, however, she waited for one or two weeks to observe the rainfall pattern. If she judged the rain was sufficiently heavy, she resumed banking. She believed that hot and dry conditions favoured termite damage since drying weeds produced heat that attracted termites. She followed this strategy in 1997/98.

6. Modify banking

The same farmer (Kamoto) described how in 1996/97 when she observed termites while banking, she and her husband modified their system of banking. Weeds were pulled from around the planting station, placed on the side or top of the ridge, and covered with soil. This kept the planting station clear of buried weeds. The farmer insisted this technique differed from *kukwezera*. With *kukwezera* soil is pulled upward from the side of the ridge, not dug from the furrow, and weeds removed from the ridge, shaken out, and laid down to dry. With this modified form of banking soil is dug from the furrow and heaped on the ridge to bury weeds save for the area immediately surrounding the planting station. This strategy was followed in 1996/97.

6. Destroy the mound

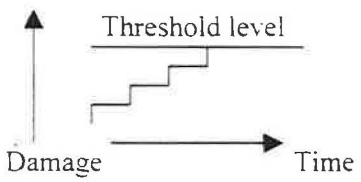
Although killing the termite queen was previously reported as a control strategy for termites, only one farmer with a *Macrotermes* mound in their fields had tried this. They reported finding four 'mother' termites in the mound. Before destroying the mound, maize had been almost totally damaged. One farmer said that local termite 'experts' could pinpoint where to dig to find the queen. Destroying the *Macrotermes* mound may be a strategy of last resort. Two farmers reported digging up mounds of *Odontotermes* that were damaging house walls and killing the termites with Liquid Actellic or Temik.

Farmers' pest management strategies

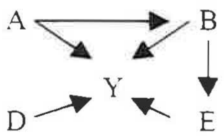
Farmers clearly have a variety of control measures for termites. The way these strategies are used raises interesting questions. If farmers rely more on intuition than analysis in making decisions about pests, then researchers may need to re-think the concept of a pest management strategy. Strategy is a concept that can be understood in several senses. Mintzberg (1988) distinguishes five different definitions of business strategy: *plan, ploy, pattern, position,* or *perspective*.

Researchers see a pest management strategy as a *plan*, something decided in advance, purposive, reached by analysis, and which can be formally documented. Researcher recommendations and most OFTs are examples of strategy-as-a-plan. Farmers' pest management decisions, however, suggest that it is more appropriate to think of strategy-as-a-pattern. Their behaviour is consistent but not necessarily based on a preconceived plan. Applied to pests, we visualise the difference like this:

A. Strategy as a plan



B. Strategy as a pattern



In its simplest form, strategy-as-a-plan assumes that farmers take control measures once a certain threshold level of damage is reached. Farmers were not comfortable with this concept, however. In strategy-as-a-pattern, farmers synthesise information about events (weather, damage levels, weed growth, potential yield) and the relationships between them. Pest management is a sub-strategy that is subordinate to the overall strategic objective of ensuring a good yield (Y). If control measures threaten yield, the best strategy is to do nothing. Strategies may be improvised (*kufukulira*, modified banking). Strategy-as-a-pattern is a performance that varies in response to events.

The concept of strategy-as-a-pattern is illustrated by farmers' use of *kukwezera*. Except in very dry years, termites are not always or even usually visible before farmers finish banking. This means that farmers have to decide - in advance - whether the cost of not banking (lower average yields) will exceed the costs of banking (termite damage). *Kukwezera*, therefore, is based on the concept of strategy-as-a-plan.

Farmers use of *kukwezera*, however, corresponds more to strategy-as-a-pattern. Among the events they have to consider in deciding to use *kukwezera* are:

- the level of termite damage. severe in some years. completely absent in others:
- greater weed biomass if weeds re-germinate. particularly dangerous in seasons of continuous rainfall like this one:
- higher risk that plants will be lodged by wind:
- higher risk of fertiliser leaching since ridges may be too low to channel runoff efficiently:
- greater risk of erosion on hillslope fields:
- lower yield than if the field is banked.

This suggests that pest management recommendations for termites are better presented as a graduated series of management options that take account of particular field conditions. For example. *kukwezera*. is appropriate where termites are visible at banking. and continuous rainfall will not encourage weeds. Improvised control measures (eg. *kufukilira*) may be recommended where severe damage occurs after banking. Salvage is perhaps the most appropriate option where damage is slight. Destroying the mound is an appropriate option where damage is consistently severe. the farmer has access to the mound. and there are no conflicts over rights to harvest alates.

Benefits of termites

Food

Macrotermes mounds produce alates (long-winged nymphs) which fly out to start new colonies. These are called *ngumbe* or *iswa* and are eaten as relish at a time when energy demands for planting and weeding are high. Highly nutritious. their fat. protein. and calorific values compare favourably with those of groundnuts (Logan. 1992). *Ngumbe* fly after one or two days of heavy rain soon after the start of the wet season. To know when they will fly. villagers watch for the lilac-breasted roller. an air-feeder. They may also scrape the mound and see if termites emerge. Villagers trap *ngumbe* by scraping a section of the mound. and digging a hole at the lower end into which they insert a pot. A frame of branches is placed over the scraped portion of the mound and covered with grass. A small window is left in the grass above the pot. Alates are then caught as they emerge from the mound. fly to the window. and fall into the pot.

Rights to catch *ngumbe* are carefully guarded and non-relatives are denied access to the mound. Alates may fly up to three times from the same mound in one season but in some years may not fly at all. One farmer with an active mound (Basikolo) reported filling one or two 50 kg fertiliser bags of *ngumbe* in one season which sold for MK 550 early in the season. Another (Mafaiti) reported filling half a 50 kg bag from one mound. with a total value of 4-500 MK. Alates are sold for 3- 2 MK for one No. 10 plate (approximately 60 grams). falling to 1 MK per plate as supply increases.

Alates of *Odontotermes*. known as *mbeleswa* or *ngawere*, are not eaten.

Larders in the ground

The soil in termite mounds is fertilised by the plant fibre collected by foraging worker termites and its high clay content helps retain moisture. Farmers usually plant pumpkins on termite mounds because the leaves will stay green well into the dry season (July/August) when few other sources of relish are available. Farmers also plant maize on termite mounds or termite-resistant plants like sorghum.

On-farm trials: Plan versus *performance*

The termite OFT compared the farmer-developed control strategy of *kukwezera* against the orthodox weeding technique of *kubandira* or banking. Our objective was to discover what form of weeding farmers had actually used as an alternative to banking. When in doubt about the weeding technique farmers had used, we checked the trial plot and the surrounding field.

Farmer	*Weeding technique*	*Checked OFT?*	*Main field*
Malita Sapuwa	*kukwezera*	Yes	*kukwezera*
Lucy Magreen	*kukwezera*	Yes	*kubandira*
Kasimu Sapanga	-	No	*kubandira*
Mai Jana	*kukhweza*	No	*kubandira*
Mai Kwizombe	*kubandira*	No	*kubandira*
Mai Chikoti	*kukhweza*	Yes	*kusenda*
Bambo Basikolo	*kubandira*	No	*kubandira*
Bambo Kawerenga	*kusenda*	Yes	*kubandira*
Bambo Kamoto	*kukhwezera*	Yes	*kubandira*
Mai Kusala	*kukhwezera*	No	*kubandira* (part)
Mai Mafaiti	-	Yes	*kubandira*

Of 11 farmers who participated in the trial, four reported using *kukwezera* and two reported using *kukhweza*. Both describe similar techniques that avoid placing weeds close to the planting station. Five farmers (45 %) reported using quite different techniques, however.

- Kasimu Sapanga did no second weeding at all. He explained that, waiting for advice on planting from the technical team, he had weeded the OFT plot before planting and this together with first weeding had produced a clean field which did not justify a second weeding.

- Mai Kwizombe did *kubandira* (banking) because the plot was full of weeds – she was late for second weeding – and it was raining continuously. In these circumstances, she was afraid that weeds would re-germinate if she used *kukwezera*. She did not meet the technical team in time to be advised on what to do. By the time she met them she had already banked.

- Bambo Basikolo did *kubandira* (banking) because (as noted above) this field had no previous history of termite damage. He had not visited the plot since banking.

- Bambo Kawerenga did *kusenda*, a form of banking where earth and weeds are scraped up together on top of the ridge, *from one side of the ridge only*. This technique saves time and is usually done when second weeding is late. In this case, the farmer explained that he had used *kusenda* instead of *kukwezera* because heavy rainfall meant that weeds left in the furrow without being buried would have re-germinated. *Kusenda* buries the weeds on one side of the ridge only, leaving one side free of buried weeds to discourage termites.

- Bambo Mafaiti also did no second weeding at all. Unlike Kasimu Sapanga, however, he had not weeded before planting. He decided against kukwezera because there was continuous rainfall, which would have led to the re-germination of weeds. He also felt that kusenda would not have covered the weeds sufficiently to prevent re-germination.

These examples highlight the difference between researchers' plans and farmers' performance. Often when trials do not go as planned we blame farmers for not following orders. We label them as 'uncooperative'. We punish them by dropping them from future trials. We treat them as 'missing data' in our statistical analyses. An alternative response is to try and learn why farmers abandoned the plan. It is clear that all five farmers had good reasons for not doing *kukwezera*. When circumstances changed, it seemed irrational to them to stick blindly to the original plan: it was more rational to adapt to these changes by using a different weeding technique. The researchers' plan then became the farmers' performance, with farmers calculating the best course of action for their particular field. Their decisions show why *kukwezera* may not always be an appropriate control strategy. We can learn from their performance as well as from our plans.

Conclusions

In a farming system with scope for great variation in pest management strategies it is easier to capture diversity by talking to farmers individually rather than in large, heterogeneous groups. Farmer control strategies included: specialised forms of weeding (*kukwezera, kupala*) which keep weeds clear of the maize roots: salvaging by collecting fallen cobs, sticking lodged plants back in the planting station, or tying up lodged plants: planting cactus: and, as a last resort, destroying the termite mound. Unlike strategy-as-a-plan, which is decided ahead of time, farmers' pest management strategies resemble strategy-as-a-pattern, where farmers synthesise events and improvise responses. This may limit the use of *kukwezera* to particular field conditions. Five farmers participating in the OFT did not follow the original plan to do *kukwezera* at second weeding. All of them had valid reasons for acting as they did. Understanding these reasons can teach us more about the potential of *kukwezera* as a control strategy for termites.

References

C. Handy (1995). *Gods of Management*. (London: Arrow).

J. W. M. Logan (1992). 'Termites (*isoptera*): a pest or resource for small farmers in Africa?'. *Tropical Science*. 32 (1): 71-80.

J. W. M. Logan. G. K. C. Nyrendra. and D. C. Munthali (1993). 'The importance of termites as pests of maize in smallholder farms in southern Malawi'. Pp. 270-277 in D. C. Munthali. J. D. T. Kumwenda. and F. Kisyombe (eds.) *Proceedings of the Conference on Agricultural Research*. Club Makakoloa. Mangochi. 7-11 June. Mimeo. 339 pp.

H. Mintzberg (1988). *The Strategy Process – Concepts. Contexts. and Cases*. (Prentice-Hall) quoted in J. I. Moore (1992). *Writers on Strategy and Strategic Management* (Harmondsworth: Penguin).

A. Orr. J. M. Ritchie. J. Lawson-McDowall. C. B. K. Mkandawire. and A. Koloko (1997). Diagnostic surveys in Matapwata and Chiradzulu North EPAs. November. Mimeo.

P. Richards (1989). 'Agriculture as performance'. Pp. 39-43 in R. Chambers. A. Pacey. and L. Thrupp eds. *Farmer First: Farmer innovation and agricultural research*. (London: Intermediate Technology Publications).

Soil Pests Project (1992). The major insect pests. plant diseases and weeds affecting subsistence farmers' crops in the southern region of Malawi. Report No. 2. August. (Zomba: Chancellor College). Mimeo. 169 pp.

Soil Pests Project (1993). Relative importance of different insect pests. plant diseases and weed species affecting farmers' crops in southern Malawi. Report No. 3. October (Zomba: Chancellor College). Mimeo. 309 pp.

Termites

Farmer:_____________________________ Date:________________________________

Identification of termites and seasonality

What types of termite have you found in your fields?

What type of damage is done by these termites to your crops?

Which month do you first see these termites in your fields?

Damage by termites to maize

Which of your fields have had termite damage to maize?

Which years has the damage occurred? (5-year period).

Why does damage vary between years?

What level of damage do you think is serious/not serious?

Control measures

What ways have you used to control termites that damage maize?

Have you tried *kukwezera* before? (Describe what you mean by *kukwezera*).

Is *kukwezera* effective in reducing termite damage?

Are there any problems with *kukwezera*

Benefits of termites

Do you eat or sell flying ants?

Price/plate

What do you plant on termite mounds?

Other information

GAMES FARMERS PLAY: CONTROL STRATEGIES FOR WHITEGRUBS

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29 April 1999.

Summary

*Twenty-six farmers were interviewed to learn about pest management strategies for whitegrubs. The most common strategies were cultural controls: replanting seeds; transplanting seedlings; digging holes around the planting station (*kufukulira*) to deny access to the pest; and timely incorporation of crop residues (*kuwojeka*) to ensure that weeds and crop residues were fully decomposed before planting. Farmers' use of the first three strategies resembled a game, with a fixed set of responses for different levels of whitegrub damage. Most farmers believed these strategies were adequate to control the damage that they experienced. However, farmers with severe whitegrub damage had developed a strategy of seed-dressing maize with Sevin (Carbaryl). This strategy was tested on-farm in 1996/97 and gave poor results. Farmers remain convinced that Sevin is effective, however, and have continued to use it. Assuming Sevin is effective, economic analysis suggests that Sevin is more profitable than replanting where damage is severe (60 % and over). Seed dressing with Sevin has spread slowly because only a minority of farmers experience this level of damage from whitegrubs.*

Introduction

Whitegrubs and termites are the only soil pests that cause major damage to maize in southern Malawi (Nyirenda *et. al.*, 1993). In diagnostic surveys in Blantyre Shire Highlands, whitegrubs were ranked as the first and second most important maize pest at FSIPM sites in Mombezi and Matapwata EPAs, respectively (Orr *et. al.*, 1997). Crop losses from whitegrubs in the FSIPM Project area were reported to be most serious in Mombezi EPA, on the vertisols of the Chitera *dambo.* On-farm trials (OFTs) have also shown that whitegrubs cause losses to maize on upland fields.

Two control methods - seed dressing with Sevin (Carbaryl) and handkilling – were identified during diagnostic surveys. Replanting seed damaged by whitegrubs and removing soil from the planting station were also identified as important strategies during field surveys in 1997 (Mzilahowa, in progress). Information was collected about farmers' use of seed dressing in order to test this strategy in 1996/97 (Orr *et. al.*, 1997; Ritchie, 1997). Results from the OFT showed that seed dressing with Sevin had either no significant effect on maize yields or (at higher dosages) actually reduced yields (Abeyesekera, 1998). Information about other control strategies – handkilling, cultural control, and replanting - is lacking.

This study investigates farmers' control strategies in more detail. The specific objectives are to determine: (1) the circumstances in which different strategies are used; (2) whether farmers have some concept of a economic 'threshold' level of damage; and (3) why farmers continue to dress maize seed with Sevin when the OFT in 1996/97 showed that this strategy was not effective or even harmful.

Methods

We interviewed all nine farmers participating in the 1998/99 OFT. These farmers were purposively selected because whitegrub damage had previously been recorded on their fields. Farmers were shown six enlarged colour photographs of whitegrub damage showing different symptoms of whitegrub damage. They were asked whether they had seen this type of damage before and what caused it. After farmers had answered these questions, we raised the issue of whitegrubs. The rest of the interview focused on control strategies. As a visual aid, we used groups of three or four stones to represent maize planting stations, removing or adding stones to simulate damage by whitegrubs and replanting of seeds or seedlings.

We also interviewed three non-participating farmers - Mai Kaponya from Chiwinja and Mai Beni from Kambuwa (who had reported problems with whitegrubs during the panel survey in January 1999) and Mai Daina Chilinkhonde (Chiwinja).

Finally, we interviewed 14 farmers who were not participants in the this year's whitegrub OFT but who had used Sevin as a seed dressing. We met: Mai Mpoya, Mai E. Chilinkhonde, Mai Misi, Mai Kaponya, Alice Ndale, Bambo Majede, and Bambo Elias (all Chiwinja village), Mai Mkwalula, Mai Lazalo, Mai Chipengule, Mai Bandula, and Rose Mwahala (all Makawa village), and Bambo William and Mai Mahatta (Lidala village).

Interviews lasted between one hour to one hour and a half. Interviews were made between 15 – 29 April 1999. The checklist of questions is provided in Appendix 1.

Identification of whitegrub damage

No.	*Growth stage*	*Damage symptoms*	*Farmers recognising*
1.	Cobbing	Hermaphrodite cob	4/9
2.	Cobbing	Small cob at tassel with no sheath	6/9
3.	Cobbing	Hermaphrodite cob at tassel	6/9
4.	Cobbing	Hermaphrodite cob and curled leaves	8/9
5.	Cobbing	Twin cob, curled leaves	9/9
6.	Early whorl	Deadheart	9/9

Of nine farmers, only four had seen all the damage symptoms shown. Most had seen twin cobs and curled leaves before, and all recognised deadheart. Farmers did not associate the symptoms in photographs 1-5 with whitegrubs but attributed them to seed that had been attacked by weevils, weak pollination, or premature flowering. Curled leaves were attributed to unknown soil diseases. Most farmers identified deadheart (photograph 6) as caused by *mbozi zoyera* or *mphutsi* (Chichewa) or *mbesi* (ChiYao), which were the names given to whitegrub larvae. Mai Marichi remembered that her parents used to call *mbozi zoyera* by the name for *Striga* (*kaufiti*) because they inflicted the same amount of damage. By contrast, damage by whitegrubs in the Chitera *dambo* was not primarily associated with deadheart but with total wilting and death of the plant caused by an adult whitegrub they called *matono*.

Not all farmers could give names for the damage symptoms they were shown. Maize plants with hermaphrodite cobs were called *chimanga cha chimuna* (male cobs) or *mbambika* (ChiYao for parasite); plants with twin cobs were called *chogwera* ; while plants with curled leaves were referred to as *chopunduka, kukundu,* or *chilikhe* (lame). Deadheart was described as *kunyala* (wilting) or *chalowa mphutsi* (*mphutsi* has entered the maize). Plants damaged by *matono* in the Chitera *dambo* were simply described as *kufa* (dead) to reflect total wilting of the plant.

Several farmers (Mai Marichi, Mai Kusala, and Mai Misi) had observed that damage was worse in dry years, particularly if there was a dry spell for one week after planting. Mai Marichi said this was because in wet years whitegrub larvae ate soil while Mai Misi thought that wet soil prevented access by *matono* to the seed.

Identification of whitegrubs

Seven species of whitegrubs have been identified in the Project area (Mzilahowa, in progress). The species found in the Chitera *dambo* has been identified as *Heteronychus licas* (Klug). Adults are black in colour. The six other species are found in upland fields in Mombezi and Matapwata, and in *dambo* fields in Matapwata. They include *Schizonycha fusca* (Brenske), *Schizonycha salaama* (Kolbe), *Schizonycha angustala* (Moser), *Trochalus exasperans* (Peringuey), *Aserica* sp., and *Anomala* sp.

Farmers have already been asked to identify different species of whitegrubs (T. Mzilahowa, in progress). They distinguish between whitegrub larvae and adults. The adult *Heteronychus licas* is known as *matono* and has been found only in the Chitera *dambo* in Mombezi EPA. On upland fields in both Mombezi and Matapwata EPAs farmers attribute damage to the larvae, which they call *mbozi zoyera*, and not to the adult beetle. Adult whitegrubs are not seen in upland fields in Mombezi but are seen in the dry season on upland fields in Matapwata where they are known as *kangawo*.

In farmers' eyes, damage from *Heteronychus licas* (*matono*) and whitegrub larvae (*mbozi zoyera*) are quite distinct. *Matono* damages the seed below ground, resulting in non-emergence or wilting of the maize plant soon after emergence. Damage occurs for the first few weeks after planting and before first weeding. *Mbozi zoyera* also damages the seed below ground, but usually the plant emerges only to wilt and die at the three to four leaf stage of crop growth. Damage is most visible between the start of first weeding and banking. Farmers believe that damage from *mbozi zoyera* stops after banking because the larvae have been killed by heavy rain.

Damage thresholds

In determining thresholds it is important to distinguish between damage from *Heteronychus licas* and other whitegrub species (Table 1). Of the nine OFTs this year, all except Mai Malonda's were located on upland fields where farmers associate whitegrub damage with *mbozi zoyera.* We asked farmers whether damage on their fields was 'serious' and what for them constituted 'serious' damage. Only three of nine farmers regarded the level of whitegrub damage on their plots as 'serious', while one farmer (Bambo Chilewe) reported that his plot had never experienced damage from *mbozi zoyera.* Asked why their field had been included the OFT, Mai Chilewe replied that the technical team had found *matono* in their fields.

Farmers have some concept of what constitutes 'serious' damage. Several specified the number of non-emerged or wilting plants they looked for in judging the severity of damage. These damage levels could not be measured very precisely. Farmers measured damage by the number of ridges or planting stations affected. This is not an economic threshold, however, because farmers automatically replant seeds or transplant seedlings whether or not they regard the damage as serious. Mai Malonda reported damage was serious when 40-50 % of seed did not emerge. This may illustrate the threshold level required before farmers adopt seed dressing as a pest management strategy.

Farmers' control strategies

Farmers reported several control strategies for whitegrubs. Curative strategies included replanting seed (*kupachiza*) and transplanting seedlings (*kuokera*). Preventative strategies included timely *kuwojeka* and dressing seed with Sevin before planting.

Farmers also reported roguing maize seed produced by abnormal cobs. One farmer (Mai Marichi) reported removing hermaphrodite cobs at banking in order not to waste fertiliser on these plants. Others left them to dry in the field until harvest. At harvest they are either left in the field or harvested but separated from normal cobs. They are then shelled together with the small maize cobs (*zikonyo*) which are not stored for seed but sent immediately to the mill and eaten first. However, since farmers do not attribute abnormal cobs to whitegrubs we have not included roguing as a preventative control strategy.

Pest management as a game

'**Game**: A form of contest played according to rules and decided by skill, strength, or luck'. *The Concise Oxford Dictionary.*

Curative control strategies for whitegrubs resemble games in which farmers make fixed moves in response to whitegrub damage. By definition, a game has rules. Farmers' responses or moves can be codified to show how these operate for a given level of damage. The essence of these games is that farmers count dead plants: routinely, carefully, and continuously for the first four weeks after emergence.

(1) The matono *game*

The *matono* game has been an annual fixture in the Chitera *dambo* for many years, but has been discontinued since 1996/97 because of a waterlogged pitch that severely depleted the whitegrub team and has led to two seasons of 'no-shows'.

Fig. 1 shows how the game is normally played. Farmers plant four maize seeds at each planting station. Damage from *matono* is inferred from the number of seeds at each station which do not emerge. With four seeds per station, this gives five possible outcomes (4, 3, 2, 1, 0). If the maize plant fails to emerge one week after planting, farmers dig up the seed to discover the reason for non-emergence. If whitegrubs are found they are killed by hand or with a hoe, and seed is replanted. Seed is not replanted in the original planting hole but adjacent and to one side. This practice stems not from fear of further damage from whitegrubs but because farmers believe that the soil around the original seed has been 'used' and will not produce a strong plant.

An additional strategy that farmers use for *matono* is to scrape the soil from around the planting station to form a *glacis* that prevents access to the seed by the pest. This is usually called *kufukilira*, although one farmer (Mai Misi) described it as *kupala*. *Kufukilira* is used only after the seedling has reached a certain height (roughly six inches) in order to avoid weakening the plant. It is used as a preventative strategy to protect replanted seeds or to protect planting stations with four undamaged plants. This adds a further three outcomes, bringing the total to eight.

Variations in moves

An important variation in the *matono* game is the number of times that farmers are prepared to replant seed. Replanting three times was reported as the maximum feasible number. Assuming plants require one week for emergence, replanting may continue up to three weeks after emergence or four weeks after first planting. However, many farmers believed that replanting three times was impractical because of the risk of shading from the maize that had been planted first. In addition, most farmers would have run out of seed by this time. Replanting twice was considered feasible, after which farmers switched strategies and planted seedlings instead of seeds.

(2) The mbozi zoyera *game*

Although similar to the *matono* game, there are important differences. These include the use of seedlings rather than seeds, and the absence of the cultural control known as *kufukilira*. While seeds may be replanted several times, seedlings are transplanted only once.

As with the *matono* game, farmers plant three or four seeds in each planting station (Fig. 2). Wilted and dying plants become visible about two weeks after emergence. Farmers who have planted four seeds per station will normally uproot one seedling for transplanting. Farmers who have planted three seeds per station will either leave three plants or remove one for transplanting. Planting stations with two healthy seedlings are normally left alone. Planting stations with only one healthy plant may either be left alone or replanted if there are sufficient seedlings. Stations with no healthy plants will normally be replanted with either one or two seedlings. Farmers tried to have at least one healthy plant at each planting station. Seedlings are sometimes planted adjacent to the wilted plant but farmers will also plant them in the original hole from which the wilted plant was removed, since they believe the soil has less work to do now that the seed has already grown. Most farmers transplanted just after first weeding, since it was easy to identify and count dead and wilted plants when weeding. The latest time for transplanting was just as or before the formation of the first node (*mpinde*) or about four weeks after emergence. If seedlings are uprooted carefully without damaging the roots it is possible to transplant five weeks after emergence.

Variations in moves

Wilted plants are uprooted and may be split open to check for the presence of *mbozi zoyera*, which are killed if found. Alternatively, one farmer (Charles Sapanga) buried the uprooted plants to prevent further damage from insects inside

Two farmers (Mai Chilinkhonde and Mai Chipakula) removed wilted parts of plants and waited for them to recover. This strategy was sometimes successful, though unsuccessful if the plant had been damaged below the growing point. Mai Chilinkhonde added that if she observed wilting plants when applying fertiliser she did not apply fertiliser to those plants.

Finally, one farmer (Bambo Tomato) told us that when damage from *mbozi zoyera* reached a certain level it was more practical to replant seeds than transplant seedlings. Farmers in the Chitera *dambo* like Mai Malonda who transplanted seedlings from the upland pointed out that it was difficult to carry enough seedlings to replant a large field.

In both the *matono* and *mbozi zoyera* games, moves are not planned in advance but are determined by variations in the level of damage farmers infer from seed that has failed to emerge or observe from plants that have wilted or died. However, they include an element of foresight and planning. *Kufukilira* is used as a preventive strategy to protect replanted seed. Also, farmers may anticipate a certain level of damage and make provision for this by planting more seeds per station or planting nurseries to provide a supply of seedlings for transplanting. Maize seed left over after the first planting is guarded – children are forbidden to roast them – while nurseries may be established in the furrows of the affected fields, or close to the home. Some farmers, reasoning that the odds of seeds surviving was higher in the upland, planted extra seed in their upland fields to use as replacements for wilted plants in the *dambo*. Some farmers thought seedlings raised in nurseries were not strong and produced less healthy plants than those simply transplanted from other planting stations.

Pest management as a plan

Timely *kuwojeka*

Farmers claim that damage from whitegrubs is reduced when weeds and crop residues from the previous crop season have sufficient time to decompose before maize planting. The practice of incorporating weeds and residues under a shallow soil covering is known as *kuwojeka* (Orr *et. al*., 1998). Farmers normally complete *kuwojeka* before the end of August, which allows approximately three months for residues to decompose before maize planting. Light rains (*chiperoni*) between June-October accelerate the process of decomposition. *Kuwojeka* is not practised in the Chitera *dambo*, however, because the hard clay soils (*makande*) can only be ridged after the start of the first rains. Thus, *kuwojeka* is not a viable strategy for *matono*.

Sevin seed dressing

Dusting maize seed with Sevin (Carbaryl) before planting to protect it from whitegrubs is an example of a 'process need' innovation (Drucker, 1985). Innovations of this type have several distinctive characteristics:

- *They focus on one weak or missing link.* The weak link in maize production in the Chitera *dambo* became apparent in the 1980s when manure from cattle that grazed during the dry season led to a build-up of whitegrubs.

- *A solution can be clearly specified.* Damage occurred to the seed below ground; farmers already used seed dressing (Actellic) to protect stored maize against weevils; and Sevin was readily available both at ADMARC depots and in local markets.

- *High receptivity.* Damage had already reached a high level, to the extent that in 1995/96 the local MP raised the issue in Parliament.

- *They quickly become standard practice.* Within three seasons, the innovation had spread to three villages (Makawa, Chiwinja, and Lidala).

Some experimentation was required before farmers fixed on Sevin and a suitable mode of application. One farmer (Mai Malonda) experimented first with pepper, another (Mai Lazalo) tried an unidentified chemical, while a third (Mai Mkwalula) tried mixing Sevin with Temik (Aldicarb, a Class Ia pesticide). One farmer (Mai Mkwalula) mixed Sevin with water in the field and applied a tablespoon of the solution to each planting station, while another (Mai Kaponya) applied Sevin directly to whitegrubs rather than to the seed. Most farmers now use the same method. They buy Sevin (85 % WP) from ADMARC rather than local markets to avoid adulteration. Mixing is done by hand in the field, without protective gloves. When rains are not continuous the seed is soaked overnight to ensure coating but when rains are continuous the seed is simply splashed with water. After use, the packet is buried in the field.

Farmers described the effects of Sevin as dramatic: large numbers of dead whitegrubs (Mai Chipengule claimed she counted 58 at one planting station), a higher rate of emergence (though some replanting was still necessary); and a much lower rate of wilting. After the second season of applying Sevin farmers generally no longer saw dead whitegrubs.

Table 2 gives details for 10 adopters. Of these, six had used Sevin continuously. In the case of Mai Mkwalula, Sevin had been used for seven seasons. (She was afraid to discontinue the use of Sevin because there was still a large area of uncultivated land in the *dambo* which harboured *matono*). Four farmers who no longer used Sevin had discontinued cultivating *dambo* fields, usually because of the high risk of maize cultivation in this marginal environment. Others with no upland fields, like Mai Malonda, or with their main field in the *dambo*, like Mai Mkwalula, have had no choice but to continue with maize cultivation. The rate of Sevin used was small, averaging one packet (40 g) each season.

On-farm trials with Sevin

Sevin seed dressing was tested in an OFT with 32 *dambo* farmers in the 1996/97 season. Farms were split equally between two sites in Mombezi and Matapwata EPAs. Treatments included a control and two levels of seed dressing (7 and 14 grams of Carbaryl 85 % WP per kg of seed). Plants were sampled six times at fortnightly intervals and dead plants checked for whitegrub damage. Yield data was obtained from 20 farms. Results showed low average yields (391 kg/ha on control plots) but even lower yields for seed dressed plots, averaging 350 kg/ha for one dose and 209 kg/ha for two doses (Abeyesekera, 1998). Based on these results, it was decided not to repeat the trial.

Why did results from the OFT contradict those obtained by farmers? Several reasons may be given:

- The OFT did not measure damage before emergence, which may be as serious as wilting in the Chitera *dambo*. In fact, because of the low level of damage in the OFT, the statistical analysis measured damage not as the number of wilted plants, which gives a measure of severity, but as the "number of plots attacked".

- Flooding at and before first weeding virtually wiped out the whitegrub population in the Chitera *dambo*, where damage had been most severe. Wilting due to whitegrub damage was recorded on eight of 16 plots in this *dambo*, and the maximum damage was 6/20 plants attacked (Mai Malonda's field). Farmers who evaluated the OFT also pointed out that flooding diluted the effect of the chemical, as did soaking the seed overnight (Jere, 1997).

- The OFT ignored the variation in whitegrub damage between *dambo* fields. First, it included dambo fields from Matapwata EPA, where there had been no report of severe damage from whitegrubs. Second, damage from whitegrubs in the Chitera *dambo* was not uniform. Sevin is most likely to have been adopted by farmers who had experienced severe damage. Information is available from the baseline survey for 14 of 16 farmers in Mombezi EPA who participated in the OFT. Of these 14, only four (Mpoya, Mombezi, Malonda, and Tepatepa) had previously used Sevin. This suggests that at least 10 of the farmers with fields in the Chitera *dambo* who participated in the OFT had not previously experienced severe damage from whitegrubs.

- Flooding meant that yield data was obtained from only eight of the 16 trial plots located in the Chitera *dambo*, whereas yield data was obtained from 12 of the 16 plots in Matapwata. This biased the results towards Matapwata, where whitegrub damage was less severe. Moreover, of the yield observations from the Chitera *dambo*, only one came from a field where damage had previously been sufficiently severe for the farmer (Mai Malonda) to have been adopted seed dressing with Sevin.

This analysis highlights the need to understand the *context* of an IPM intervention before designing an OFT. Without this context, the statistical results are of no value or, in this case, may actually be misleading. In retrospect, there was a collective failure – economics, entomology, statistics – to understand the real nature of this technology.

The economics of plans and games

What is the level of whitegrub damage that makes seed dressing with Sevin worthwhile for small farmers? We can answer this question by comparing the relative costs of seed dressing and replanting in the Chitera *dambo*.

The cost of replanting requires information on farmers' seed rates, the cost of seed, and the cost of labour. The recommended seed rate for local maize is 25 kg/ha. This is based on an intra-row spacing of 90 cm, inter-row spacing of 90 cm between planting stations, and three seeds per planting station, giving a population of 37,000 plants/ha (MOALD, 1994). Based on personal observation, however, farmers in the Chitera *dambo* use an intra-row spacing of 60 cm between planting stations, four seeds per station, and an inter-row spacing of 135 cm which allows higher ridges and reduces damage from waterlogging. This gives a plant of 49,000 plants/ha and a seed rate of 30.3 kg. At replanting, however, farmers plant three seeds per planting station and the seed rate is therefore 25 kg/ha.

The ADMARC price of local maize seed in late November was 7.25 MK/kg. The cost of labour was estimated at 15 MK for a working day of six hours. The labour requirement for planting was 30 hours/ha. The OFT in 1996/97 tested seed dressing at rates of 7-14 grams per kg of seed. The cost of Sevin from ADMARC was 13.50 MK per sachet of 40 grams. Thus, the total cost of dressing using farmers' seed rate of was 72-144 MK/ha. All prices are those for November 1999. The labour cost for seed dressing is minimal and was not included.

Figure 3 shows the parametric budget for seed dressing and replanting at various levels of whitegrub damage. Two cost lines are shown, for seed only and for seed plus labour. The regression equations are:

$$Y = 0.2157 + 2.56\ X_1 \quad (1)$$

$$Y = 0.2157 + 1.81\ X_2 \quad (2)$$

Solving these equations to give the breakeven level of damage gives values of 28 % and 56 % when Sevin is applied at a rate of 7 grams/kg, and 40 % and 80 % when Sevin is applied at the rate of 14 grams/kg. Thus, there is no financial advantage to farmers to seed dress maize seed with Sevin when damage is less than 30 %. Usually, the minimum acceptable rate of return for innovations is 100 %, or a 2:1 return. Therefore, damage from whitegrubs would have to reach 60 % or more before farmers would be likely to adopt seed dressing as a pest management strategy.

The analysis suggests seed dressing with Sevin is profitable among farmers in the Chitera *dambo* whose fields have a history of consistent and severe damage from whitegrubs. These farmers were confronted with a level of damage beyond the scope of traditional pest management strategies. Farmers who replanted ran out of seed (Mai Kaponya) or gave up in despair after four replantings (Mai Malonda) while those who transplanted seedlings (Mai Chilinkhonde, Mai Chipengule) ran out of seedlings. Once this threshold was reached, farmers faced the choice of either abandoning their fields or inventing a new strategy. Sevin may well be ineffective on fields where damage is low, but effective in fields where whitegrub damage is so severe that they would otherwise produce nothing. Yields that are low by researchers' standards may still be valuable to small farmers. A yield of 200 kg/ha, for example, will feed one adult for a year.

Diffusion of Sevin seed dressing

Seed dressing with Sevin is a farmer-developed innovation. Although invented in 1992/93, however, this strategy is still used by only a handful of farmers. Why?

Fig. 4 shows the diffusion of Sevin among households in three villages. This is not a complete picture of the diffusion process but is based on information from only 12 households. Also, farmers were reluctant to name others from whom they had first learnt of seed dressing; several claimed to have invented it. Consequently, Fig. 4 only shows links where we have confidence that farmers were being truthful. Despite these limitations, the results suggest that the slow diffusion of this innovation may be explained by three factors:

- Knowledge tends to be shared first with relatives. Adoption seems to have been fastest within family groups. Four groups are identified on the chart. In Makawa, the earliest user of Sevin for seed dressing was Mai Mkwalula in 1992/93. Her husband was a driver who advised her on which chemical to use and the rate to apply. In Chiwinja, the earliest users were Mai Malonda and Mai Kaponya who both used Sevin in 1993/94. Mai Malonda claims to have invented the process independently but may have learnt about it from someone in Makawa. Similarly, Mai Mpoya adopted Sevin in 1994/95 and her daughter Mai Mombezi the following year. In Lidala, Mai Mahatta used Sevin in 1996/97 and shared information with her daughter Mai Kusatha and her mother Mai Nambewe. Information-sharing among relations meant that the news about Sevin spread quickly between different villages.

  Where the incentive to learn was absent, however, the innovation did not spread even between households that were closely related. This is neatly illustrated by the case of Bambo Chilewe, who participated in this year's OFT. We interviewed Bambo Chilewe in the presence of his father, Bambo Elias. When Bambo Chilewe stated that he had never seed dressed maize with Sevin, Bambo Elias volunteered that when he lived in Makawa village he had used Sevin for three seasons. This came as a complete surprise to Bambo Chilewe, who had never discussed the issue with his father. But then Bambo Chilewe does not regard whitegrubs as a serious problem.

  Conversely, where there *was* an incentive to learn about Sevin, the absence of family relationships posed no barrier to communication. For example, Mai Mpoya learnt about Sevin by watching Mai Mkwalula plant strangely coloured seed in her garden. Others learnt by noticing higher yields on their neighbour's field and asking them why. Still others (Mai Misi) sought out early adopters like Mai Malonda to ask for information.

- Adoption of Sevin spread slowly because the need was location-specific. Unlike a high-yielding variety, seed dressing against whitegrubs is not an innovation with universal appeal. Demand remains confined to farmers in certain areas of the Chitera *dambo* where damage is abnormally high. Since these are a minority, seed dressing with Sevin has not been widely adopted. The same is likely to be true for other IPM innovations made in response to high crop losses.

- The pool of potential adopters is shrinking as farmers switch out of maize cultivation in the Chitera *dambo* because of devastating crop losses from floods in 1996/97 and 1998/99. As we saw (Table 2) three households which formerly used Sevin no longer grow maize on their *dambo* fields. Instead they grow sweet potato intercropped with field peas that are planted in March at the end of the rains. Abnormal flooding has resulted from failure to maintain flood control structures installed in the late 1950s.

Conclusion

Most farmers use a mixture of cultural pest management strategies against whitegrubs. Losses can be reduced by using preventative strategies such as timely burying of crop residues (*kuwojeka*) or tillage practices which deny the pest access to the planting station (*kufukulira*). Alternatively, losses can be made good by curative strategies such as replanting seed or transplanting seedlings. These last named strategies resemble 'games' in which farmers react to change as it happens, rather than pre-determined plans based on a predicted level of crop loss. The games identified were against *matono* (*Heteronychus licas*) in the Chitera *dambo*, and against *mbozi zoyera* (whitegrub larvae) in upland fields. These strategies seem reasonably effective for the level of damage experienced by the majority of farmers.

As with termites, it proved difficult to determine whether the concept of an economic threshold held any meaning for farmers. They usually had a clear idea of what constituted 'serious' damage. But curative strategies like replanting or transplanting seedlings were applied routinely, whether or not farmers saw damage as serious. Farmers seem to have employed a threshold concept in adopting seed dressing, however, when confronted with extreme losses for which traditional pest management strategies offered no solution.

A minority of farmers in the Chitera *dambo* has experienced severe damage from whitegrubs. This has resulted in a farmer-developed innovation, seed dressing with Sevin. Although an OFT in 1996/97 found it ineffective, farmers have continued to use this strategy. The mismatch between the results of the OFT and farmers' perceptions may be due to the fact that Sevin was introduced in areas of the Chitera *dambo* where damage from whitegrubs had been particularly severe, leading to total loss of the maize crop. Seed dressing may provide a minimum acceptable yield on such fields that would otherwise produce nothing.

References

S. Abeyasekera (1998). FSIPM 1996-97. On-station and On-farm Experimental Trials. Statistical Analysis Reports. Statistical Services Centre, University of Reading. March.

MOALD (1994). *Guide to Agricultural Production in Malawi.* (Lilongwe: MOALD)

P. F. Drucker (1985). *Innovation and Entrepreneurship.* (London: Heinemann).

P. Jere (1997). Integrating farmer evaluations in Integrated Pest Management research: concepts, experiences and lessons. FSIPM Projet. 29 August. Mimeo, 16 pp.

G. K. C. Nyirendra, D. C. Munthali, and J. W. Logan (1993). 'Relative importance of various soil insect pests of maize (Zea mays) in southern Malawi', Pp. 253-269 In D. C. Munthali, J. D. T. Kumwenda, and F. Kisyombe eds., *Proceedings of the Conference on Agricultural Research for Development*, 7-11 June, Club Makokola, Mangochi, Malawi.

T. Mzilahowa (in progress).

A. Orr, C. S. M. Chanika, and A. Koloko (1998). Farmers' tillage practices in relation to green manuring with *Tephrosia vogelii* and *Crotalaria juncea.* FSIPM Project, 28 September. Mimeo, 18 pp.

A. Orr, J. M. Ritchie, J. Lawson-McDowall, C. B. K. Mkandawire, and A. Koloko (1997). Diagnostic surveys in Matapwata and Chiradzulu North EPAs. November. Mimeo.

J. M. Ritchie (1997). Use of Sevin (Carbaryl) by farmers in Chiwinja village against Black Maize Beetle (Matono). October. Mimeo.

J. M. Ritchie, A. T. Daudi, W. K. Fero, C. B. K. Mkandawire, T. H. Maulana, T. Milanzi and E. Shaba (1997). Farming Systems Integrated Pest Management Project: Interim Progress Report on Pest Management Trials in Intercropped Maize, Pigeonpeas and Beans, 1996/97. Mimeo.

Table 1. Damage levels for whitegrub larvae (*mbozi zoyera*) and adult (*matono*).

No.	*Name*	*Landtype*	*Pest*	*Main symptom*	*Serious damage ?*	*Threshold level*
1	Mai Malonda	*Dambo*	*Matono*	Non-emergence	Yes [a]	Replant seeds immediately if 4-5 stations out of 10 have not germinated
2	Bambo Chilewe	Upland	*None*	None	No	No serious damage on this plot. Never replanted seeds or seedlings
3	Emily Muchera	Upland	*Mbozi zoyera*	Wilting	Yes	Replant seeds if a total of 3 stations have not germinated; expects more damage if this happens
4	Charles Sapanga	Upland	*Mbozi zoyera*	Wilting	No	Transplant seedlings at first weeding. Current damage 1 plant in 10 planting station. Transplanted this year.
5	Daina Chipakula	Upland	*Mbozi zoyera*	Wilting	No	Transplant seedlings at first weeding. Current damage less than 4 plants in area 10 m^2. Ten ridges damaged would be 'serious'. No transplanting this year
6	Mai Kusala	Upland	*Mbozi zoyera*	Wilting	No	Serious damage is loss of 2-3 out of 5 planting stations. 'Not serious' is the loss of one planting station in 5. Replanted only once this year because first planting was late
7	Bambo Tomato	Upland	*Mbozi zoyera*	Non-emergence, Wilting	No	Serious damage if 20 planting stations do not germinate in one field Replants seeds where large number of plants do not germinate, otherwise transplants seedlings
8	Bambo Gomani	Upland	*Mbozi zoyera*	Non-emergence	Yes	Serious damage if only 3 planting stations germinate on a 10 m ridge
9	Mai Marichi	Upland	*Mbozi zoyera*	Non-emergence, Wilting	No	Serious damage where no planting stations germinate on 5 m ridge

[a] before she started seed dressing with Sevin (c. 1993?)

Table 2. Seed dressing with Sevin against whitegrubs, Ciwinja and Makawa villages, Mombezi EPA.

No.	Name	Village	Season adopted	Rate	Continuity of adoption
1	Mai Malonda	Chiwinja	1993/94	One packet (MK 11) for one maize field in 1998/99	Used continuously
2	Mai Kaponya	Chiwinja	1993/94	One packet for one-half pail of seed in 1998/99	Used continuously
3	Mai Mpoya	Chiwinja	1993/94	Two packets (150 g) in two pails of seed (22.5 kg).	Used for three seasons. Stopped cultivating this *dambo* field in 1997/98 after death of husband
4	Mai Mombezi	Chiwinja	1994/95	Three packets (255 g) in seed for 0.2 ha	Used for two seasons. Stopped cultivating maize in *dambo* field in 1997/98 because of flooding.
5	Mai Chilinkhonde	Chiwinja	1996/97	One packet for one basin of seed	Used continuously
6	Mai Misi	Chiwinja	1996/97	Two packets in one winnowing tray	Used for one season. Stopped cultivating maize in dambo field in 1997/98 because of flooding.
7	Mai Mkwalula	Makawa	1992/93	Three packets for approx. 2 ha of maize	Used continuously
8	Mai Bulanda	Makawa	1995/96	One packet for one basin of seed	Used continuously
9	Mai Chipengule	Makawa	1997/98	One third of a bottle (33 g) for 1 ha of maize	Used continuously
10	Bambo Elias	Chiwinja, (formerly Makawa)	1994/95	One packet for one basin of seed	Used for three seasons. Stopped cultivating this *dambo* field in 1997/98 after death of wife

Source: Field interviews, Mombezi EPA, Blantyre Shire Highlands

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Fig. 1.* The *matono* game: *Heteronychus licas* vs. farmers in Chitera *dambo

1. Time: from emergence to first weeding

2. Moves: up to three moves per player

3. To start: plant 4 seeds....

No.	Damage at emergence	Farmer's move	Description of farmer's move
1	O O O O	O O O O	No move. Wait till first weeding.
2	O O O O	O O O O	Do *kufukilira* to protect undamaged plants
3	O O O	O O O	No move, if plants are still small
4	O O O	O O O O ◄	Replant one seed and do *kufukulira* if plants are tall enough
5	O O	O O	No move, if plants are still small
6	OO	O O ◄ O	Replant one seed and do *kufukulira* if plants are tall enough
7	O	O O ◄ O ◄	Replant two seeds
8		O O ◄ O ◄ ◄	Replant three seeds

Source: interviews with 9 OFT farmers, FSIPM Project, Blantyre Shire Highlands RDP.

Notes: = *kufukulira*

◄ = replant seed

***Fig. 2.* The *mbozi zoyera* game: six whitegrub species vs. upland farmers**

1. Time: from two weeks after emergence to banking

2. Moves: one per player

3. To start: plant 3 or 4 seeds....

No.	Damage after two weeks	Farmer's move	Description of farmer's move
1	O O O O	O O O O ►	Wait till first weeding, then uproot one seedling for transplanting.
2	O O O	O O O	No move.
3	O O O	O O ► O	Wait till first weeding, then uproot one seedling for transplanting.
4	O O	O O	No move.
5	O	O O ◄	Replant one seedling at first weeding
6	O	O	No move
7		O ◄ O ◄	Replant two seedlings at first weeding
8		O ◄	Replant one seedling at first weeding

Source: interviews with 9 OFT farmers, FSIPM Project, Blantyre Shire Highlands RDP.

Notes: ► uproot seedling

◄ transplant seedling

Fig. 3. The economics of seed dressing maize with Sevin, Chitera dambo, ***1998/99 season.***

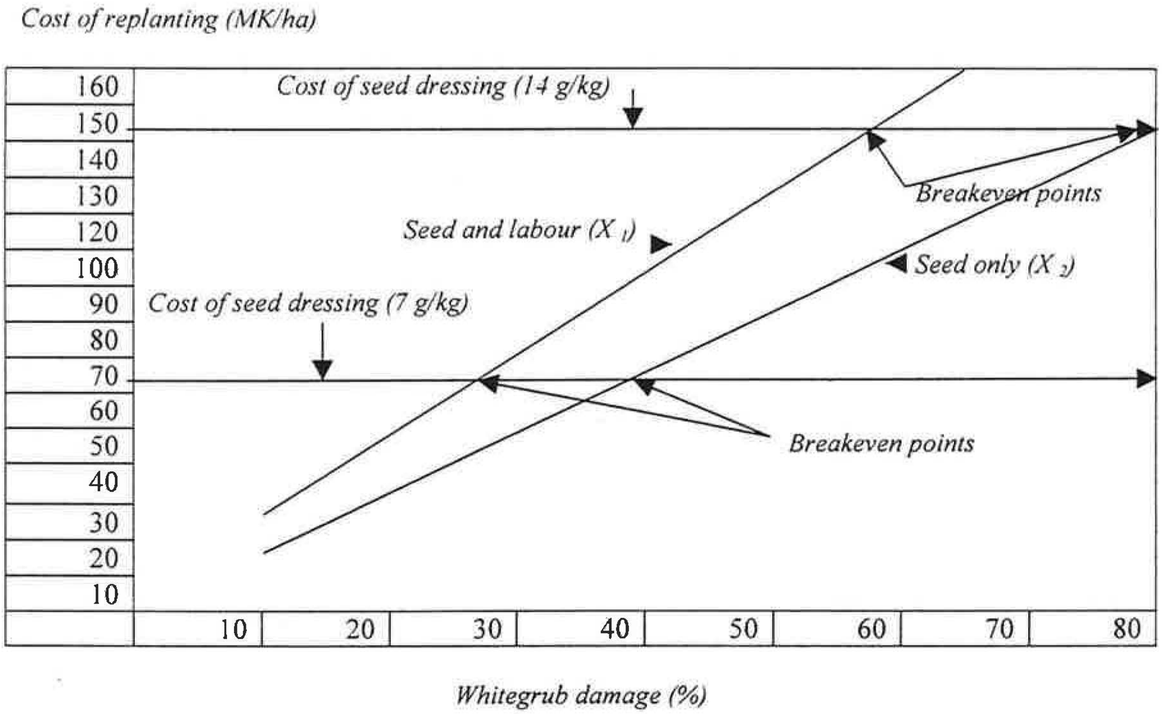

Fig. 4. The diffusion of chemical seed dressing against whitegrubs in the Chitera *dambo*, Mombezi EPA, 1992-1997.

Year/ village	Makawa	Chiwinja	Lidala
1992/93	Mai Mkwalula* [1]	Bambo Majede	
1993/94	Bambo Jusa +	Mai Malonda ^ * [3] Mai Kaponya [3] Mai Mpoya * ^ [2]	
1994/95	Bambo Elias	Mai Mombezi [2] Mai Nankonya +	
1995/96	Mai Bulanda ^ [5] Mai Nambewe [4]		Mai Mahatta [6] → Mai Kusatha + [6]
1996/97	Rose Mwahala ^ [5] Mai Maondo	Mai Misi Mai Chinangwa # Mai Nachuma + Bambo Chilenje	Bambo William # [4] Gogo Nambewe [6]
1997/98	Mai Black Mai Lozalo [1] Mai Falesi [1] Mai Chipengule [3 5]	Alice Ndale Bambo Kainga [3]	Mai Matemba [4]

Source: Field interviews with 12 households in Makawa, Chiwinja, and Lidala villages, Mombezi EPA.

Notes: + deceased/moved away
1, 2, 3, 4, 5, 6 = related
^, *, # = adjacent fields
→ information about seed dressing

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Appendix 1.

WHITEGRUBS CONTROL STRATEGIES

Name:______________________________ Date:________________

Damage symptoms

Do you know what causes this type of damage to maize ?

At which crop stage is the damage most serious?

What do you do with cobs damaged like this?

Identification

What are local names?

1. Larvae
2. Pupae
3. Adults

Damage levels

Which of your fields have had damage from whitegrubs ?

Has damage been continuous in these fields ? (5-year period)

Control strategies

What ways have you used to control whitegrubs damaging maize ?

Which seasons did you use these strategies ?

Have you tried seed dressing before?

Are there any problems with seed dressing ?

Threshold levels

What level of damage is serious/not serious ?

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

Farmers' Cultural Practices and Control of the Sweet Potato Weevil (*Cylas puncticollis*)

Paper Presented at Crop Protection Meeting,
NRC, Lilongwe, 4-9 August 1999

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Abstract

*A sample survey of 60 sweet potato growers in Matapwata and Mombezi EPAs. Blantyre Shire Highlands RDP. was made to determine cultural practices in relation to the sweet potato weevil (*Cylas puncticollis*). Results showed significant scope for reducing crop losses from the weevil by appropriate rotation. timely planting. sanitation of vines. avoidance of adjacent planting. removal of crop residues. and early harvesting. The main constraint on adoption of cultural control is that growers are unaware of the life cycle of the sweet potato weevil. To understand the rationale for improved cultural practices. therefore. farmers will require education in the biology of this pest. Economic analysis showed no benefit from sealing cracks in sweet potato ridges (hilling up) when this was done more than six weeks after planting.*

1.0 Introduction

Smallholder farming systems in Malawi are based on maize (*Zea mays*) which accounts for over 80 % of calories consumed. Following the collapse of the smallholder credit system and increasing real cost of fertiliser, however, root crops have become more competitive with unfertilised maize. National statistics over the past five years show a nine-fold increase in production of sweet potato (*Impomea batatas*). The crop is grown throughout the country both for cash and for food.

Evidence suggests that crop losses from sweet potato weevil are a major production constraint. The sweet potato weevil known to occur in Malawi is *Cylas puncticollis*, (Commonwealth Bureau 1970). Tubers damaged by weevils are usually bitter because of the substances secreted by the insect and are not marketable or, if marketed, fetch very low prices. The development of sweet potato varieties that are resistant to this pest has so far had only limited success. A more promising IPM approach is to encourage adoption of cultural practices that prevent build-up of the pest, and reduce damage to economically acceptable levels. However, no detailed studies exist that document and assess Malawian farmers' cultural practices in sweet potato production and their effectiveness in controlling *Cylas weevil*. The extent to which farmers already use these practices or not, and the reasons for not using them, are also not known.

2.0 Objectives and hypotheses

The general objective of this study was to determine the scope for reducing losses from the sweet potato weevil by improvement in farmers' cultural practices. The specific objectives were to determine:

- Farmers' existing cultivation practices for sweet potato;
- Constraints on adoption of improved practices; and
- The costs and benefits of hilling up as a strategy against *Cylas puncticollis*.

Hypotheses

It was hypothesised that:

- Farmers' cultural practices encourage build-up of the sweet potato weevil;

- There are socio-economic constraints on adoption of improved cultural practices; and
- Hilling-up sweet potato ridges increases the benefit-cost ratio of sweet potato production.

3.0 Cultural practices for sweet potato weevil

Cultural control (defined as management practices that make the environment less favourable to pest reproduction, dispersal and/or survival) is an important component of IPM. Some of these practices are so common among farmers that they are not always recognised as techniques of cultural control against sweet potato weevil. They include:

- *Rotation and timely of planting.* Growing sweet potato continuously in the same field increases the build up of *Cylas* weevil as does the late planting (Pardales *et al.*, 1987).
- *Hilling up.* Covering the base of sweet potato plants with soil creates a mechanical barrier that renders the tubers inaccessible to weevils. Field experiments have shown that plants which were not hilled-up incurred significantly more weevil-damaged tubers compared to those that were hilled-up, regardless of frequency (Pardales *et al.*, 1987).
- *Use of clean planting material.* Sweet potato weevil may infest a newly planted field by being introduced with planting material. The probability of finding weevils inside the stems decreases in younger (tip) cuttings (AVRDC, 1991).
- *Destruction of sweet potato debris.* The destruction of crop residues left in the field after harvest is important since the insect may survive in roots or stems and infest succeeding or neighbouring sweet potato crop.
- *Avoidance of adjacent planting and alternate hosts.* Planting successive crops of sweet potato in closely adjacent fields encourages build up of the weevil, as does cultivation of alternate hosts such as ground beans.
- *Early harvesting.* Late harvesting increases damage from rodents or weevils. Moyo (1999) reported that the optimal time for harvesting sweet potato was 5 months after planting in the case of Kenya and Semsa and 4 months after planting for Tainon.

Smallholders face various constraints in adopting some of these cultural control strategies. These include:

- *Socio-economic factors.* Sweet potato may be grown as a secondary subsistence crop to which farmers devote little effort in increasing yield (Swindale, 1991). In such circumstances, farmers attach little importance to improved cultural practices since they believe that they can manage without them (Fielding *et.al.*, 1995).
- *Economic factors.* Although cultural control strategies may be technically sound, farmers may have insufficient labour or land to adopt them. Labour-intensive strategies may have a high opportunity cost, and there may be insufficient cash to hire labour. Some smallholders may have insufficient land to adopt rotation. Farmers may be unwilling to harvest early if there is no market for the crop or if prices are low at this time.
- *Lack of knowledge.* On-farm research in Malawi and elsewhere has shown gaps in farmers' knowledge of pest biology. Such knowledge is obviously necessary if farmers are to understand why control is possible and how the measures will work (Sherrington and Martin 1996).

4.0 Data and methods

Blantyre Shire Highlands RDP is one of the most important growing area for sweet potato in Blantyre ADD. Annual sweet potato production in the RDP accounted for over 30% of the total production in the ADD in the past five years. Two EPAs (Matapwata and Mombezi) were chosen for this study. Matapwata EPA is notable for a longer rainy season (900 – 1200 mm) and growing season (195-240 days). Commercial production of sweet potato is high. Mombezi EPA has a notably rugged topography with an annual rainfall of between 900 –1200 mm and slightly a short growing season of 135 – 165 days. Most of the sweet potato in this EPA is grown for food.

Sample survey

A list of about 120 sweet potato growers was made from which 60 were randomly selected for survey, with 30 chosen from each EPA. Data was collected through a structured questionnaire administered in six villages (Pindani, Gumbi, Muhura, and Chimwanga in Matapwata EPA and Chiwinja and Lidala in Mombezi EPA). The survey was administered in May 1999.

Economic evaluation of hilling up

A cost-benefit analysis was made for hilling-up as a cultural strategy against sweet potato weevil. The FSIPM Project tested the effectiveness of this strategy in two EPAs during the 1998-99 season (Ritchie, ed. 1999). The trial design required a total of up to three additional crack sealings. The timing of hilling up was determined in consultation with farmers. Planned treatment structure and actual timing for carrying out additional crack sealing are presented in Table 1. Data on labour requirements, wages, and sweet potato prices were collected separately for each EPA.

5.0 Results

General Characteristics of the Farming Households

Table 2 shows that 30% of the sample farmers were female-headed households (FHHs). Mombezi had a higher proportion of FHHs (40%) than Matapwata (20%). Most of the respondents were married. Only about 30 % of the respondents in Mombezi EPA were not married, either because of separation or divorce or they were widowed. In Matapwata only 12 % of the respondents were not married.

About 37 % of the farmers in Matapwata had on average three gardens while in Mombezi 43 % of farmers had four gardens. Only 13 % of the farmers in Matapwata and 10% in Mombezi did not use all their gardens. The reasons for not using them were mainly due to sickness, labour shortage, renting out and fallow to restore fertility. In terms of land tenure, most farmers (73 %) in Matapwata and 77 % in Mombezi owned the gardens. Only about 27 % of the farmers in Matapwata and 23 % in Mombezi also rented some of the gardens they used this season.

The majority of farmers in Matapwata (77 %) and Mombezi (80 %) have been growing sweet potato for more than a decade.

Farmers Cultural Control Practices

5.1 *Planting material and their source.*

Table 3 shows that most farmers (33 %) in Matapwata use either terminal cuttings only or terminal cuttings plus the middle part of the vine. Only 23 % used the middle part only. In contrast, most farmers in Mombezi used terminal cuttings and middle part of the vine (40%) and 30% of them used either the middle part only or terminal cutting only. Most farmers, 40% in

Matapwata and 47 % in Mombezi, used vines from their own field plus gifts from other farmers. Only 17 % of the farmers in Matapwata and 23 % in Mombezi used vines solely from their own field.

5.2 Planting time and crop intensity

The majority of farmers in both EPAs (80 %) grow more than one crop of sweet potato a year. Of these farmers, about 47 % in Matapwata grow three crops of sweet potatoes a year and 30% grow two crops. In Mombezi, 63 % of the farmers grow two crops and 17 % grow three crops. In both EPAs, farmers started planting sweet potato from November. In Matapwata, sweet potato was mostly planted in February (24 % of plantings) and April (25%), while in Mombezi, peak sweet potato growing periods were in January (20 %) and February (32 %). About 20 % of the sweet potato grown in Mombezi was planted in April.

5.3 Distance between plots

In one garden or field, about 30% of farmers in Matapwata and 27% of farmers in Mombezi reported to have sweet potato plots of different ages at close distances, while 53 % of the farmers reported not have planted sweet potato at different times in adjacent fields. About 17 % of the farmers in Matapwata and 20% in Mombezi had only one crop of sweet potato and, therefore, the question of adjacent planting was not relevant.

5.4 Rotation

In 60% of the cases in Matapwata and 43 % in Mombezi, maize was reported to be the previous crop grown before planting sweet potato. Fallow was largely reported in Mombezi EPA (47 %) compared to only 17 % in Matapwata. Only 7 % of the cases in both Mombezi and Matapwata mentioned sweet potato as the previous crop. Only a few cases reported other crops like groundnuts, ground beans, pigeon peas, and tobacco.

5.5 Weed management

The majority of farmers (67 %) in Mombezi weeded their sweet potatoes once, compared to only 30% in Matapwata. One-third of the farmers in Matapwata also indicated that they do both first weeding and second weeding (*kukwezera*) or hill up in their sweet potato fields. Another 33 % of the farmers in Matapwata just hill up as part of weed management. Overall, most farmers In Matapwata (66 %) practised hilling-up as a weed management technique.

5.6 Time of harvesting

In 50% of the plantings in Matapwata, sweet potato is harvested five months after planting while in Mombezi, the same period was reported in 48 % of plantings. A good proportion of the sweet potato (24 % in Matapwata and 29 % in Mombezi) is harvested four months after planting. In about 19 % of the plantings in Matapwata and 17 % in Mombezi, sweet potato is harvested 6 months after planting.

5.7 Residue management

Most farmers (30 % in Matapwata and 44 % in Mombezi) indicated leaving sweet potato residues in the field after harvest. Tubers with primary damage are usually taken home for food, in almost 33 % and 38 % of the cases in Matapwata and Mombezi, respectively. Only 24 % of the respondents in Matapwata reported that they use sweet potato residues as animal feed compared to 12 % in Mombezi. Fewer than 10 % of farmers reported burning sweet potato residues. Only 3 % of the farmers in Matapwata reported that they bury residues in the field.

5.8 *Removal of debris, sanitation, and selection of clean planting material*

Most farmers (73 % in Matapwata and 83 % in Mombezi) planted clean sweet potato vines. But only about 35 % of the farmers in Matapwata and 37 % of the farmers in Mombezi clean up the field after harvest. Only 10 % of farmers in Matapwata indicated that they sanitised vines with ash before planting to prevent diseases. No farmer reported any form of vine sanitation in Mombezi.

Constraints to adoption of cultural practices

Farmers did not practice cultural controls because they were not aware that they help reduce weevil population and infestation. About 86 % of farmers in Matapwata said this for not using clean plant material; 80% for not practising rotation; 50% for not cleaning up the field after harvest and 54 % for not sealing cracks. Similarly, 80% of farmers in Mombezi did not follow these practices because they were not aware of the benefits of reducing weevil infestation in their sweet potato field so they did not see any need to clean up the field after harvesting their sweet potatoes.

Shortage of labour for not practising field clean up was only reported in 31 % of the cases in Mombezi. Other reasons for not cleaning up the field were to restore soil fertility and keep residues as animal feed (13 % and 17 % cases for both Matapwata and Mombezi). Farmers in Mombezi (13 %) also said they do not clean up the field to keep seed for next growing season. Only one farmer in Matapwata and three in Mombezi said they did not practice crop rotation in sweet potato production because of shortage of land. Four farmers did not find hilling up necessary because they satisfy their food and income expectations from sweet potato cultivation with just one weeding.

Economic evaluation of hilling up

The economic evaluation is presented for Mombezi EPA, where farmers did not give sweet potato a second weeding.

Crack sealing had a negative effect yield of sweet potato in the upland but a positive effect in the dambo. Total average yield (clean + damaged tubers) and yield of undamaged tubers decreased with crack sealing while percentage crop losses due to *Cylas* increased with crack sealing. In the dambo, crack sealing had a positive effect on yield of sweet potato but negatively effected yield of field peas, a normal intercrop in dambo sweet potato fields. Total average yield (clean + damaged tubers) and yield of undamaged tubers increased with crack sealing but percentage crop losses due to *Cylas* increased with crack sealing. However, the results between the three crack sealing treatments and the farmer practice and across the three treatments were not significantly different ($p=0.05$), both in the upland and dambo.

The budget analyses showed that crack sealing was generally not beneficial to the farmer when done more than seven weeks after planting. Net benefits were higher under existing farmer practices in both upland and dambo.

6.0 Discussion

Scope for cultural control

Farmers' management practices in sweet potato cultivation show that scope exists for cultural control of the sweet potato weevil. Very few farmers used the tips of vines as planting material. Extension message may need to emphasis not only on choice of clean planting material but also the parts of vines that farmers grow. Furthermore, most farmers still plant sweet potato during the dry months of April-May, when damage from weevils is most severe. Farmers' tendency to leave damaged tubers and vines in the field without removing them also facilitates the build up of *Cylas* weevil. Other cultural practices that favoured pest build-up included rotating sweet potato with ground bean (an alternate host) and not cleaning the field after harvest. About one third of the farmers in the sample area reported to have sweet potato plots of different ages, very often at close distances. Research is required to establish the minimum distance for different plantings under smallholder conditions in various agro-ecological zones.

Because the means of dispersal and infestation of the sweet potato weevil are so diverse, successful cultural control requires a holistic approach. Reliance on one form of cultural control, such as hilling up, is unlikely to be successful if other important management practices that reduce build up of the weevil are ignored. Key cultural practices on which efforts should focus include cleaning up the field after sweet potato harvest, avoidance of rotating sweet potatoes with crops that are alternate hosts for *Cylas*, sanitation, and harvesting sweet potatoes at the right time.

Constraints to adoption of cultural control

Although most farmers in the sample were experienced sweet potato growers, they had no conscious strategy for controlling *Cylas* weevil despite having lived for so long with this pest. The majority of farmers (70%) said they that did not know any control practice for *Cylas*. There was a clear knowledge gap about the behaviour and life cycle of the pest, the knowledge that is necessary for farmers to recognise why control is possible and how it could be done. Consequently, some cultural practices that farmers followed were conducive to *Cylas* weevil build up. Those farmers who used cultural practices that reduced potential weevil damage did so for reasons other than pest management.

Economic evaluation of hilling up

The results of the OFT for hilling up showed no economic advantages over existing farmer practice. Two reasons may be suggested. First, both areas experienced a relatively high amount of rainfall during the past season. Weevil damage is generally low in wet years. Second and most important, cracks were sealed during the period when there is a high potential risk of damage to tuber yield. Sweet potato experiences active tuber enlargement from six weeks after planting until about the sixteenth week after planting (Bouwkamp, 1983). Injury to tubers from hilling up during this period would impair tuber development and reduce final yields. As noted, the first hilling up in the FSIPM OFT was made seven weeks after planting and continued up to 11 weeks in the upland and 12 weeks in the dambo. Previous work has shown that, while two hillings-up at four and six weeks after planting increased yields, hilling up after six weeks did not further reduce weevil damage but instead tended to reduce yields (Pardales *et. al.*, 1987).

Where sweet potato production is more commercialised, as in Matapwata EPA, farmers already give two weedings, at three and seven weeks after planting, respectively. In Mombezi EPA, however, farmers generally give only one weeding for sweet potato, at three weeks after planting. Therefore, the proposal to hill up five or six weeks after planting as planned by the OFT (Table 1) might reasonably have been expected to increase yields. In fact, the first hilling up was done seven weeks after planting. Yields did increase, but only in the dambo where they rose from 2.2 mt/ha to 3.4 mt/ha. There was no yield increase in the upland where yields fell slightly from 5.4 mt/ha to 5.3 mt/ha. Yield gains in the dambo might also have come from reduced weed competition, a significant constraint on sweet potato production in that zone.

7.0 Conclusions

Scope exists to reduce losses from sweet potato weevil through cultural control. Key management practices that require research and extension effort are cleaning up the field after sweet potato harvest. avoidance of rotating sweet potatoes with crops that are alternate hosts for *Cylas*. sanitation. harvesting sweet potato at the right time and hilling up. A holistic approach. which combines various forms of cultural control. is likely to prove more effective than reliance on a single control method. such as hilling up. Socio-economic factors such as shortage of land and labour do not appear to be important constraints to the adoption of improved management practices. The main constraint is farmers' knowledge of the sweet potato weevil. Before instructing farmers on cultural control. they need to understand the rationale for such controls. Most farmers have no knowledge of the life cycle of *Cylas* weevil and its means of dispersal and infestation. Empowering farmers through training is therefore an essential first step in any IPM programme of cultural control.

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Table 1: Treatment structure and timing for crack sealing

Area	Matapwata		Mombezi- Upland		Mombezi- Dambo	
Treatment	**Planned dates of operation**	**Actual dates of operation**	**Planned dates of operation**	**Actual dates of operation**	**Planned dates of operation**	**Actual dates of operation**
Median planting dates	**2^{nd} February**	**2^{nd} February**	**27^{th} January**	**27^{th} January**	**4^{th} March**	**4^{th} March**
Farmer Practice- 1^{st} weeding	3 weeks after planting	3 weeks after planting	3 weeks after planting		3 weeks after planting	
Farmer Practice- 2^{nd} weeding	7 weeks after planting	7 weeks after planting	-	-	-	-
1^{st} additional crack sealing	10 weeks after planting	10 weeks after planting	5 weeks after planting	7 weeks after planting	6 weeks after planting	7 weeks after planting
2^{nd} additional crack sealing	13 weeks after planting	13 weeks after planting	7 weeks after planting	9 weeks after planting	8 weeks after planting	9 weeks after planting
3^{rd} additional crack sealing	15 weeks after planting	15 weeks after planting	9 weeks after planting	11 weeks after planting	10 weeks after planting	12 weeks after planting

Table 2: General Characteristics of the Farming Households

Household Characteristics	Matapwata		Mombezi	
	N	%	N	%
Household head				
Male	24	80	18	60
Female	6	20	12	40
Marital status				
Married	26	86.7	20	66.7
Wife of polygamist	-	-	1	3.3
Widowed	2	6.7	1	3.3
Divorced	2	6.7	4	13.3
Separated	-	-	4	13.3
No. of gardens held				
One	3	10	1	3.3
Two	8	26.7	5	16.7
Three	11	36.7	11	36.7
More than three	8	26.7	13	43.3
Used all gardens this season				
Yes	26	86.7	27	90
No	4	13.3	3	10
Reasons for not using all gardens				
Sickness	1	25		
Labour shortage	-	-	2	66.67
Rented out	2	50	1	50
To restore fertility	1	25		
Land tenure				
Own	22	73.3	23	76.7
Own plus rented	8	26.7	7	23.3

No. of years since farmer has been growing sweet potato	Matapwata		Mombezi	
	N	%	N	%
1- 5 years	3	10	5	16.7
6-10 years	4	13.3	1	3.3
More than ten years	23	76.7	24	80
	30	100	30	100

Table 3: Farmers Cultural Control Practices

Part(s) of sweet potato that farmers plant	Matapwata		Mombezi	
	N	%	N	%
Middle part only	7	23.3	9	30
Terminal cuttings and middle part	10	33.3	12	40
The whole vine	2	6.7	-	-
No terminal cuttings used	1	3.3	-	-
Terminal cutting only	10	33.3	9	30
	30	99.9	30	100
Sources of sweet Potato planting Material	**Matapwata**		**Mombezi**	
	N	%	N	%
Own seedling from field	5	16.7	7	23.3
Gift	6	20	7	23.3
Purchased	3	10	1	3.3
Own seedling plus gift	12	40	14	46.7
Own seedling plus purchase	1	3.3	1	3.3
Gift plus purchase	3	10	-	-
	30	100	30	99.9
Planting time and crop Intensity No. of sweet potato Crops per year	**Matapwata**		**Mombezi**	
	N	%	N	%
One crop	6	20	6	20
Two crops	9	30	19	63.3
Three crops	14	46.7	5	16.7
Four Crops	1	3.3	-	-
Months when farmers Plant sweet potato	**Matapwata**		**Mombezi**	
	N	%	N	%
November	1	1.38	1	1.6
December	9	12.5	5	8.47
January	10	13.88	12	20.33
February	17	23.61	19	32.20
March	13	18.06	8	13.56
April	18	25	12	20.33
May	4	5.6	2	3.39
Total	72	100	59	100

Table 3. Conti.

Plant successive crop Adjacent to each other	Matapwata		Mombezi	
	N	%	N	%
No adjacent planting	16	53.3	16	53.3
Not Applicable	5	16.7	6	20
Yes, adjacent planting	9	30	8	26.6
	30	100	30	99.9
Rotation				
Previous crop in sweet potato field	**Matapwata**		**Mombezi**	
	N	%	N	%
Sweet potato	2	6.7	2	6.7
Maize	16	60	13	43.3
Fallow	7	16.7	14	46.7
Groundnuts	1	3.3		
Ground beans	2	6.7		
Pigeon peas	2	6.7		
Tobacco	-	-	1	3.3
	30	100.1	30	100
Farmers weed management practice in sweet potato field	Matapwata		Mombezi	
	N	%	N	%
Kupalira only	9	30	20	66.7
Hill up only	10	33.3	4	13.3
Kupalira plus hill up	10	33.3	6	20
Kupalira plus hand weeding	1	3.3	-	-
	30	99.9	30	100
Total time before farmers start harvesting sweet potato	**Matapwata**		**Mombezi**	
	N	%	N	%
3 months	4	5.6	4	6.78
4 months	17	23.6	17	28.81
5 months	34	50.0	28	47.46
6 months	13	19.4	10	16.95
7 months	-	-	-	-
8 months	1	1.4		
	72	100	59	100

Table 3. Conti.

What farmers do with Debris of sweet potato	**Matapwata**		**Mombezi**	
	N	%	N	%
All left in the same field	10	30.30	15	44.2
Feed to livestock	8	24.24	4	11.76
Burning	3	9.09	2	5.88
Bury them in the field	1	3.03	-	-
Tubers of primary damage are taken home for food	11	33.33	13	38.23
	33	99.99	34	100.07
Other farmer cultural Practices	Matapwata		Mombezi	
	N	%	N	%
Use clean cuttings to plant	22	73.33	25	83.33
Sanitise vines	3	10	-	-
Clean up the field	12	36.36	11	33.33

Table 4: FSIPM Project Sweet Potato Crack Sealing Trial 1999- Mombezi EPA

(a) Zone: Upland

	Treatment		Net plot Stand count	No. of Clean tubers	Total weight clean tubers (kg)	No. damaged Tubers	Total weight (kg)	Total yield (kg)	Percentage of yield damaged
0	No sealing	Mean	54.40	117.58	8.24	21.58	2.29	10.53	21.75
		STD	8.95	56.06	4.72	15.16	1.70		
1	One sealing	Mean	56.92	106.58	6.69	34.33	3.60	10.29	34.99
		STD	5.65	43.13	2.55	29.03	3.48		
2	Two Sealings	Mean	55.58	87.50	6.66	32.58	3.53	10.19	34.64
		STD	8.61	24.39	2.62	13.12	1.77		
3	Three Sealing	Mean	56.50	93.25	6.64	34.50	2.91	9.55	30.47
		STD	4.93	37.04	2.56	19.67	1.57		

(b) Zone: Dambo

	Treatment		Net plot Stand count	No. of Clean tubers	Total weight clean tubers (kg)	No. damaged Tubers	Total weight (kg)	Total yield (kg)	Field peas yield per net plot (gm)	Percentage of yield damaged
0	No sealing	Mean	49.67	77.83	2.73	33.08	1.51	4.24	875	35.61
		STD	7.55	44.71	2.02	25.14	1.39		0.34	
1	One sealing	Mean	50.58	66.58	3.55	50.75	3.07	6.62	635	46.37
		STD	8.82	38.51	3.03	44.95	2.27		0.18	
2	Two Sealings	Mean	50.33	72.25	4.14	40.00	2.22	6.36	865	34.91
		STD	6.11	40.87	3.38	30.77	1.33		0.66	
3	Three Sealing	Mean	52.33	70.91	4.02	42.33	2.65	6.67	620	39.73
		STD	7.12	38.70	2.87	34.08	2.45	-	0.24	-

Table 5: Cost Benefit Analysis for Crack Sealing- Upland Farmers, Mombezi EPA

Item	Treatment			
	Farmer Practice	One Crack Sealing	Two Crack Sealing	Three Crack Sealing
Outputs				
Total Average sweet potato yield(kg/ha)	5417	5298	5237	4913
% Crop Losses due to weevil	22	35	34	30
Total Average sweet potato yield- clean tubers (kg/ha)	4240	3441	3426	3416
Unit price[1] (MK/kg)	3	3	3	3
Total Gross Benefits (unit price* clean yield)	**12720**	**10323**	**10278**	**10248**
Inputs (Labour[2]- man-hrs/ha				
Land Preparation	210	210	210	210
Planting	141	141	141	141
Farmers' cultural practice	145	145	145	145
One Crack Sealing	0	149	149	149
Two Crack sealing	0	0	124	124
Three Crack Sealing	0	0	0	109
Harvesting	220	220	220	220
Total Labour input (man-hrs/ha	716	865	989	1098
Wage rate[3] (MK/hr)	4.85	4.85	4.85	4.85
Total Labour Cost	**3472.6**	**4195.25**	**4796.65**	**5325.3**
Total Net Field Benefits	**9247.4**	**6127.75**	**5481.35**	**4922.7**

[1] Unit price is price that prevailed during the survey period. Price for main crop sweet potato
[2] Labour for land preparation. planting. farmers' cultural practice and harvest were obtained from secondary sources but additional crack sealing was timed during actual operation in the OFT plots
[3] Wage rate is calculated based on Government rate of K 33.99/day payment for labourers working from 7.00 a.m. to 2.00 p.m.

Table 6: **Cost Benefit Analysis for Crack Sealing- Dambo Farmers, Mombezi EPA**

Item	Treatment			
	Farmer Practice	One Crack Sealing	Two Crack Sealing	Three Crack Sealing
Outputs				
Total Average sweet potato yield(kg/ha)	2181	3405	3272	3431
% crop losses due to weevil	36	46	35	40
Total Average sweet potato yield- clean tubers (kg/ha)	1404	1826	2130	2068
Unit price (MK/kg)	3	3	3	3
Total sweet potato benefits	**4212**	**5478**	**6390**	**6204**
Total Average Field peas yield (kg/ha)	450.1	318.93	444.96	326.65
Unit price (K 5/ # plate > K 144/kg)	72	72	72	72
Total field peas benefits	**32407.20**	**22962.96**	**32037.12**	**23518.80**
Total Gross Benefits	**36619.20**	**28440.96**	**38427.12**	**29722.80**
Inputs (Labour- man-hrs/ha				
Land Preparation	210	210	210	210
Planting	141	141	141	141
Farmers' cultural practice	145	145	145	145
One Crack Sealing	0	218	218	218
Two Crack sealing	0	0	167	167
Three Crack Sealing	0	0	0	126
Harvesting	220	220	220	220
Total Labour input (man-hrs/ha	**716**	**934**	**1101**	**1227**
Wage rate (MK/hr)	4.85	4.85	4.85	4.85
Total Labour Cost	**3472.6**	**4529.9**	**5339.85**	**5950.95**
Total Net Field Benefits	33146.60	23911.06	33087.27	23771.85

References

Asian Vegetable Research and Development Centre (AVRDC) (1991). Annual Review 1990. Crop: Sweet Potato. Discipline: Entomology (Shanhua, Republic of China: AVRDC), 16 Pp.

Bouwkamp, J.C. (1983). Growth and partitioning in Sweet Potatoes. Annals of Tropical Research, 5, 53-60

Fielding W.J., and Van Crowder L. Jr. (1995). Sweet Potato Weevils in Jamaica: Acceptable Pests?

Moyo, C. C. (1999). Sarmet Phase I Term Report for Malawi. Root and Tuber Crops.

Pardales, J.R. *et. al.* (1987). An Agronomic Approach Tot The Control Sweet Potato Weevil (*Cylas Formicarius Elegantulus* F.). Tropical Pest Management, 33(1), 32-34.

Ritchie ed. (1999). On-Farm Trials of Soil Crack-Sealing against Sweet Potato Weevil 1999 Season

Sherrington, J. And Martin, A. (1986). Participatory Research Methods: Implementation, Effectiveness and Institutional Linkages. Paper For the Socio-economic Methodologies Workshop, 29-30 April.

Swindale, A. (1991). Rapid Rural Appraisal Of Sweet Potato In Jamaica, Farmer Interviews, January 25-29. International Potato Centre (CIP), Santo Domingo, Domican Republic, Unpublished, 19pp.

Lawson-McDowall
16.02.2000

DECISION MAKING FOR WEEDING: Interim report from case study work in Magomero

The main reasons for not weeding are:

a) *Rain*
Farmers do not see any point in weeding if rain is heavy and continuous. In their view, weeds uprooted when it is raining or very damp simply replant themselves too quickly to make weeding worthwhile. Weeding requires sunshine to dry out the weeds so that they do not regrow [n.b. this would in part explain the very poor weeding practice that we saw last year].

b) *Competing demands on farmers' time*
The need for food and cash for inputs is a major determinant of labour availability for fieldwork. The majority of farmers in this sample - which excludes any very well off households - have to balance the demands of their fieldwork against other elements in the overall package of activities that makes up their livelihood strategy.

- The better off farmers are able to hire ganyu labour so that their weeding and banking is done in a timely fashion [e.g. Mr Mazinga in the Chimvula cluster or Bambo Julius] or have sufficient labour available within the household or cluster [e.g. Kalonga].

- A less well off group of farmers find themselves caught between the necessity to do fieldwork and the immediate requirements of their household for cash for food and agricultural inputs. that is. they may literally have no ufa or wish to purchase fertiliser. they therefore give time to

  a) marketing activities by the wife and sometimes also the husband [January household. Mai Elizabeth. Mai Yasini]. These households depend more heavily on teenage children and are more likely to be female headed.

  b) vegetable growing

  c) employment i.e. those who have jobs e.g. on estates or with wealthier farmers have to fit in fieldwork at home with the requirements of their jobs: this is true all year round but has greater implications at times of peak labour demand

- The poorest group is obliged to seek ganyu labour. increasingly. as the season progresses. for food [commonly in the form of madeya. maize bran] or against credit either for food or inputs. [Mai Muthowa. Mai Anderson. Simeon Magomero].

c) *Lack of inputs or a distant field*
Farmers make a cost-benefit calculation regarding the likely returns to labour and the condition of the field. Some farmers have abandoned fields where. for example. they have not had time to weed and weediness is choking out plant growth. This is particularly the case where they have been *unable to apply fertiliser* [due to the cost] or where the field is at a considerable *distance* and the farmer has not been able to get to the field often enough. Similarly. if a field has been left too long. farmers will combine first weeding with banking.

d) *Illness*
Illness is an important factor at this time of year: the rains bring mosquitoes and malaria and local clinics are chronically short of drugs. only a few households have sufficient money for transport to better equipped hospitals. Illness may be a particularly serious problem this year given that more poorer households than normal are missing meals and eating meals of low nutritional value [wild relish is the main diet of some of the poorest clusters].

Lawson-McDowall
16 02 2000

Note on Ganyu

Before concluding that seasonal or occasional piecework agricultural labour interferes with a household's ability to manage its fields and hence to achieve its livelihood strategy, it is important to understand this type of ganyu labour in the broader social context and to grasp the potential significance of the connection between employer and employee in the longer term.

Within the five clusters where the social anthropology team has been working, 'ganyu' is normally done for relatives, neighbours and associates. Therefore, the apparently simple contractual arrangement for weeding or banking may be set within a 'nest' of other relationships. The 'employer', for example, may be a brother [Mr Bonongwe and Simeon Magomero and Simeon's sister] a friend and confidant [Marichis and Nantchengwas, Marichis and Julius] , a wealthier neighbour who not only gives bran, madeya,on credit but who, previous to this loan, may have made gifts of seeds [Muthowa and Julius]: a source of fresh produce for marketing [Marichis and Julius - tomatoes, maize]. Furthermore, as neighbours, each household would participate in the significant rituals of its neighbouring households [visiting after births, taking part in funerals, attending weddings, or sadakas] which further enhance social bonds.

Consequently, ganyu labour may be one strand in a network of ties between households which may, over time, provide something of a safety net for poorer households by linking them to wealthier households and clusters from which small amounts of credit or assistance may be forthcoming. Farmers themselves certainly identify an component of social assistance within the contracting of labour for agricultural activities: they say that giving your neighbours the first chance to earn some money or food is a way in which you can help them [Marichis and Andersons].

n.b. This year, it has been suggested that more adults been competing for ganyu and that this reflects the poor harvest in the 1996-97 season.

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FARMING SYSTEMS INTEGRATED PEST
MANAGEMENT PROJECT

'Why don't they weed ?'
Researcher recommendations and farmers' weeding decisions in southern Malawi

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Abstract

Researchers recommend that farmers keep maize weed-free for the first six weeks after emergence. Survey data from Blantyre Shire Highlands RDP show that 75 % of the area planted to maize was weeded once within three weeks of planting. By contrast, only 49 % of the area planted to maize was weeded twice within six weeks of planting in 1996/97 and 64 % in 1997/98. Farmers had developed specific weeding techniques to cope with continuous rainfall, termites, labour shortages, and compacted soils. Measuring the area planted to maize which received a second weeding in terms of only one technique (*kubandira,* or banking) underestimated the area weeded by 13 %. On-farm trials are required to test the effectiveness of *kukwezera*, a farmer-developed strategy against termites. Modeling farmers' weeding decisions using hierarchical decision-trees showed that the chief reasons for absence of second weeding were sickness, shortage of family labour and expectation of low maize yields. IPM interventions are required to reduce late second weeding on 12.4 % of the area planted to maize; gross benefits in Blantyre Shire Highlands RDP were estimated at MK 3.2 million ($ US 154.382) in 1996/97 prices.

1.0 Introduction

Late and incomplete weeding is widely perceived as a cause of significant yield losses in smallholder maize (*Zea mays*) production. Field trials in Malawi suggest that pure-stand maize should be weeded twice, at 21 and 45 days after planting (Kabambe *et. al.*, 1993). Where intercrops provide ground cover to suppress weed growth, the optimum time of second weeding for maize may extend up to 56 days after planting (Kumwenda and Kabambe, 1995). Researchers therefore recommend that farmers keep maize free of weeds for the first six weeks after emergence (MOALD, 1994).

Farmers use an array of weed management strategies. These include cropping practices (intercropping, rotation, mulching, smother or cover crops, date of planting, row spacing, seed rate), tillage practices (tillage depth, crop residue management), chemical control (herbicides)and physical control (weeding) [Altieri, 1995]. Smallholders in Malawi use all of these methods except chemical control. Physical weed control is done manually by hoeing or hand-pulling. Although weeding absorbs more labour than any single crop management activity, one-third of smallholder maize fields in Malawi are either left unweeded or weeded after the critical six-week period for weed-crop competition (GOM, 1984).

Research on weed management for smallholders has focused on the technical merits of alternative interventions (Compton, 1982). Very little is known about farmer decision-making for weeding or why, when, and how farmers choose to weed. Consequently, the reasons why farmers fail to follow researcher recommendations are poorly understood. This paper explores the process of decision making for weeding maize, the staple cereal in Malawi. The specific objectives of the paper are to: (1) identify farmers' weeding practices for first and second weeding; (2) determine farmers' decision criteria in deciding whether or not to weed, and what type of weeding to give; (3) compare the timing of farmers' weeding with researcher recommendations; and (4) determine which households do not finish weeding maize within six weeks of planting and why.

2.0 Data and methods

The study region

The Farming Systems Integrated Pest Management (FSIPM) Project operates in Matapwata and Mombezi Extension Planning Areas (EPAs) in Blantyre Shire Highlands Rural Development Project (RDP.) The maize ecology in the Shire Highlands is representative of 40 % of the area planted to maize in Malawi (Heisey and Smale, 1995). Sixty percent of holdings are under 0.5 hectares. Female-headed households (FHHs) comprise 38 % of households in the RDP (GOM, 1996). The farming system is maize-based with pigeonpea (*Cajanus cajan*) and beans (*Phaseolus* spp.) as the main pulse and legume intercrops. Relay-planting of beans and green peas (*Pisum sativum*) is also practised. Official crop statistics showed maize yields averaged 836 kg/ha for local varieties and 1765 kg/ha for hybrid semiflint varieties between 1992-96. Low average yields reflected poor soil fertility and low use of inorganic fertilizer. Burley tobacco (*Nicotiana tabacum*) and dry-season vegetables grown on residual moisture or with irrigation are the most valuable cash crops.

Weed *florae* in the southern region are diverse with over 57 species recorded during the 1991/92 crop year; the same survey identified 23 and 34 weed species in Mombezi and Matapwata EPAs, respectively (SPP, 1993). The regional occurrence of all weed species was 1.7 plants per square metre. The most abundant species were *Commelina benghaliensis* (7.3), followed by *Digetaria borbonica* (6.0), *Corchorus olitorious* (5.8), *Bidens pilosa* (5.5), and *Tridax procumbens* (3.3). The greatest abundance of weed species was found in Matapwata (5.6) and Mombezi EPAs (4.9); this was probably due to higher rainfall at these sites which encouraged early weed growth. Farmers in these two EPAs ranked the five most troublesome weeds as *Eleusine indica*, *Panicum maximum*, *Cynodon dactylon*, *Leersia hexandra*, and *Bidens pilosa* (Orr *et. al.*, 1997). Although *Striga asiatica* is widespread, severe infestation (affecting most of the ridges within a field) accounts for only 8 % of the area planted to maize (Ritchie and Koloko, 1998; Chanika and Koloko, 1998). Legume intercrops such as beans, cowpea (*Vigna unguiculata*), and groundnut (*Arachis hypogaea*) are frequently parasitised by *Alectra vogelii*.

Data

Data on time and frequency of weeding were collected for a sample of 120 farm households during the 1996/97 crop year (October - March). The sample was randomly selected from household listings of four villages in Matapwata and Mombezi EPAs. The sample was stratified by sex of household head and participation in FSIPM on-farm trials (OFTs). Thus, 30 households were FHHs and participated in OFTs, while 30 were FHHs but did not participate, with the same for male-headed households (MHHs). FHHs included both *de jure* FHHS where the head was widowed, separated, or divorced and *de facto* FHHs where the husband was absent for six months of the year or more. In 1997/98, 110 of the same households were resurveyed; information on 10 households was not available due to death or out-migration. Data on farmers' weeding decisions was collected from a subsample of these 110 households. Thirty households were randomly selected, stratified by sex of household head, giving 15 male- and 15 female-headed households. For both data sources, information on weeding was collected in the last week of January, approximately eight weeks after maize planting.

Methods

Farmers' decision-making for weeding was modeled using hierarchical decision-trees. A decision-tree may be defined as a sequence of discrete decisions which have to be made before a particular outcome can be chosen. Decision trees are widely used in market research to identify the criteria used by consumers when purchasing new products (eg. Bagozzi 1996). They have also been applied to a wide range of farmer decisions, such as whether to transplant or dry seed rice (IRRI, 1995), the timing and rate of fertiliser application (Gladwin, 1976), the adoption of a new maize variety (Franzel, 1984) and the decision to get credit for fertiliser (Gladwin, 1992).

The methodology of hierarchical decision trees has been described in detail elsewhere (Gladwin, 1989). Briefly, a decision-tree has three elements: a choice of alternatives, decision criteria, and decision outcomes. The choice of alternatives appears at the top of the tree and must represent an either-or choice {weed; don't weed}. The set of alternatives must contain all the possible outcomes at the end of the tree. The decision criteria are the set of factors which is actually considered in order to reach the final outcome(s). There are several types of decision criteria. Some are mutually exclusive alternatives ordered on a particular feature or aspect of these alternatives. In the criterion < Is it more profitable to grow maize than sweet potatoes ? > , for example, the alternatives have been ordered on the aspect of profitability. Other decision criteria are constraints which must be overcome or 'passed' to reach a particular outcome. An example is the decision criterion < Do you have enough family labour for weeding ? > , which determines whether the farmer has sufficient labour to weed. Decision criteria may only admit two outcomes (Yes/No). Finally, the decision outcomes are located at the ends of the paths of the tree and represent the results of a particular decision criterion.

The decision trees for weeding were modeled in two stages. The first stage identified the decision criteria which farmers used in deciding to weed. Decision criteria were elicited through in-depth individual interviews with a group of 11 key informants. Each key informant was interviewed twice, with the second visit used to clarify and cross-check against answers provided by other key informants. The criteria provided by key informants were then ordered in sequence to form a tree. In the second stage, the tree was validated by testing it with a separate sample of 30 randomly selected households from the same research sites. To test the model, the decision criteria were listed as a series of questions requiring the answer Yes or No in the format of a structured questionnaire survey. Households were asked the answer to each decision criterion. Since weeding practices may differ between fields, the answers for each decision criterion were determined separately for each field cultivated by the household. Answers were then processed to obtain counts of the number of outcomes for each decision criterion. The success rate was calculated by dividing the total number of correct predictions by the total number of cases. A successful decision-tree predicts 85-90 % of outcomes (Gladwin, 1989).

3.0 Results

Data on the area weeded and timeliness of weeding are from the sample surveys in 1996/97 and 1997/98. Figure 1 shows that 76 - 83 % of the area planted to maize was weeded within 21 days of planting. There was no significant difference between years (Chi-square = 1.800 ns). Second weeding generally took the form of 'banking', in which earth is moved from the furrows to build up the sides of the two ridges and support the maize plant, burying the weeds. Figure 1 shows that in 1996/97 49 % of the area planted to maize had been banked within six weeks of planting, compared to 64 % in 1997/98. The difference between years was statistically significant (Chi-square = 7.704 $P < .021$). The contrast between years was even stronger eight weeks after planting. In 1996/97, 53 % of the area planted to maize had been banked within this period compared to 79 % in 1997/98 (Chi-square 14.483 $P < 0.0001$). Second weeding in 1996/97 was delayed by heavy rainfall in January and February (Figure 2). The January and February rainfall totals were 544 mm and 434 mm respectively, compared to the average of 279 mm and 197 mm for the three previous seasons.

Interviews with key informants revealed seven different weeding practices (Figure 3). The most common were *kupalira*, used for first weeding, and *kubandira*, used for second weeding. In addition, farmers specified five weeding practices which represented either alternatives to *kupalira* or *kubandira*, or which were used in conjunction with them. *Kuzulira* was a form of handweeding used either on (a) vertisols which required more strength to weed using other methods or (b) hillslope fields with heavy weed infestation, where it served as a preliminary to *kupalira*. *Kusenda* or *kwojekera* was a labour-saving form of weeding used in place of *kupalira* when farmers were pressed for time, for example when heavy rains had delayed first weeding. *Kukwazira* or *kupala* was used in place of *kubandira* on compacted soils, or after *kubandira* on fields where weeds had regerminated. *Kukwazira* was also used for relay-crops such as beans, green pea, and sweet potatoe (*Solanum tuberosum*) grown under the *mbwera* system. Finally, *kukwezera* was used as an alternative to *kubandira* where farmers wished to avoid burying weeds close to the maize planting station because they believed this encouraged termites.

Table 1 shows the number of fields according to weeding practices for first and second weeding. Of 57 fields, 55 (97 %) were first weeded using *kupalira* and only one by *kusenda* or *kuwojekera*. Greater variation was observed in second weeding. Of 57 fields, 37 (65 %) were weeded using *kubandira*. The 10 remaining fields which received weeding were weeded using *kukwezera* or *kuwojekera* or a combination of *kukwezera* and *kubandira*.

Decision-trees for first weeding and banking are shown in Figures 4 and 5. Choice *alternatives* are shown in a set at the top of the tree , denoted by { } and the *decision criteria* at the branches or nodes of the tree denoted by < > , and the *decision outcomes* denoted by [ ] at the ends of the paths of the tree. The choice of alternatives for both decision trees were posed as: {Weed; don't weed}. Part-weeded fields were treated as fully weeded to avoid over-complicating the tree.

Farmers used 14 separate decision criteria in choosing to do first weeding (Figure 4). Of these, eight concerned labour availability, and the remainder decisions regarding rainfall, landtype, the growth stage of maize, and soil conditions. The success rate of the model was 95 % (three errors/57 cases). The three errors occurred where (1) there was enough family labour to do *kupalira* but labour was hired as a favour to a neighbour; (2) there was not enough family labour for *kupalira* but the household did *kuwojekera* instead; and (3) the farmer believed first weeding was not necessary to loosen the soil but weeded anyway.

- In 16 cases, farmers were either too sick to do first weeding (criterion 1) or had too little family labour (criterion 2) or had alternative uses for family labour (criterion 4). In six cases, farmers could afford to hire labour to weed (criterion 5) and had no alternative uses for this cash (criterion 7) but in 10 cases the fields were unweeded.

- Continuous rainfall prevented *kupalira* in only one case (criterion 9) in 1997/98, in contrast to the previous year. Similarly, there was not enough rainfall in 1997/98 to require kuzulira on hillslope fields (criterion 12).

- In 42 cases, farmers weeded maize before knee-height (criterion 13). In the three cases where maize was above knee-height when weeded, farmers believed first weedeing was necessary to loosen the soil and allow greater root penetration (criterion 14).

Figure 5 shows 24 separate decision criteria used by farmers for second weeding. Of these, nine concerned decisions about labour use. Other decisions concerned fertiliser application, termites, soil condition, growth stage of the maize plant, intrcrops, relay croping, and weediness after second weeding. The sucess rate of the model was 81 % (11 errors/57 cases). Of 11 errors, eight concerned decisions about labour availability. Errors on labour availability occurred where (1) farmers had enough family labour for second weeding but were simply too tired; and (2) family labour was adequate but labour was hired as a favour. Errors in later stages of the model occurred where (1) the farmer saw termites but did not do *kukwezera* because she had no experience of this; (2) a farmer could not move pumpkin vines in the field but banked anyway, destroying the pumpkins; (3) the farmer banked although the crop had already tasseled because he had been late applying fertiliser; (4) the field was weedy after banking but the farmer did not do *kupala* because he was busy preparing fields for *mbwera*.

- In 13 cases, farmers were either too sick to bank (criterion 1) or had too little family labour (criterion 2). For these fields, seven were not banked because there was no cash to hire labour (criterion 5) or because this cash had some alternative use (criterion 8). Of 44 fields for which enough family labour was available, in three cases there was an alternative use for this labour (criterion 4) and two of these fields were not weeded. Thus, shortage of labour accounted for absence of weeding on nine fields.

- In 20 cases, farmers did not apply fertiliser to maize. In 17 of these caases, however, farmers gave a second weeding because they believed it would improve yield (criterion 11). In two cases, farmers did not give second weeding because they expected low yields and did not think banking was necessary for other reasons (criterion 14).

- Termites were visible in nine fields (criterion 13) and in seven cases farmers chose not to bank because of the risk of getting soil too close to the planting station (criterion 12).

- In 17 cases, farmers planned to relay crop beans or field peas with maize (criterion 19). Banking was considered helpful for relay cropping because high ridges made soil available for constructing a bed for relay crops in the furrow (criterion 20).

- Four fields were too weedy for banking despite first weeding (criterion 22) and farmers did a preliminary weeding before banking (criterion 21).

Figures 6 and 7 show the area planted to maize weeded within six weeks of planting by fertiliser use for each variety group. No significant difference in weeding between fertilised and unfertilised maize was observed in 1997/98. In 1996/97, however, 84 % of the area planted to maize and fertilised was weeded within six weeks of planting; the corresponding share for the area not fertilised was only 56 %. The difference in proportions was significant (Chi-square = 3.637 $P < .0565$) and explained by late weeding on unfertilised hybrid maize (Chi-square = 4.813 $P < .0283$). There was no significant difference in the proportion weeded for fertilised and unfertilised local maize.

To test hypotheses about reasons for late weeding, households were divided into terciles based on the proportion of maize which had received a second weeding within six weeks of planting (Table 2). Among households in the first tercile none of the area planted to maize had been weeded . The area unweeded by these households accounted for 66 % of the total area unweeded. Data on labour supply for weeding are from the decision-tree subsample. Because of small sample size, it was not possible to test the statistical significance of the labour supply variables. The number of FHHs, days worked off-farm as *ganyu* labour, the area planted to maize, the area weeded with hired labour, the number of households using fertiliser, and share of cash income earned off-farm all differed significantly at the 5 % level or above.

4.0 Discussion

4.1 Cultivation practices

While *kupalira* and *kubandira* are well known weeding practices, *kukwezera*, *kuwojekera*, *kupala*, and *kukwazira* have not previously been documented by researchers. This highlights the complexity of cultivation practices in a hoe agriculture characterised by erratic rainfall, small holding size, intercropping, and pest build-up. This complexity is reflected in a rich farming vocabulary. The local Chichewa language has no fewer than 36 different meanings for the English verb 'to hoe', with some meanings described by several verbs (Guerin, 1985). Weeding practices are based on long experience. A description of the Shire Highlands in the 1880s describes how, when maize was three feet tall, "earth is pulled to the roots of the plant, which enables it to support itself against the wind, and affords its adventitious roots a medium of supplying itself with the necessary sustenance" (Buchanan, 1885). Thus, 'banking' (*kubandira*) represents an adaptation from slash-and-burn to permanent agriculture, grafted on to the system of land preparation using ridges which was introduced in the 1950s. Ignorance of farmers' practices may lead to underestimates of the area planted to maize which is actually weeded. Measuring the area weeded only in terms of one technque (*kubandira*, or banking) underestimated the area which had a second weeding by 13 % (Table 1).

Learning about farmer practices takes time. Discussions with key informants about weeding required a week. Most of the techniques popularised by Farming Systems Research (diagnostic surveys, rapid rural appraisal) and by Participatory Rural Appraisal (ranking, mapping, transects) are designed to obtain information quickly. While these broad-brush aproaches generate much useful information, experience in Malawi suggests they provide insufficient detail on crop husbandry practices (Jones, 1993). Knowledge of farmer practices is best obtained through open-ended conversations with key informants carefully selected from different socio-economic groups. Anthropologists have pioneered the use of the 'ethnographic interview' (Gladwin, 1989). Greater emphasis is required on the need for such techniques during the diagnostic phase of FSR since farmer practices for tillage, weeding, and fertilising which may differ greatly from recommendations developed on research stations. This will allow OFTs to be designed to fit as closely as possible to existing farmer practices. Greater knowledge of cultivation practices may also encourage efforts to determine their scientific basis, a subject largely ignored by researchers. Of the hundreds of adaptive research trials conducted in Malawi, only one appears to have tested a farmer-developed cultivation practice (LWADD, 1991).

4.2 Weeding decisions

The complexity of weeding decisions illustrates the importance of viewing farmer practices not in terms of predetermined designs but as a series of adjustments made in the face of unpredictable events. Farmers cannot predict weather, sickness, or the severity of termite infestation. Their weeding decisions are put together in a sequence as the cropping season unfolds, and cannot be predicted in advance. Smallholder decision-making has been compared to a 'performance', or adjustments and improvisations in the face of uncertainty (Richards, 1989). This has important implications for the design of OFTs. Weed trials based on a fixed design where treatments are appropriate for particular weather and pest conditions become artificial if those conditions change, and farmers adjust their weeding regimes to cope with these changes. In wet years, for example, farmers delay first weeding to avoid regermination of weeds. To make up lost time, they then use *kuwojekera* rather than *kupalira*. Forty-three percent of farmers in the decision-tree sample had used *kuwojekera* at some point in their weeding experience. Trials to test the effect of weeding frequency on maize yields should also use the weeding technique which is most appropriate for that season. It is preferable to adjust the 'performance' to the audience and not the other way around.

Termites

Farmers in the southern Malawi consistently rank termites as an important pest of maize (Logan *et. al.*, 1993) and have developed a number of management strategies for this pest. Farmers in Machinga use *kaselera*, whereby soil is removed from the maize plants to form a ridge suitable for relay crops and next season's maize (Logan *et. al.*, 1993). In Thucila, where termite infestation is severe, farmers avoid disturbing soil on the tops of the ridges and only remove weeds in the furrows and at the sides of the ridges (Shaxson *et. al.*, 1993). Finally, farmers in the Shire Highlands have developed a weeding technique called *kukwezera*, in which they scrape weeds upwards towards the planting station but do not cover them because they believe this attracts termites (Figure 3). While this may encourage lodging, farmers are evidently willing to take this risk. Given the importance attached to termites, it was surprising to find that *kukwezera* was used on only nine fields (16 %) (Table 1). Termite damage may vary considerably between years, however, even on the same field. When we asked farmers if they had *ever* used *kukwezera* against termites, 13 (43 % of the sample) said 'Yes'.

There is currently no research recommendations for control of termites. Two farmer-developed control strategies (banking versus *kaselera* and banking versus weeding without banking) were tested by the FSIPM Project in OFTs in the 1996/7 and 1997/98 seasons. Neither strategy was found to have a significant effect on maize yields, however. This may have been due to low levels of termite infestation (< 5 % of maize plants damaged) on trial plots. Since banking increases maize yields, the economic question is: what rate of termite infestation do farmers consider necessary before the costs of banking (in terms of maize lost to termites) exceed the benefits ? It is also not clear whether the strategy being tested in these OFTs ('weeding without banking') was equivalent to farmers' actual practice of *kukwezera*, or whether some other form of weeding was done. This illustrates the need for accurate knowledge of farmer cultivation practices before designing OFTs.

Fertiliser use

Farmers weed maize regardless or whether or not they have applied fertiliser. This is evidenced by the fact that in 1997/98, there was no significant difference in the proportion weeded between fertilised and unfertilised maize (Figure 4). This is supported by evidence from demonstration trials which show that farmers may obtain the same yield from weeding twice, with half as much fertiliser, as farmers who apply the recommended fertiliser rate but only weed once (MOALD, 1998). Crop husbandry data over four crop years (1980/81, 82/83, 83/84, 85/86) provide estimates of relative yield increases from weeding and fertiliser in farmers' fields (GOM, 1988, 1992). On average, second weeding added 403 kg/ha to the yield of hybrid maize, while fertiliser added 662 kg/ha. For intercropped local maize, second weeding added 181 kg/ha while fertiliser added 1202 kg/ha. Farmers who do not fertilise may give a second weeding for reasons other than reducing weed-crop competition, such as preventing lodging or providing enough soil to make a bed for a relay crop (Figure 6).

Maize may not be weeded twice when farmers expect low yields, however. In 1996/97, for example, average maize yields in the Shire Highlands were reduced by heavy rainfall which increased soil erosion and leaching of inorganic fertiliser. The average yield of local maize (454 kg/ha) was 38 % below the average for the previous three seasons (BLADD, 1997). Expectations of low yields discouraged the majority of farmers from weeding twice on unfertilised maize. Only 56 % of the area planted to maize which was unfertilised received a second weeding, compared to 84 % of the area which had been fertilised (Figure 5). Farmers' weeding decisions elsewhere show a similar logic. In Botswana, sorghum planted late receives less weeding because farmers expect low yields and during drought years less than two thirds of plots are weeded (Baker, 1987).

Even in 1997/98, however, some farmers growing maize on degraded soils saw no economic benefits from second weeding without fertiliser. These farmers either abandoned the field altogether or upooted the maize to plant sweet potatoes. National statistics show a nine-fold increase in sweet potato production between 1990-97; converted to maize equivalents, sweet potato now accounts for over 10 % of crop production compared to 2 % in 1990 (Simmons, 1998). A combination of high nitrogen: maize price ratios following the collapse of the smallholder credit system in 1993 and decreasing soil fertility have forced many poorer smallholders to search for alternatives to unfertilised maize.

4.3 Timeliness of weeding

Farmers were well aware of the need for timely first weeding. Three quarters of the area planted to maize was weeded within three weeks of planting. Delays occurred mainly with second weeding. These findings are in line with other studies (GOM, 1984; SPP, 1993). The technique most farmers use for second weeding in Malawi (*kubandira*, or banking) involves much more labour than the technique used at first weeding (*kupalira*). The labour requirement for banking is estimated at 270 hours/ha compared to 170 hours/ha for first weeding (Werner, 1987).

4.4 Why do farmers weed late ?

The decision tree suggests that the most important explanation for late or incomplete second weeding is shortage of labour (Figure 5). This result has to be interpreted carefully, however. Farmers will weed only when they believe that weeding will produce a satisfactory return, and when this return is greater than the return which could be obtained by using the same quantity of labour elsewhere. It may be quite rational, therefore, for farmers to weed late or not at all if they perceive no economic benefit from weeding or if they perceive a greater economic benefit from some alternative activity.

Among households in the first tercile, the total quantity of labour (defined as the weighted total of adult males, females and children) was not strikingly lower than in other terciles. Labour *available for weeding* was lower, however. In particular, the participation rate for adult males (53 %) was well below average (61 %) and much lower than the participation rate observed in the third tercile (71 %). The explanation for late second weeding thus appears to lie with a low participation rate among adult males, not with an absolute shortage of labour.

One explanation for low participation rates lies in competing demands on labour time. Households in the first tercile reported an average of 8 days off-farm *ganyu* employment in the period of second weeding, compared to 2-4 days in other terciles. Moreover, off-farm employment in the first tercile involved greater numbers of people, with a higher proportion of households reporting simultaneous employment of heads of household, spouses, and children. The most frequent reason given for *ganyu* by all farmers was the need for cash to buy food. The majority of households in all terciles had run out of home-produced maize by January and relied on market purchases. Households in the first tercile appear to have relied on *ganyu* labour as the main source of cash for maize purchases. Over 60 % of household cash income was earned off-farm.

A second explanation for late weeding is that households in the first tercile did not hire labour for second weeding. Shortage of cash reserves was also reflected in lower adoption rates (39 %) for inorganic fertiliser. Average household expenditure on fertiliser (187 MK) was also lower, as was the fertiliser rate applied to maize, although these differences were not statistically significant. As noted above, lower fertiliser use in this tercilemay also have discouraged farmers from second weeding.

Finally, farmers' perceptions of reasons for late weeding highlighted the importance of sickness. The decision tree also shows that in 14 cases (38 %) farmers were either too sick or too fatigued to complete weeding (Figure 5). Villagers reported the months December through March as the worst for morbidity, with diarrhoea and dysentery highest in the December and January when second weeding occurs (Orr *et. al.*, 1996).. Sickness among adults affected labour supply directly while sickness among children affected labour supply indirectly through the need for nursing and seeking treatment. Nine households in tercile one reported sickness as the reason for late weeding compared to just two in the second tercile. In combination, therefore, *ganyu*, sickness, and the lack of cash to hire labour appear the most likely explanations for late weeding.

4.5 The scope for IPM interventions

IPM interventions cannot directly assist households in the first tercile, which account for the lion's share of the area left unweeded. Late weeding among this tercile can only be addressed indirectly through poverty alleviation and preventative health care. Similarly, interventions are not necessary for households in the third tercile which had completed second weeding in time. What can IPM offer households in the remaining tercile ?

Households in the second tercile had completed second weeding on 72 % of their maize area within six weeks of planting. The area weeded late among these households accounted for 34 % of the total left unweeded. Households in this tercile had a significantly higher area planted to maize (0.83 ha) but the proportion of maize weeded using hired labour was only 16 % compared to 23 % among the third tercile. Fertiliser adoption and fertiliser rates applied to maize were both similar to the third tercile, however. Among households in the second tercile, therefore, labour is short in comparison with the third tercile, and priority is given to buying fertiliser rather than hire labour for second weeding. This decision is quite rational since, as noted above, fertiliser adds more to average maize yields than second weeding. Recent fertiliser price hikes may have aggravated cash shortages for households in this tercile.

Households in the second tercile would benefit from IPM interventions which saved household labour or cash costs for hired labour. Expenditure on hired labour is relatively low (520 MK/ha or about 73 MK/household). Thus, the scope for substituting herbicides for family and hired labour is limited. Besides high cost, herbicides do not increase average crop yields, reduce the supply of edible weeds for humans and livestock (Seubert *et. al.*, 1989) and may be toxic to intercrops (Altieri and Liebman, 1986). The most promising interventions, therefore, are those which reduce weed-crop competition through biological means. Unfortunately, these have attracted little attention from researchers. Varietal resistance against weeds has been a low priority for plant breeders for whom weeds are an 'unfashionable' pest (Lipton and Longhurst, 1994). By contrast, farmers may select varieties for their tolerance to pests, such as the local varieties of sorghum grown in western Kenya which are resistent to *Striga* spp. (Conelly, 1988). Biological weed management will require a much greater understanding of the biological processes at work where maize is grown with two or more intercrops (Altieri and Leibman, 1986). A recent review of weed research in Malawi also stressed the need for greater understanding of how weed control fitted into the overall scheme of crop management (Mloza-Banda, 1995).

What are the economic benefits from timely second weeding ? Data from FSIPM OFTs is not yet available (Chamango, 1997). Nationwide demonstration trials suggest that the yield increase from second weeding may average 16 % for hybrid maize varieties (MOALD, 1998). Given average yield rates for hybrid maize in Blantyre Shire Highlands (1765 kg/ha) this is equivalent to an additional 282 kg/ha. The farmgate price for maize in 1996/97 was 1.55 MK/kg. Hence, the gross return from more timely weeding is 437 MK/ha. This is less than the additional cost of hiring labour for second weeding (521 MK/ha). Farmers may value additional maize production more highly than the opportunity cost of their own labour, however. Assuming zero opportunity cost for family labour, the net benefits are equivalent to an additional 3,073 MT maize production in Blantyre Shire Highlands RDP, valued at MK 3.2 million in 1996/97 prices ($US 154,382). This figure represents the maximum possible return.

5.0 Conclusions

Farmers' weeding practices for maize are more complex than previously thought. Variation reflects the complexity of weeding decisions confronting farmers faced with unpredictable rainfall, pests, soil conditions, and an often inadequate labour supply. Given these constraints, the fact that the majority of farmers successfully weed twice within six weeks of planting is a remarkable achievement. IPM interventions are unlikely to improve timeliness of weeding for the the majority of those who weed late, since late weeding occurs because of the need to work for wages to buy food or because family labour is incapacitated by illness. Interventions to assist other farmers who weed late are limited by their lack of purchasing power for additional hired labour or herbicides. Biological methods of reducing weed-crop competition seem to offer the most promising interventions but it will first be necessary to establish whether the cost of this research investment is justified by the expected yield benefits.

References

M. A. Altieri (1995). *Agroecology: the science of sustainable agriculture.* Second edn. (London: Intermediate Technology Publications).

M. A. Altieri and M. Leibman (1986). ' Insect, weed, and plant disease mamnagement in multiple cropping systems', Pp. 183-218 in C. A. Francis (ed.) *Multiple Cropping Systems* (New York: Macmillan).

R. P. Bagozzi (1986). *Principles of Marketing Management* (New York: Maxwell Macmillan).

D. Baker (1987. 'Weed control during drought: a fact sheet', Pp. 9-16 in W. T. Stewart-Jones ed., *Weeds, their growth, impact and control in Botswana. Proceedings of a Workshop held at the Botswana Agricultural College, Gaberone, June.* (Gabarone: Department of Agricultural Research).

Blantyre Agricultural Development Division (BLADD) (1997). *Third Crop Estimates, 1996/97.* Mimeo.

J. Buchanan (1885). *The Shire Highlands as a Colony and a Mission.* (Edinburgh: Blackwood).

A. M. Z. Chamango (1997). Characteristics of existing weed control practices and crop loss due to weeds in Matapwata EPA of Blantyre ADD. M.Sc. Research Proposal, Bunda College of Agriculture.

C. S. M. Chanika and A. M. Koloko (1998). *Striga* Transect Survey, Kayenda Village, March 31 1998. FSIPM Project. Mimeo.

J. A. F. Compton (1982). *Small farm weed control: an annoted bibliography.* (London: Intermediate Technology Group and International Plant Protection Centre).

W. T. Conelly (1988). 'Insect and weed control in subsistence farming sysyems: western Kenya', Pp. 121-135 in D. W. Brokensha and P. D. Little (eds.) *Anthropology of Development and Change in East Africa* (Boulder, Co.: Westview Press).

S. C. Franzel (1984). 'Modeling Farmers' Decisions in a Farming Systems Research Exercise: The Adoption of an Improved Maize Variety in Kirinyanga District, Kenya', *Human Organisation*, 43, (3): 199-207.

C. H. Gladwin (1976). 'A View of the Plan Puebla: An Application of Heirarchical Decision Models', *American Journal of Agricultural Economics*, **58**, December: 881-887.

C. H. Gladwin (1989). *Ethnographic Decision Tree Modeling.* Sage University Series on Qualitative Research Methods, vol. 19. (Beverly Hills, CA: Sage).

C. H. Gladwin (1992). 'Gendered impacts of fertilizer subsidy removal programs in Malawi and Cameroon', *Agricultural Economics*, 7: 141-153.

GOM (1984). *National Sample Survey of Agriculture, 1980/81. Vol. 1: Household characteristics, labour availability, and garden details.* (Zomba: National Statistical Office).

GOM (1988). Annual Survey of Agriculture 1986/87. (Lilongwe: Ministry of Agriculture). Mimeo.

GOM (1992). *Annual Survey of Agriculture 1982/83 -1984/85.* (Zomba: National Statistical Office).

GOM (1996). *Annual Survey of Agriculture, 1992/93. Vol 1: Smallholder Household Composition Survey Report.* (Zomba: National Statistical Office).

J. Guerin (1985). *A Concise English-Chichewa Dictionary.* 2 Vols. (Blantyre: Privately Printed).

P. W. Heisey and M. Smale (1995). *Maize Technology in Malawi: A Green Revolution in the Making?* Research Report No. 4 (Mexico, International Maize and Wheat Improvement Centre (CYMMT)).

International Rice Research Institute [IRRI] (1995). *Program Report for 1994.* (Los Banos, Philippines: IRRI).

R. B. Jones (1993). 'The development of technologies for farmers by traditional commodity research teams:L the Malawi experience', Pp. 82-87 in P. Heisey and S. Waddington eds., *Impacts of On-Farm Research. Proceedings of a Workshop on Impact of On-Farm Research in Eastern and Southern Africa*, Harare, Zimbabwe 23-26 June, 1992. (Mexico, D.F.: CIMMYT).

V. H. Kabambe, J. D. T. Kumwenda, L. D. M. Ngwira and W. D. Sakala (1993). 'Effective weed control in maize in Malawi', Pp. 207-214 in D. C. Munthali, J. D. T. Kumwenda and F. Kisyombe (eds.), *Proceedings of the Conference on Agricultural Research for Development,* Mangochi, Malawi 7-11 June.

J. D. T. Kumwenda and V. H. Kabambe (1995). 'Critical period of weed interference in pure maize and maize/pigeonpea and maize/soybean intercrops in Malawi', pp. 234-237 in D. C. Jewel, S. R. Waddington, J. K. Ransom, and K. V. Pixey (eds.), *Maize Research for Stress Environments. Proceedings of the Fourth Eastern and Southern Africa Regional Maize Conference, Harare, 28 March-1 April 1994.* (Mexico D. F.: CIMMYT).

M. Lipton with R. Longhurst (1989). *New Seeds and Poor People.* (London: Unwin Hyman).

J. W. M. Logan, G. K. C. Nyrendra, and D,. C. Munthali (1993). 'The importance of termites as pests of maize in smallholder farms in southern Malawi', Pp. 270-277 in D. C. Munthali, J. D. T. Kumwenda and F. Kisyombe (eds.), *Proceedings of the Conference on Agricultural Research for Development,* Mangochi, Malawi, 7-11 June.

Liwonde Agricultural Development Division [LWADD] (1991). *Adaptive Research Trial Results, 1989/90.* Adaptive Research Section, Liwonde ADD. March.

H. R. Mloza-Banda (1995). 'Which way weed control and crop protection in Malawi ?', Paper presented at the seminar on Improvement of Agricultural Production and Food Security in Malawi, Lilongwe, 14 -16 December. Mimeo, 14 pp.

Ministry of Agriculture and Livestock Development (MOALD) (1994). *Guide to Agricultural Production in Malawi, 1994/95-1995/96.* (Lilongwe: MOALD).

Ministry of Agriculture and Livestock Development (MOALD) (1998). *The 1997/98 Maize Fertilizer Recommendations Demonstration.* Newsletter 3. May.

A. Orr, P. Jere and A. Koloko (1997). *Baseline Survey, 1996/97.* FSIPM Project. November. Mimeo, 46 pp.

A. Orr, J. M. Ritchie, J. Lawson-McDowall, A. M. Koloko and C. B. K. Mkandawire (1996). *Diagnostic Surveys in Matapwata and Chiradzulu EPAs.* FSIPM Project, October. Mimeo.

P. Richards (1989). 'Agriculture as a performance' Pp. 39-43 in R. Chambers, A. Pacey and L. Thrupp eds., *Farmer First. Farmer innovation and agricultural research.* (London: Intermediate Technology Publications).

J. M. Ritchie and A. M. Koloko (1998). *Striga* Transect Survey, Magomero Village, 20 March 1998. FSIPM Project, Mimeo.

C. Seubert, Z. Mmaba and N. Patrick (1989). 'Farming Systems Research in weed mamagement in Swaziland', Pp. 48-68 in C. R. Namonya ed., *Strategy for Integrated Pest Management and Weed Control for Smallholder Farmers in SADCC Countries. Proceedings of a SACCAR Workshop held in*

Mbabane, Swaziland, 1-4 August, 1988. (Gabarone: Southern African Centre for Cooperation in Agricultural Research).

L. J. Shaxson, C. R. Riches and J. H. Seyani (1993). 'Incorporating farmer knowledge in the design of weed control strategies for smallholders'. Pp. 1149-1154 in Proceedings of the Brighton Crop Protection Conference, Weeds.

S. Simmons (1998). Personal communication.

Soil Pests Project (SPP) (1993). *Relative importance of different insect pests, plant diseases, and weed species affecting farmers' crops in southern Malawi.* Report No. 3. October. Mimeo, 309 pp.

J. Werner (1987). Labour requirement and distribution for smallholder crops. Adaptive Research Section, Liwonde Agricultural Development Division. Mimeo, 44 pp.

Table 1. Farmer practices for first and second weeding, FSIPM survey sites, 1997/98 season. (n= 57 fields)

Weeding practice	Fields (no.)	Percent	Area (ha.)	Percent
FIRST WEEDING				
Kupalira (fully)	51	89.5	18.0	86.3
Kupalira (partly)	4	7.0	2.5	11.9
Kusenda/kuwojekera	1	1.8	0.1	0.3
Not weeded	1	1.8	0.3	1.5
SECOND WEEDING				
Kubandira (fully)	30	52.6	10.9	51.9
Kubandira (partly)	7	12.3	12.3	19.9
Kubandira + kukwezera	5	8.8	2.1	8.1
Kukwezera	4	7.0	0.9	4.5
Kuwojekera	1	1.8	0.2	0.7
Not weeded	10	17.5	3.1	14.8
Total	57	100.0	20.9	100.0

Source: FSIPM survey, 1997/98.

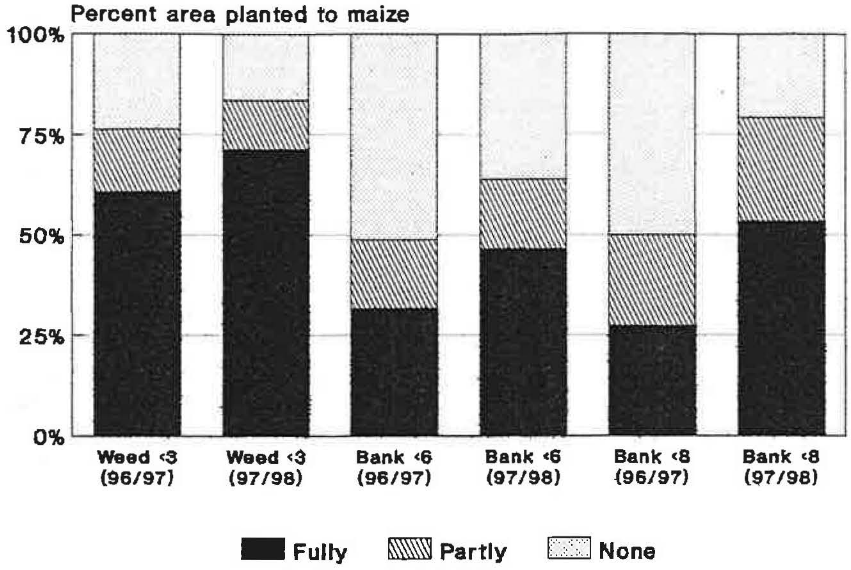
Table 2. Socio-economic indicators for households with late second weeding, FSIPM sites, 1997/98 season.

No.	Variable	Tercile 1 (n=36)	Tercile 2 (n=36)	Tercile 3 (n=38)	All households (n=110)	Sig. - level
1	Area planted to maize banked within six weeks of planting (%)	0	72	100	64.0	P <.000
2	Area not banked within six weeks of planting (%)	65.6	34.4	0.0	36.0	P < .000
3	Female-headed households (no.)	21	10	25	56	P <.0001
4	*Total weighted household labour supply* [a b]					
	Labour used for banking					
	- adult males	15.0	24	7.0	46.0	na.
	- adult females	12.0	8.8	12.8	33.6	na.
	- children	8.5	5.3	12.3	26.0	na.
	Participation rate for banking (%)					
	- adult male	53.3	62.5	71.4	60.9	na.
	- adult female	66.7	72.7	62.5	66.7	na.
	- children	23.5	9.5	34.7	25.9	na.
5	*Labour demand*					
	Days worked as *ganyu* during banking period (no.)	7.8	1.6	2.9	4.1	P < .0286
	Area planted to maize (ha)	0.44	0.83	0.57	0.61	P < .0023
	Area planted to maize banked with hired labour (ha)	0.00	0.14	0.13	0.09	P < .0126
6	*Fertiliser use*					
	Households using (no.)	14	24	21	59	P < .0523
	Total expenditure on fertiliser (MK/hh)	187	373	380	314	P < .1934
	Fertiliser rate (kg N ha^{-1})	17.7	21.6	37.2	25.7	P < .1225
7	*Income*					
	Share of household cash income earned off-farm (%)	64.4	44.7	56.0	55.8	P < .0688
8	*Farmer perceptions*					
	Major reasons given for late second weeding (no.)					
	1. Sickness	9	2	-	11	P < .4386
	2. Shortage of labour	8	6	-	14	
	3. Termites	4	4	-	8	
	4. Working as *ganyu*	3	1	-	4	

a Decision-tree sample (n=30)

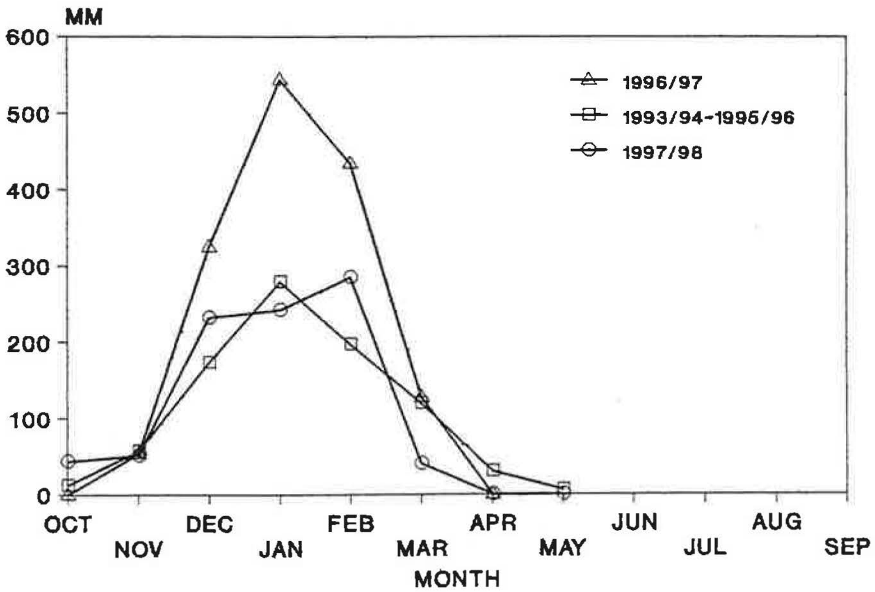
b Weighted by sex and age (males aged 14+, 1.0; females aged 14+, 0.8; children aged <13, 0.5).

Figure 1. Area planted to maize weeded within three and banked within six or eight weeks of planting, FSIPM research sites, 1996/97 and 1997/98 seasons.



Source: FSIPM Surveys, 96/97, 97/98.

Figure 2. Monthly rainfall distribution, FSIPM research site, Mombezi EPA, 1993/94 - 1997/98.



Source: Matambo Estate records

Figure 3. Farmers' weed management practices, Blantyre Shire Highlands, southern Malawi.

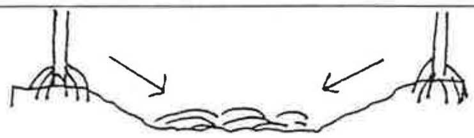
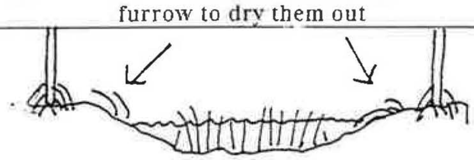
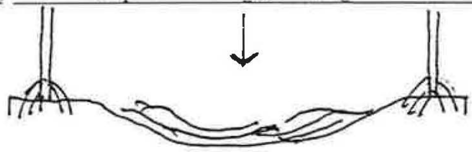
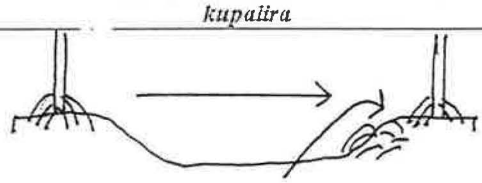
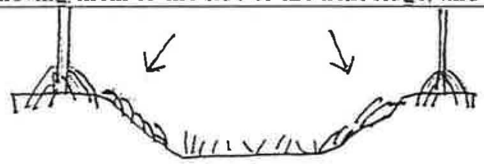
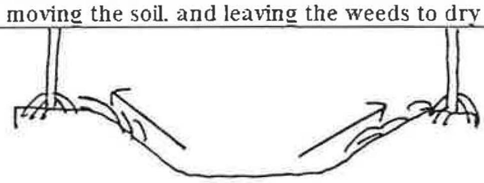
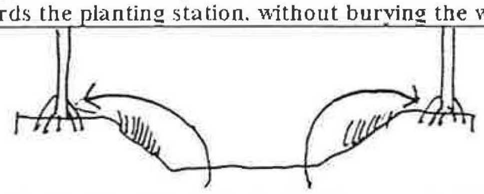
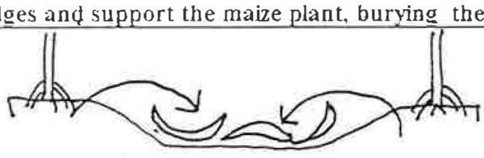
No.	Name	Description
1	*Kupalira*	 Weeding by hoeing the sides of two ridges and laying weeds in the intervening furrow to dry them out
2	*Kuzulira* (*dambo*)	 Handweeding tall weeds, then scraping smaller weeds from sides of the ridge with a hoe, and laying both on top of the ridge, leaving weeds in furrow untouched
3	*Kuzulira* (hillslope)	 Handweeding tall weeds and laying them in the furrow or in a heap before starting *kupalira*
4	*Kusenda*, or *Kuwojekera*	 Weeding by hoeing weeds from the side of one ridge, downwards from the maize planting station, *moving them to the side of the next ridge*, and burying the weeds
5	*Kukwazira* or *Kupala*	 Weeding by using a hoe to scrape the weeds from the side of the ridge without moving the soil, and leaving the weeds to dry
6	*Kukwezera*	 Weeding by using the hoe to scrape weeds from one side of the ridge upwards towards the planting station, without burying the weeds
7	*Kubandira*	 'Banking' or using the hoe to move soil from the furrow to build up the sides of the two ridges and support the maize plant, burying the weeds
8	*Mbwera*	 Stripping the bottom leaves from the maize plant, laying them in the furrow, then covering them with soil from the old ridges to create a new ridgefor planting a relay-crop of beans or field-peas

Figure 4. Hierarchical decision-tree for first weeding of maize, FSIPM survey sites, 1997/98 season.

38 6

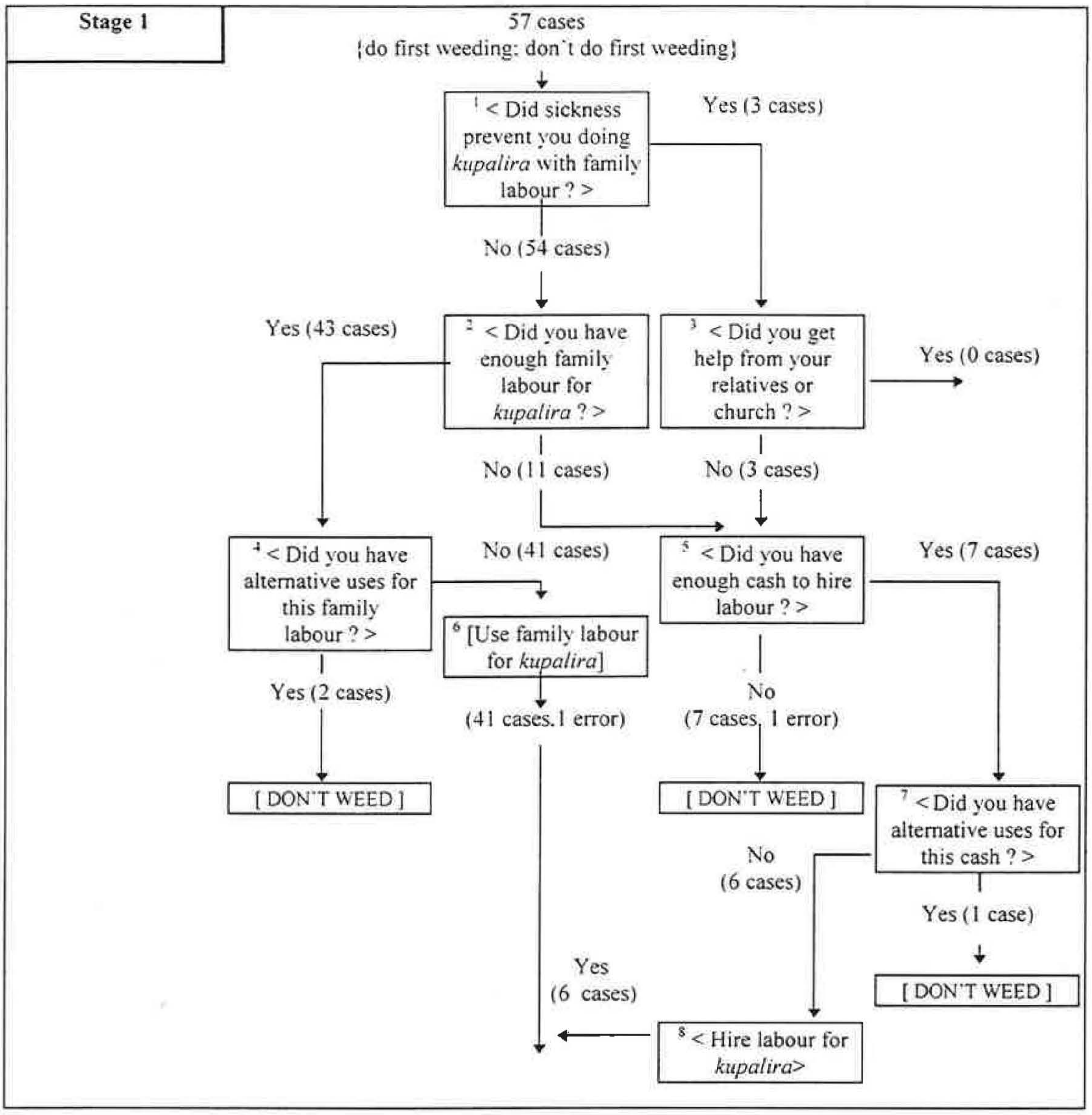
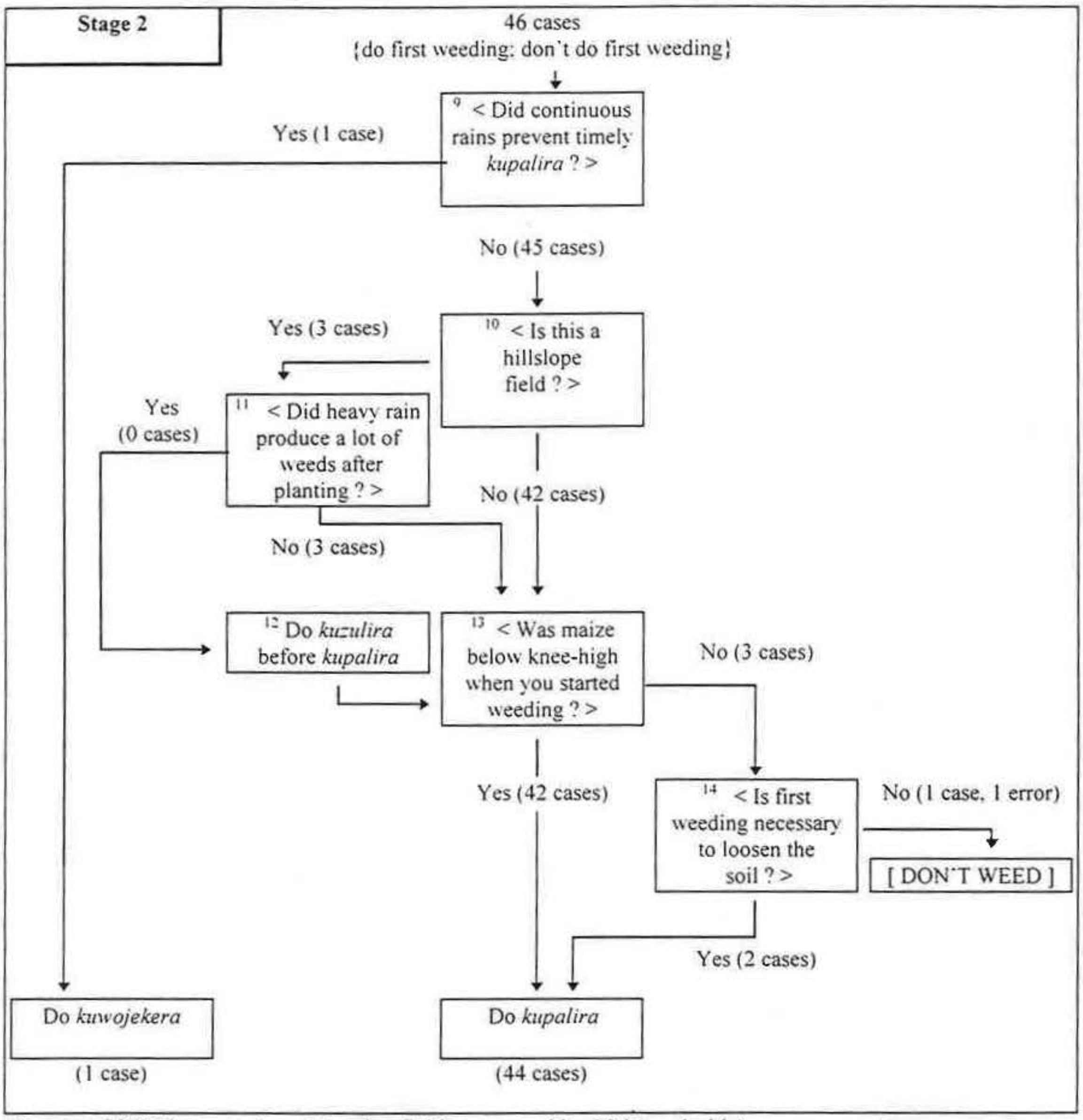


Figure 4 (cont.) Hierarchical decision-tree for first weeding of maize, FSIPM survey sites, 1997/98 season.



Source: FSIPM survey (n = 57 maize fields, operated by 30 households)

Figure 5. Hierarchical decision-tree for second weeding of maize, FSIPM survey sites, 1997/98 season.

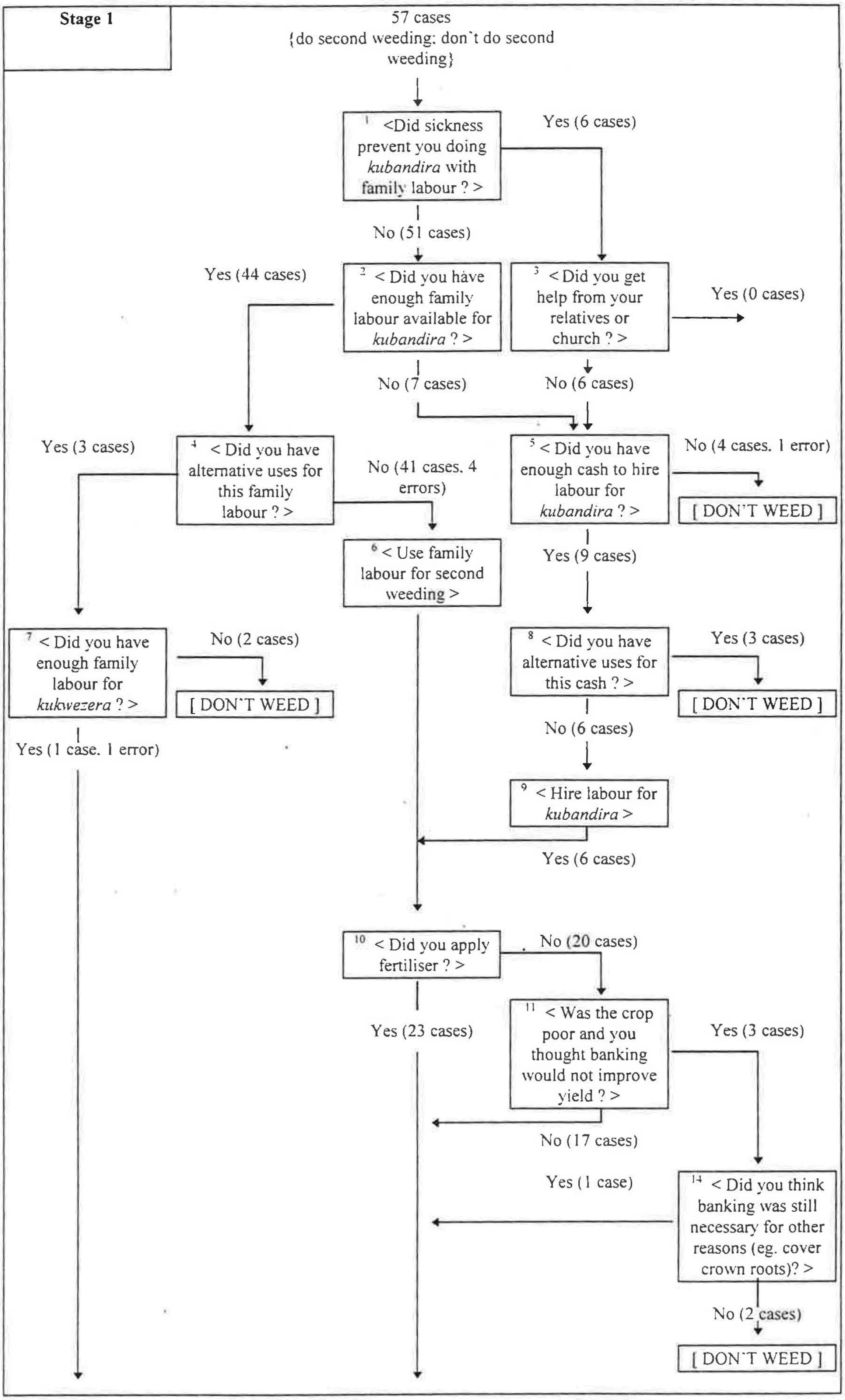


Figure 5 (cont). Hierarchical decision-tree for second weeding of maize, FSIPM survey sites, 1997/98 season. 389

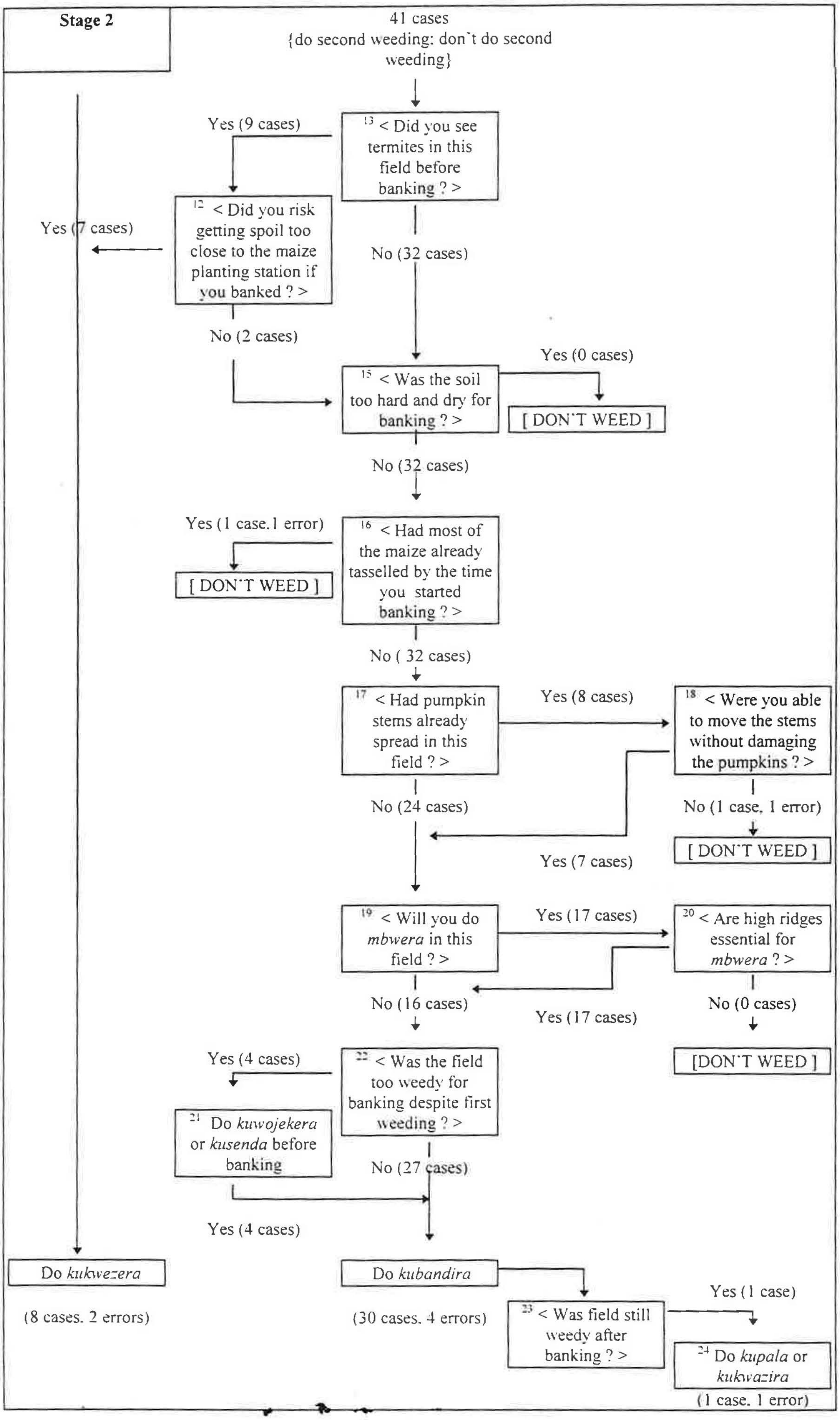
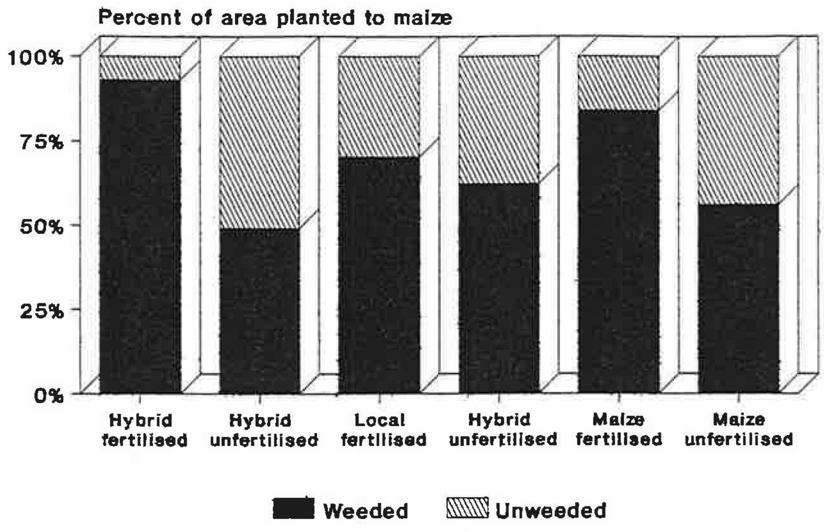
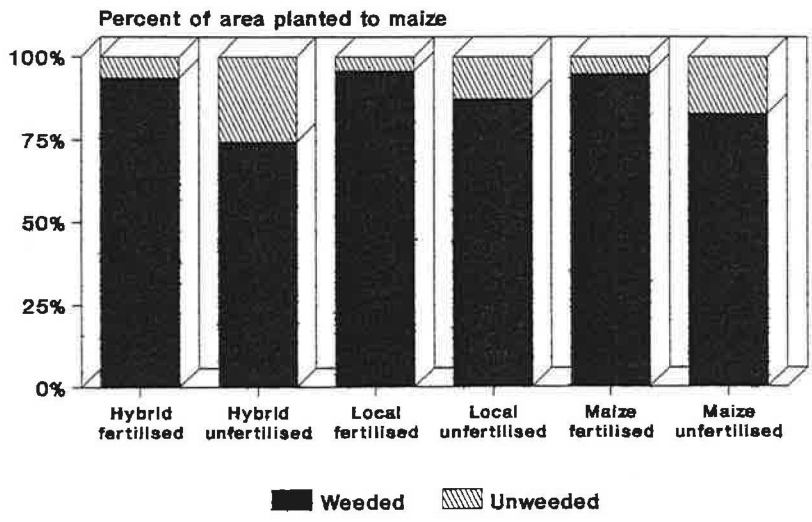


Figure 6. Area planted to maize banked within six weeks of planting, by fertiliser use, FSIPM sites, 1996/97 season.



Source: FSIPM survey, 1996/97

Figure 7. Area planted to maize banked within six weeks of planting, by fertiliser use, FSIPM sites, 1997/98 season.



FSIPM Survey, 1997/98

Appendix 1

Farming Systems Integrated Pest Management Project
Ministry of Agriculture and Irrigation,
Department of Agricultural Research,
Bvumbwe Research Station,
PO Box 5748, Limbe

WEED DECISION MAKING, 1997/98 CROP SEASON

Farmer code number	

	Identification	Code
EPA		
Village		
Name of head of household		
Name of person interviewed		
Date of interview		
Interviewer		

Section 4. First weeding

4.1	**Garden number**	**1**	**2**	**3**	**4**
4.2	Are these the same gardens as last year ? (1 = Yes, 2 = No)				
4.3	Landtype (1 = dambo, 2 = munda, 3 = hill)				
4.4	Soiltype				
4.5	Main crop this season (1997/98)				
4.6	Maize variety this season (1997/98)				
4.7	What type of first weeding was done ? 1 = kupilira 2 = kusenda/kwojekera				
4.8	What proportion of field received kupilira ? (none, 1/4, 1/2, 3/4, all)				
4.8a	Kuwojeka done on this field ?				

Decision criteria for first weeding, by plot (Y/N)

4.9	Did you or your spouse get sick ?				
4.10	If yes, did you get help from relatives or church members ?				
4.11	Did you have enough family labour available for *kupalira* ?				
4.12	If no, did you have alternative uses for this family labour (eg. *ganyu*) ?				
4.13	Did you have enough cash to hire labour ?				
4.14	Did you have alternative uses for this cash ?				
4.15	Did you hire labour for *kupalira* ?				
4.16	Was the crop in good condition and you expected some yield ?				
4.17	Did continuous rain prevent *kupalira* ?				
4.18	Was maize below knee high when you started weeding ?				
4.19	If yes, were there too many weeds to go straight to banking ?				
4.20	If no, do you think first weeding is necessary to loosen the soil ?				
4.21	If no, did you go straight to banking ?				
4.22	If no, were you too old/weak to do *kwojekera* ?				
4.23	Did you do *kuzulira* instead of *kwojekera* ?				
4.24	Is this a hill field ?				
4.25	Did heavy rain produce a lot of weeds after planting ?				
4.26	Did you do *kuzulira* before *kupilira* ?				
4.27	Did you do *kupilira* ?				

5. Banking

5.1	**Garden number**	**1**	**2**	**3**	**4**
5.2	Landtype (1 = dambo, 2 = munda, 3 = hill)				
5.3	Maize variety this season (1997/98)				
5.4	Did you bank this plot ? 1 = Partly, 2 = Fully, 3 = No				
5.5	What type of banking was done ? 1 = kubandera 2 = kuwojekera 3 = kukwezera 4 = kukwazira				

Decision critera for banking, by plot (Y/N)

5.6	Did you or your spouse fall sick ?				
5.7	If yes, did you get help from relatives or your church ?				
5.8	Did you have enough family labour available for banking ?				
5.9	If yes, did you have alternative uses for this family labour (eg. *ganyu*) ?				
5.10	If no, did you have enough cash to hire labour for banking ?				
5.11	Did you have alternative uses for this cash ?				
5.12	Did you hire labour for banking ?				
5.13	Did you have enough labour for *kukwezera* ?				
5.14	Did you apply fertiliser ?				
5.15	Was the crop poor and you thought banking would not improve yield ?				
5.16	Did you think banking was still necesary for other reasons ? (eg cover roots etc)				
5.17	Did you see termites in the field before you started banking ?				
5.18	Was there a high risk of getting soil close to the planting station if you banked ?				
5.19	Was soil too dry for banking ?				
5.20	Had pumpkins and stems spread in this field ?				
5.21	Were you able to move stems without damaging the pumpkins ?				
5.22	Will you do *mbwera* in this field ?				
5.20	Are high ridges necessary for *mbwera* ?				
5.21	Had most of the maize already tasseled by the time you were ready to start banking ?				
5.22	Did you do *kukwezera* instead of banking ?				
5.23	Was field too weedy for banking even after first weeding ?				
5.24	Did you do *kwojekera* or *kusenda* before banking ?				
5.25	Did you bank this field ?				
5.26	Was the field still weedy after banking ?				
5.27	Did you do *kupala* or *kukwazira* after banking ?				

6. REASONS FOR LATE/INCOMPLETE WEEDING

6.1 If first weeding done partly or not done, give reasons:

____

____

6.2 If first weeding done late, give reasons,

____

____

6.3 If banking done partly or not done, state reasons:

____

____

____

6.4 If banking late, state reasons:

____

____

6.5 Did you ever do:

No.	Activity	Yes	No
6.6	*Kwojekera/kusenda* instead of *kupilira*		
6.7	*Kukwezera* instead of banking		
6.8	*Kupala/kukwazira* after or before banking		
6.9	*Kuzulira* (eg. ppea)		

7.0 Hired labour

7.1 Used this season YES/NO

7.2 Casual YES/NO
7.3 Permanent YES/NO

No.				Cost (MK)	Cost (MK)
	Activity	Casual	Permanent	Casual	Permanent
7.4	First weeding				
7.5	Banking				

8. Labour use for weeding and banking this season (1997/98)

	A1	A2	A3	A4	A7	A8
N	Name of household member	Rel. to HH	Sex	Age	First weed-ing	Banking
1						
2						
3						
4						
5						
6						
7						
8						
9						

Section 9. Who USUALLY participates in these activities for the MAIZE crop ?

For household head:

9.1 Mother alive ? YES/NO
9.2 Mother in law alive ? YES/NO
9.3 Sisters alive ? YES/NO 9.4 Sisters resident ________________YES/NO

No.	Task	Head only	Spouse	Both head and spouse	Child-ren	Hired labour	Wif's sisters	Wife's mother	Mother	Other relatives
9.5	Kuwojeka									
9.6	Making ridges									
9.7	Planting									
9.8	First weeding									
9.9	Banking									
9.10	Fertilising									
9.11	Harvesting									
9.12	Storage									
9.13	Seed selection									

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Farming Systems Integrated Pest Management Project

Pests and markets: Why farmers grow susceptible varieties of pigeonpea

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Abstract

*We interviewed 15 farmers and six market traders in Mombezi and Matapwata EPAs, Blantyre Shire Highlands RDP, about pest management for pigeon pea (*Cajanus cajan*). Farmers' perceptions of damage from insect pests were significantly lower than researchers'. Only in the worst cases (damage > 60 %) did pods or seeds have no economic use. Samples of 24 farmer selections of local pigeon pea were collected. Farmer selections varied widely in field duration, taste, cooking time, and marketability. Farmers' reluctance to plant ICP 9145, which is resistant to* Fusarium *wilt, is largely explained by three factors, namely risk aversion, consumer preferences, and the nature of the market for this crop. Since pigeon pea is an important cash crop, the link between pests and markets is vital. Although ICP 9145 is higher yielding than local varieties, it lacks other varietal characteristics (seed size, colour, and easy de-hulling) that would make it attractive to the domestic processing industry and to foreign buyers. Consequently, there is no price premium for ICP 9145 on the local market. A more holistic breeding strategy is required that combines resistance to* Fusarium *wilt with other traits that will make improved varieties more marketable and attract a price premium. We conclude that the most effective route to improved pest management for pigeon pea is for plant breeders to address the missing link between pests and markets. Generally, linking pests and markets may hold the key to successful IPM for food crops for which smallholders do not invest in chemical forms of crop protection.*

1.0 Introduction

Pigeon pea (*Cajanus cajan*) is the most widely grown maize intercrop in Blantyre Shire Highlands RDP. In the 1998/99 crop season, it occupied 15,700 ha or three times the area planted to beans (*Phaseolus vulgaris*) (BLADD, 1999). Eaten with or without maize, pigeon pea is the main source of protein between October and February, when most smallholder households have run out of maize. Baseline survey data for the FSIPM Project showed that pigeon pea is also an important cash crop: two thirds of growers sell pigeon pea and on average half of pigeon pea production is sold (Orr *et. al*, 1997: 47). The main buyers for pigeon pea in Malawi are processing mills located in the nearby towns of Blantyre and Limbe. Unlike beans, which are not exported, Malawian pigeon pea is traded on the world market.

Pigeon pea is susceptible to diseases and insect pests. *Fusarium* wilt and leaf spot diseases (*Cercospora cajani*) are the most important diseases (Reddy, 1991). A survey in 1980 estimated the incidence of *fusarium* wilt in Malawi at 36% (Subrahmanyam, 1996). The main insect pests are pod borers (*Helicoverpa armigera*) and pod-sucking bugs (*Nezara viridula, Clavigralla spp.*) (Minja, 1996). Surveys on farmers' fields in Malawi in 1995 showed that 16 % of the crop was damaged by pests (Minja *et. al.*, 1996). Chemical control is not feasible for smallholders because they cannot afford pesticides. The main IPM strategy for pigeon pea, therefore, has been the development of resistant varieties.

The wilt-resistant variety ICP 9145 was first released in Malawi in 1986/87. One decade later, however, it was estimated that ICP 9145 occupied only 15-20 % of the area planted to pigeon pea (Subrahmanyam, 1996). The reasons for this low rate of adoption remain unclear. Anthropologists have pointed out that farmers do not understand the biology of *Fusarium* wilt (Lawson-McDowall and Kapulula, 1999). It is true that farmers' inadequate knowledge of biology may hinder the dissemination of IPM strategies for certain diseases and insect pests (Riches *et. al.*, 1993). However, this is not the case with *Fusarium* wilt. Farmers recognise the symptoms of *Fusarium* wilt (*kunyala*) and are aware that ICP 9145 (locally known as Chinese or 'hybrid') is more resistant than local landraces (Orr *et. al.*, 1997: 74). The problem is not knowledge, but behaviour. Why, when it comes to pigeon pea pest management, are farmers such reluctant strategists?

We argue that, in farmers' eyes, planting a mix of local varieties and ICP 9145 offers several advantages. These include risk aversion; consumer preferences; and marketability. Given the importance of pigeon pea as a cash crop, we emphasise the importance of markets. We argue that the main explanation for the slow adoption of ICP 9145 is that researchers have paid insufficient attention to the link between pests and markets. While ICP 9145 is resistant to *Fusarium* wilt, and produces a higher yield than local varieties, it lacks other characteristics that are important for rural consumers and processors. A more holistic breeding strategy is required that combines resistance to *Fusarium* wilt with other varietal traits that will make the pigeon pea more attractive to domestic and foreign buyers.

The general objective of this report is to understand why farmers continue to grow varieties of pigeon pea that are susceptible to pests and diseases. The next section outlines our methods. Section 3.1 compares farmers' and researchers' perceptions of crop losses from pests. In section 3.2 we describe the diversity of local varieties grown by farmers at our research sites, while in section 3.3 we analyse why farmers continue to grow local varieties. Section 4 outlines farmers' alternative pest management strategies. Finally, the conclusion expands on the original theme and suggests that the link between pests and markets may provide the basis for a new approach towards the development of IPM strategies for food crops.

2.0 Methods

Pigeon pea management

We interviewed a total sample of 15 households in Mombezi and Matapwata EPAs. Of these, nine were households that participated in FSIPM on-farm trials (OFTs) while six were non-participants. We deliberately included non-participants because they had no knowledge of the recently-developed pigeon pea varieties tested by the Project. Most of the interviews involved women. Since women are usually responsible for seed selection and for marketing the crop they know more about pigeon pea than men. In two cases, however, men were interviewed because their wives were not available. Farmers were shown samples of 17 different local pigeon pea farmer selections plus ICP 9145 to assist in identification and understanding of their characteristics. Interviews were made using a short checklist (Appendix 1).

Damage from insect pests

Samples of damaged pods and seeds by pod suckers and borers were shown to farmers to assess their perception about the severity of damage. Three levels of damage were shown. These included a worst case and one or more levels of intermediate damage that might be accepted or rejected by farmers for specific purposes such as planting, sale, food, or feed for livestock. A full description of these damage levels for both pod and internal seed damages by pod sucking bugs and pod borers is given in Appendix 1.

Pigeon pea marketing

We interviewed four traders buying pigeon pea at Mbulumbuzi market, Mombezi EPA. They were Mai Mitochi (Kachingwe village), Mai Irene Msusa (Makalani village), Mai Bvayala (Juwa village) and Mai Sapanga (Kachere Township). Mai Sapanga was also involved in selling *chipere* (processed pigeonpea) that she bought from mills in Limbe. In addition, we interviewed two pigeonpea traders at Mangunda market, Matapwata EPA. They were Mr Mofati Minjali (Ndalama village) and Mr Eni Mawere (Muhura Village).

Traders were asked about the prices of pigeon peas at planting and harvest, and about price differentials between local varieties and ICP 9145. The quantity of pigeon pea sold for these prices was bought and weighed in the laboratory. Samples of damaged pigeon peas were shown to both groups of traders to check if they were of saleable quality or of any particular use

Table 1 lists our key informants, including market traders. All the interviews were made between 20 - 28th September, 1999. This period coincided with the harvest of long-duration, local pigeon pea varieties.

Pigeon pea stem weights

To compare fuel wood from local and improved varieties, stems were harvested from the OFT plots of 15 farmers in Mombezi EPA who participated in pigeon pea trials in the 1998/99 season. For each variety (local, ICEAP 00053, ICEAP00040, and ICP 9145), five stems were randomly selected from a total of 36 planting stations on a nett. plot area 3.6 x 9.0 m. The samples were dried in the laboratory oven to obtain dry weight equivalents.

3.0 Results and discussion

3.1 Farmers' perceptions of pest damage

Plants attacked by *Fusarium* wilt produce no seed yield, while seed from plants attacked by insect pests may have some economic value. Damage by pod sucking bugs is characterised by shrivelled seeds with dark patches. Normally such seeds do not germinate and are not suitable for human consumption. Young pod borer larvae feed by scraping green tissue while older larvae chew into pods leaving characteristic round holes. Usually developing and partly matured seeds are eaten completely. At times, a portion of the seed and *testa* remains (Tuwafe *et. al.*, 1996).

External pod damage by bugs and borers

Farmers' perceptions of the severity of external damage to pods are shown in Table 2 and summarised below.

- All the sample farmers reported that *completely shrivelled* pods with all seeds unfilled were left in the field.

- About 60 % of the sample reported that *partly shrivelled* pods with one or more unfilled seeds were harvested for home use. Forty-seven percent of the sample reported that *partly shrivelled* pods with three or more unfilled seeds were harvested for home use, while 47 % simply left them in the field.

- Farmers considered pod damage by borers more serious than damage from pod sucking bugs. About 40 % of the sample said that mature pods with one visible hole were left in the field. Six out of ten farmers reported that pods with two or more holes were also left in the field. Sixty-seven percent of the farmers said that pods that have many visible holes or sections missing were left in the field. At all three levels of damage, the best alternative use was to feed damaged pods to livestock.

Internal seed damage by bugs and borers

Farmers' perceptions of the severity of internal damage to mature seed are shown in Table 3 and summarised below.

- About 80 % of the sample reported that mature seed with *slight discolouration or a small dent* could be used for planting. Seventy-three percent reported that such seed could be sold. One-third of the sample said that they could cook them, while one respondent said that they could be fed to livestock. No respondent said that this type of seed was unusable.

- Forty-seven percent of the sample reported that mature seed that was *clearly dented and discoloured* could be used for planting, eating, or feeding to livestock. Thirteen percent of farmers said that they could sell clearly dented mature seeds while 13 % said that they were unusable.

- None of the sample farmers thought that *seriously dented* seed could be sold or eaten. Nine out of ten farmers said that they could feed those seeds to livestock. Only 13 % said that seriously dented, mature seeds were unusable.

- Again, pod borers were perceived as more damaging than pod-suckers. All the three levels of damage were considered bad enough to make the seed unusable for planting or sale. While 80 % of the responses were that *slightly damaged and medium damaged* seeds could be cooked for food, especially in the form of *chipere*, *seriously damaged* seeds were thought to be good only for feeding livestock by 80 % of the sample farmers.

Seed coat splitting

All farmers in the sample said that seed with a burst seed coat could be used for *chipere*. Only one-third believed that they could sell this seed when mixed with undamaged seed.

Farmers' and researchers' perceptions of pigeon pea damage compared

The discussion suggests that researchers' rating of pigeon pea losses from pests and diseases is much higher than farmers' own perceptions. Farmers only considered pigeon pea unusable (ie. pods were simply left in the field) when all pods were completely shrivelled or when mature pods had many visible holes or sections missing (Table 2). One or more levels of intermediate pigeon pea damage was accepted for specific purposes such as planting, sale, food, or feed for livestock. Thus, the economic threshold level required for farmers to adopt pest management strategies for insect pests of pigeon pea was much higher than that of researchers.

Varietal differences

Asked if they had observed any differences between varieties in the attack by these pests, 67 % of the sample replied that local varieties generally experienced more damage. Mai Ayimu and Bambo Mankhanamba observed more pod damage to Chilinga than to the other varieties that they planted. About 20 % of the farmers could not distinguish any difference in pest attack between varieties, while 13 % said that they had observed more pest damage on ICP 9145 than on local varieties. Preliminary findings from FSIPM OFTs in the 1998/99 season indicate that local varieties are indeed more susceptible to insect pests than research varieties.

3.2 Diversity

Research on pigeon pea has always stressed genetic diversity in order to reduce production risk for small farmers. Over the past eight years, ICRISAT has supplied over 1,300 breeding lines as part of a collaborative effort to improve the diversity of pigeon pea in Malawi (Tuwafe *et. al.*, 1996).

A feature of both our research sites in Blantyre Shire Highlands RDP was the diversity of local landraces of pigeon pea. Farmers in Mangunda section, Matapwata EPA, identified 16 different local selections while farmers in Lirangwe section, Mombezi EPA, identified nine. This gives a total of 24 local selections. On average, each household planted six different varieties. In all cases but one, farmers were growing ICP 9145 and local varieties as a mixture, rather than planting them separately.

Table 2 lists the pigeon pea selections that we collected from farmers in both Matapwata and Mombezi. The list represents only those pigeon peas that we obtained from farmers and traders in the course of our field visits, and is by no means a complete inventory of selections in the RDP as a whole. The most common types in both areas were *Nandolo wamkulu wamakolo*; *Chilinga* (two types); *Nazikambe* (three types); *Ndewelewe* and *Nazombe*. Appendix 2 shows photographs of these local pigeon pea selections. Two important common features characterise these local selections. First, each local selection has a distinctive colour that differentiates it from other selections. This characteristic plays an important role in the marketing of pigeon peas, because coloured pigeon peas sell faster than the uncoloured ones. Second, all the eight local selections are big-seeded. ICP 9145, which is liked for the weight of its seed, is plain white in colour and has a small seed.

3.3 Why diversity?

We offer four main reasons why farmers continue to grow a range of local pigeon pea varieties.

Risk aversion

Even if the economic returns from two varieties of pigeon pea are identically distributed, mixing them provides a more favourable risk-rewarding combination. Different varieties respond differently to adverse pressures of pests, diseases and weather conditions. If one variety fails, at least the remaining ones may survive. Farmers cited several examples of such varietal differences. Some farmers said that the local variety *Nazombe* performed better than other varieties on poor soils. Others said that the local variety *Nazikumbe* was more tolerant than other varieties to short dry spells.

Consumer preferences

During the dry months, pigeon peas are almost a daily dish because alternative forms of home-grown relish are almost completely absent. Farmers prefer to eat fresh rather than dried pigeon peas. To maximise the supply of fresh pigeon peas, farmers select varieties according to field duration. Researchers classify the maturity of pigeon pea by the number of days after planting to achieve 50 % flowering. 'Early' varieties require 100 days or less; medium, 100-130 days; and late, 131 days or more (Soko, 1996: 72). Farmers, however, classify the maturity of pigeon pea into early, medium, or late according to the varieties with which they are familiar. We have used farmers' classification unless otherwise specified.

- *Chilinga* – a local variety – is an early-maturing variety that produces edible fresh pods as early as May-June. Thus, *Chilinga* and other quick-maturing varieties ensure an early source of cash. Some farmers nicknamed *Chilinga 'mchotsa njala' ()* because of its quick maturity. *Chilinga* may flower as many as three times during a single season, providing fresh pods at different times.

- ICP9145 is a medium-maturing variety that produces fresh pigeon pea one month later than *Chilinga*, in July-August.

- Most local varieties are late-maturing and produce fresh pigeon pea in August-September. The latest-maturing local selections continue producing fresh pods as late as October.

One early study reported that the taste of ICP 9145 compared favourably with that of local varieties (Kawonga, 1992). Farmers in our sample did not share this view, however, and preferred local varieties for their taste, flavour and palatability. ICP 9145 was not believed to be as tasty as local varieties; some likened its taste to that of ground beans. Farmers said that most research varieties used in OFTs had a hard seed coat that made them unpalatable when cooked.

Farmers prepare pigeon peas for food in various forms:

- *Makata.* Pigeon peas are cooked in pods but the pods are removed before eating. *Makata* is frequently eaten for lunch as a main meal instead of nsima in order to conserve the household's dwindling maize supply. Pigeon peas from the local variety *Chilinga* can be eaten as *makata* as early as seven months after planting.

- *Makaka* - dried cassava - with *dried pigeon peas.* This is also eaten as a main meal in place of *nsima*. It is the most favoured form of cooking dried pigeon peas especially between December - January when most households have run out of maize.

  Chipere or *dhal.* After removing the seed coat, the cotyledons of dry seeds are known as *chipere*. This dish is popular because it cooks quickly and has an acceptable appearance, texture, palatability, and overall nutritional quality. Farmers make *chipere* from both fresh and dried pigeon peas. *Chipere* is most popular between October - December.

  To prepare *chipere*, the seed coat is removed by de-hulling. Two forms are practised. Seed is boiled in water for few minutes and then soda or *chidule* (ash and water) added to condition the husk. Alternatively, the seed is boiled and sieved ash is then added to the boiled seeds. In both cases, after boiling the seeds are pounded in a mortar using a pestle. The husks are then removed using a winnowing basket just as with maize. The *chipere* is then washed two or three times in water to remove the ash. The yield of *chipere* from whole pigeon pea varies between 50-80 % depending on the method of processing. Farmers reported that the nature of the seed coat, seed shape and size also influenced the efficiency of de-hulling and the quality of *chipere*. The *chipere* is cooked in a pot by a process called *chipukuso* (vigorously stirring with a special cooking stick until it becomes a thick paste). Cooking takes a very short period, between 18 – 30 minutes depending on the variety.

- *Whole dried seed.* Pigeon pea seed has a hard seed coat with a slightly acid taste. The dried pigeon pea seeds are cooked with salt and spices plus tomatoes and eaten together with *nsima* or cassava.

- *Green seed.* Green pigeon pea pods are harvested before physiological maturity and the seeds used as a vegetable. Many farmers said they liked this type of relish. Green seeds contain more protein, sugar and fat than mature dry seeds. Varieties with large seeds and pods are preferred for consumption as green seed. The local varieties *Nazombe* and *Ndewelewe* were particular favourites.

Markets

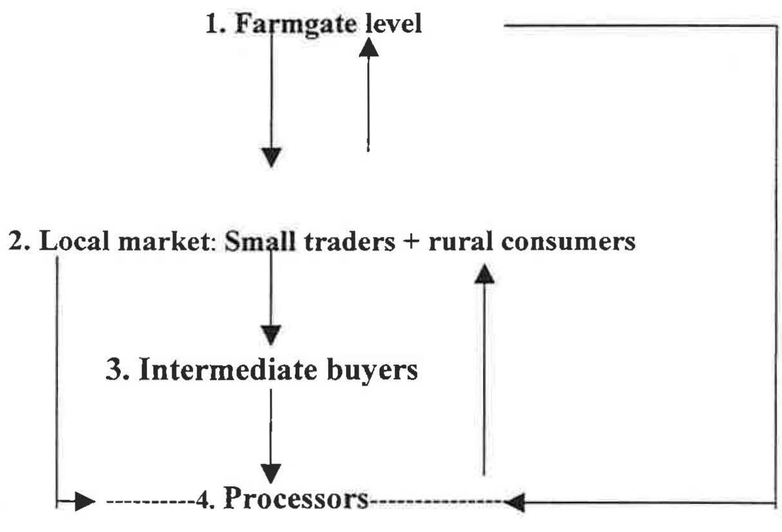
The market for pigeon peas was observed to operate at four different levels (see text figure):.

- At the *farmgate* level, producers either sell pigeon pea directly to consumers or to small traders at local markets. The bulk of pigeon pea sales are made immediately after harvest in September-October to small traders. Sales made directly to consumers are generally for food or for seed. These sales are not common at harvest but are concentrated either at time of planting (late November) or during the hungry months (December-February).

- At the *local market* level, small traders (who may also be farmers) buy pigeon pea directly from producers. Traders who can buy 10 or more 50 kilogram bags may themselves sell directly to processors.

- *Intermediate buyers* usually employ agents who buy from local traders. They are the main suppliers of pigeon pea to the domestic processing industry, which prefers to deal in large volumes. Average prices paid by processors tend to be higher for bulk deliveries.

- Finally, at the *processing* level, there is the Dhal Millers Association, an informal grouping of 16 mills that have negotiated forward contracts with foreign buyers either for whole pigeon pea seed or split pigeon pea (*toordhal*). Some processed pigeon pea also finds its way back to the local market where it is sold by women traders as *chipere*.



The point to note from this analysis is that, unlike beans, the market for pigeon pea has two distinct segments: rural consumers and processors. Because these two markets operate in quite different ways, market segmentation has important implications for farmers' choice of pigeon pea varieties.

A. Rural consumers

Rural consumers are *discriminating* buyers. They are particular about taste, seed and pod size, the colour of the pigeon pea soup when cooked, and the time required for cooking. Most of the local selections are generally known to be more marketable than research varieties, especially when purchased for food, because consumers are not familiar with them..

- The early-maturing variety *Chilinga* was nicknamed *mchotsa njala* because its quick maturity ensured an early supply of relish when most households had run out of beans.

- *Nazombe* sells well on the market for *makata* because the pods and seeds are big.

- *Nandolo wamakolo wamkulu* is the most marketable pigeon pea because of its good taste.

- Small seeded pigeon peas (e.g. *Nandolo wamakolo wang'ono*) are more difficult to sell and are usually sold mixed with larger-seeded varieties.

- Varieties that produce a black or colourless soup when cooked are less marketable on their own than when mixed with coloured pigeon pea varieties. Local pigeon peas are also marketable for their colour.

- Farmers with sufficient pigeon pea often use it to pay hired labour during peak periods. For example, Mai Chisanga and Mai Ayimu reported that they usually hire labour for weeding maize fields in exchange for pigeon peas. Labourers prefer to receive local pigeon peas because they eat it immediately as relish. This season, Mai Chisanga has sold all her three 50 kilogram bags of improved pigeon pea varieties but has kept two bags of local pigeon pea in reserve for future use.

Sales of pigeon pea for seed or for food are not made by weight using a scale, but by quantity using a No. 10 plate. It is more profitable to sell local varieties by the plate because the seeds are lighter than those of ICP 9145. In this segment of the market, there was clear evidence of a price premium for individual varieties of pigeon pea. In Mombezi, for example, the differential between graded and ungraded varieties at planting was 33 % (Table 5). It was possible find pigeon pea being sold by the plate after harvest in Mombezi, with a similar price premium. However, the bulk of pigeon pea sales were made to small traders using scales. In Matapwata after harvest, we found that all sales were made by weight using a scale.

B. Processors

In contrast with rural consumers, processors are *undiscriminating* buyers. Two features of this market segment are important for ensuring the production of local varieties:

Sale by mixtures

Unlike beans, which are always sold as separate varieties, processors buy pigeon pea in mixtures. The pigeon pea variety group is of no particular importance. In the jargon of marketing economics, therefore, pigeon pea is an undifferentiated commodity. Consequently, in this market segment there are no price premiums. At both Mbulumbuzi and Mangunda markets, traders reported no price differentials between local varieties and ICP 9145 (Table 5).

Buyers have no economic incentive to offer such a premium for ICP 9145 since it lacks important qualities that make it attractive to processors or the world market. The seed coat of ICP 9145 is tough and hard to remove when de-hulling. Normally, the seed has to be milled twice. The seed colour is creamy, rather than pure white.

Sale by weight

Unlike sales to rural consumers for seed or food, sales of pigeon pea to traders are always made by weight using a scale. Large producers prefer this method because it is not as time-consuming as selling on a plate basis and they get their money more quickly. Sale by weight favours ICP 9145, which weighs more than long-duration local varieties. Laboratory measurements showed that the mean weight of 100 seeds of ICP 9145 ranged between 12 and 14 gm while the weight for local varieties was as low as 8 gm (Daudi and Makina, 1995), with the exception of *Chilinga* that weighed up to 24 gm. Kawonga (1992) also noted that ICP 9145 was heavier than local pigeon pea varieties. Farmers said they grow ICP 9145 mainly for the market because of its weight advantage over local varieties when bought using a scale. Because processors buy in mixtures, however, farmers maximise returns by mixing their local selections with ICP 9145. Sale by weight also makes it easier for farmers to offload poor quality seed, by mixing damaged seed with good.

Residual reasons

While other factors are not likely to be decisive in influencing farmers' choice of pigeon pea varieties, farmers mentioned several.

Firewood

Farmers use stems of pigeon peas as fuel for cooking especially during the wet season when firewood is scarce and there is limited time available to search for fuel. Nyondo (1996) states that up to 10 t/ha of dry wood can be obtained from pigeon pea depending on the variety. The heat value of pigeon pea stems is said to be one half of the same weight of coal. In both EPAs, farmers said that the amount of fuel wood they get from pigeon peas varies with variety. They said that some local selections were better for firewood because they were taller and had more and bigger branches. These results were confirmed by physical measurements of dry pigeon pea stems. The mean weight for local pigeon pea was 0.114 kg/plant, compared to 0.099 kg/plant for ICP 9145. At the recommended planting density of 37,000 plants/ha, the weight of fuel from local varieties was 4.2 t/ha, or half a tonne greater than the 3.7 t/ha obtained from ICP 9145.

Medicinal value

Some of the farmers we interviewed said that dry roots, leaves and flowers are used to treat a wide range of ailments of the skin. Nyondo (1996) outlines a lot of uses of pigeon pea as medicine.

Pod splitting

Mai Ng'omba observed that the pods of improved pigeon pea varieties have a greater tendency to split if they are left un-harvested in the field for a long time after maturity. As a trader who travels a lot, she mostly grew local pigeon pea varieties because they can tolerate a later harvest. This may also be a problem for other farmers with labour constraints.

4.0 Other pest management strategies

Only one farmer - Mai Ng'omba - suggested that planting wilt-resistant varieties was the *only* way to tackle *Fusarium* wilt. We list some of the strategies mentioned by farmers.

Farmers as breeders

Cross-pollination in pigeon pea averages 20 % (Tuwafe and Singh, 1996). Thus, the purity of a particular variety can only be maintained when grown in isolation. Due to land constraints, most farmers grow pigeon pea in mixed stands of local and improved lines. Unintentionally, therefore, farmers are transferring wilt-resistant genes to local germplasm by cross-breeding local and improved varieties. This suggests that the local pigeon pea selections are not pure lines but hybrids. One farmer, Bambo Chabila, observed that from the early 1990s he had experienced less wilt attack on local pigeon peas. Although he could not explain why, the answer may lie in cross-pollination by wilt-resistant varieties.

Cultural practices

Farmers cited a number of cultural practices that they found to be effective against wilt and insect pests.

- *Rotation.* Mai Muhemwe, Mai Chisanga, Bambo Mankhanamba, and Mai Phambala all said that they avoided planting pigeon pea continuously on the same piece of land because it led to the build-up of *Fusarium* wilt. Farmers who did not practice crop rotation gave land shortage as the cause.

- *1-2 year fallow.* Mai Chisanga said that if she noticed serious damage by wilt in any part of her fields, she avoided planting pigeon peas on those particular sites for one or two years. When planted to pigeon peas again, she observed less *Fusarium wilt* on her pigeon peas.

- *Planting clean seed.* All farmers agreed that selecting good seed for planting was an effective control strategy against *Fusarium* wilt. Pigeon pea kept for seed was normally harvested separately. Seed selection was usually made in the field while the crop was still standing. Seed for planting was only harvested from those plants that looked healthy and strong.

- *Early* kuwojeka. Mai Malonda claimed that *Fusarium* wilt was reduced when weeds and crop residues from the previous crop season have sufficient time to decompose before pigeon pea was planted. The practice of incorporating weeds and residues under a shallow soil covering is known as *kuwojeka*. She also observed, however, that it is difficult to practice *kuwojeka* on hard clay soils such as those found in the Chitera dambo.

- *Planting on top of ridges and removing volunteer plants.* Mai Ayimu believed that planting pigeon peas on the top rather than the side of the ridge and removing volunteer plants helped to reduce the incidence of *Fusarium* wilt. Although she was unable to explain why planting on the side of the ridges encouraged wilt, she believed volunteer plants became ready hosts for the fungus that causes wilt. Field trials by the FSIPM Project, however, have shown no significant differences in seed weight or total pod weight between planting on the top or the side of the ridge (Abeyasekera *et. al.*, 1999).

- *Choice of site.* Mai Phambala, Bambo Mankhanamba and Bambo Wesere believed that certain soil types were more prone to *Fusarium* wilt than others. As such, they deliberately avoid planting susceptible varieties on those soils. Bambo Wesere observed that local pigeon peas were less susceptible to wilt when grown on upland fields. He chose to plant local pigeon peas in the upland and the improved pigeon peas in the dambo. This farmer perception is confirmed by statistical analysis of OFTs in the 1998/99 season, which show a higher incidence of *Fusarium* wilt in dambo fields (Abeyasekera, 1999: 4-21). Kawonga (1992) cites studies stating that clay soils are more associated with *Fusarium wilt* than sandy soils.

5.0 Conclusion: a new approach to IPM for food crops?

The adoption of IPM strategies in the Blantyre Shire Highlands is likely to be market-driven. This is not just because smallholders in this peri-urban environment are strongly oriented towards the market but because it is the market that provides farmers with the economic incentive to reduce crop losses from pests. The operation of both these factors is seen very clearly in the cultivation of *dimba* vegetables. Vegetable production is a purely commercial enterprise that offers high economic returns. To protect these returns, growers invest heavily in pesticides. Rationalising the indiscriminate use of pesticides then becomes a promising IPM strategy that directly increases farmers' revenues by reducing their production costs.

Identifying similar economic incentives for the adoption of IPM strategies for food crops (maize, beans, pigeon pea, sweet potato) is less straightforward since, as a rule, these crops are grown without cash investment in chemical forms of plant protection. This does not render IPM a lost cause, however. Opportunities for IPM interventions are created by the frequency with which these crops are marketed. In the Blantyre Shire Highlands, there is no hard-and-fast distinction between a food and a cash crop. IPM strategies that capitalise on this insight may offer an effective, though indirect, route to reducing crop losses.

Pigeon pea is a prime example. This crop is widely sold and is an important source of cash income for most smallholders, including poorer households. Demand for the crop is high, and the domestic market is reasonably competitive, ensuring fair producer prices. A growing volume of Malawian pigeon pea enters the world market. Unfortunately, pigeon pea also suffers severely from insect pests and diseases, notably *Fusarium* wilt. Despite the release of the wilt-resistant variety ICP 9145, however, farmers largely continue to grow local varieties. One important reason is that ICP 9145 lacks important varietal characteristics that might attract a price premium in domestic and foreign markets. Pigeon pea is traded as a mixture, with no attempt made to separate local and improved varieties. This reduces the economic incentive for growers to adopt varieties that are resistant to wilt. A more holistic breeding strategy is required, one that combines resistance to pests and diseases with the other qualities that are desirable for the processing industry and world markets. In short, varietal resistance is a necessary, but not a sufficient condition for an IPM strategy for pigeon pea in Malawi. For such a strategy to be successful, breeders must pay more attention to the link between pests and markets.

The varieties of pigeon pea currently being tested in Malawi suggest that this lesson has been partly learnt. Among these, the varieties ICEAP 00040 and 00040 have received an enthusiastic response from farmers in OFTs. Both are long-duration varieties selected from Kenyan landraces. ICEAP 00020 is described as tolerant to wilt while ICEAP 00040 is described as resistant (ICRISAT, 1999). Unlike ICP 9145, however, both are rated highly both for taste and marketability. Their large seed size, white colour, and ease of de- hulling make them particularly suitable for export markets.

The link between pests and markets may prove equally important for beans, another food crop that is frequently sold. Both main crop beans and, to a lesser extent, the relay crop, are attacked by a complex of pests and diseases. The task of breeding varieties that are resistant to such a wide range of pests is daunting. As with pigeon pea, however, the market has created an opportunity for IPM. Early-maturing bean varieties enjoy a hefty price premium because they provide a source of protein during a period of severe food shortage (Orr *et. al.*, 1999). By a happy coincidence, early-maturity may also reduce their exposure to pests and diseases. Thus, promoting the spread of quick-maturing varieties may well prove to be the most effective IPM strategy for beans. Once again, the link between pests and markets is critical.

The principle may also hold true for IPM strategies that involve cultural practices. Sealing cracks on sweet potato ridges within six weeks of planting is known to reduce damage to tubers from the sweet potato weevil. This strategy – which requires additional labour – may only be economically viable in areas where the crop is grown primarily for sale. In areas of the Blantyre Shire Highlands where sweet potato is grown as a cash crop, farmers grow a quick-maturing, high-yielding hybrid variety, and the labour input for weeding is twice that where the crop is grown for home consumption. Growers in these areas have a strong economic incentive to reduce damage from pests. An IPM strategy to reduce losses from sweet potato weevil, therefore, is more likely to win acceptance from market-oriented growers who have already demonstrated their willingness to invest labour in protecting their crop.

Pests and markets, therefore, may form the basis of a new philosophy of IPM for resource-poor African farmers, and particularly for food crops where farmers cannot afford to make cash investments in chemical control. In essence, the approach involves three steps:

- Identify the varieties that enjoy a competitive advantage on local markets;
- Isolate the varietal traits that create this competitive advantage; and
- Combine IPM strategies with these desirable traits to ensure farmer adoption.

Implementing this approach will require a farming systems perspective on IPM which accepts that controlling pests and diseases is only one of several factors determining the farmer's choice of crop varieties.

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References

S. Abeyasakera (1999). FSIPM 1997-98. *On-station and On-farm Experimental Trials. Statistical Analysis Reports*. Vol. 1. University of Reading: Statistical Services Centre.

S. Abeyasekera, J. M. Ritchie, C. S. M. Chanika, S. J. Ross, A.T. Daudi, C. B. K. Mkandawire, T. H. Maulana, E. R. Shaba, and T. T. K. Milanzi (1999). Assessment of performance of pigeonpea varieties in relation to disease damage and yield under smallholder management in Blantyre Shire Highlands. FSIPM Project. September. Mimeo, 31 pp.

BLADD (1999). Third Round Agricultural Estimates, 1998/99 Crop Season. Mimeo, 19 pp.

A. T. Daudi and D. W. Makina (1995). Screening pigeonpea lines for resistance to root knot nematodes. Pp. 60-63 in S. N. Silim, S. B. King, and S. Tuwafe (eds) *Improvement of pigeonpea in eastern and southern Africa – Annual Research Planning Meeting 1994, 21-23 September, 1994, Nairobi, Kenya*. (Patancheru: ICRISAT).

ICRISAT (1999). Pigeon pea variety descriptors. Mimeo, 6 pp.

J. Lawson-McDowall and P. Kapulula (1999). 'Cause Unknown': Farmers' perceptions of wilt in pigeon peas. FSIPM Project. August. Mimeo, 15 pp.

W. T. Kawonga (1992). 'Adaptive Research on Varieties of Pigeon Peas with resistance to *Fusarium* wilt in Blantyre Agricultural Development Division, Malawi'. *Farming Systems Bulletin, Eastern and Southern Africa*, 10 (January-June): pp 1-4.

E. M. Minja (1992). Anthropod pests of pigeonpea and their management. Pp. 48-62 in S. Tuwafe and F. Singh, comp., *Regional Pigeon Pea Production Technology Training Course Manual*. ICRISAT Pigeon Pea Improvement Project for Southern and Eastern Africa.(Lilongwe: ICRISAT).

E. M. Minja, T. G. Shanower, J. M. Songa, J. M. Ong'aro, P. Mviha, F. A. Myaka, and H. Okurut-Akol (1996). Pigeonpea seed damage from Insect Pests in Farmers' Fields in Kenya, Malawi, Tanzania, and Uganda. *ICP Newsletter*, 3: 97-98.

P. Mviha and J. Kumwenda (1999). 'Effects of Cypermethrin + Dimethoate and extracts of Neem *Azadirachta indica* and Fish bean, *Tephrosia vogelli* on pod borers and pod suckers of short duration pigeon peas', Annual Research Project Report, 1998/99, Legume Entomology.

F. K. Nyondo (1996). Economic advantages of pigeonpea production in eastern and southern Africa. Pp. 113-120 in S. Tuwafe and F. Singh, comp., *Regional Pigeon Pea Production Technology Training Course Manual*. ICRISAT Pigeon Pea Improvement Project for Southern and Eastern Africa.(Lilongwe: ICRISAT).

A. Orr. P. Jere, and A Koloko (1997). *Baseline Survey, 1996/97*. FSIPM Project. November. Mimeo.

A. Orr, B. Mwale, and D. Saiti (1999). The accidental strategists: how farmers avoid bean pests and diseases without even trying. FSIPM Project. September. Mimeo, 20 pp.

M. V. Reddy (1991). Disease problems of pigeonpea in Eastern Africa – Progress and future research needs. Pp. 60-64 in *Proceedings of the First Eastern and Southern African Regional Legumes (Pigeonpea) Workshop, 25-27 June, Nairobi, Kenya*. (Nairobi: ICRISAT).

C. R. Riches, L. J. Shaxson, J. W. M. Logan and D. C. Munthali (1993). *Insect and Parasitic Weed Problems of Southern Malawi and the Use of Farmer Knowledge in the Design of Control Measures*. ODI Agricultural Administration (Research and Extension) Network Paper No. 42. July.

J. M. Ritchie and C.S.M. Chanika, eds. (1999). Proposal for On-farm Pest Management Field Trials, 1998/99 season. FSIPM Project. Mimeo.

H. N. Soko (1996). 'Pigeonpea based cropping system', Pp. 67-76 in 44 in S. Tuwafe and F. Singh, comp.. *Regional Pigeon Pea Production Technology Training Course Manual*. ICRISAT Pigeon Pea Improvement Project for Southern and Eastern Africa.(Lilongwe: ICRISAT).

P. Subramanyam (1996). 'Diseases of pigeonpea in southern and eastern Africa' Pp. 41-44 in S. Tuwafe and F. Singh, comp., *Regional Pigeon Pea Production Technology Training Course Manual*. ICRISAT Pigeon Pea Improvement Project for Southern and Eastern Africa.(Lilongwe: ICRISAT).

S. Tuwafe and P. Subrahmanyam (1994). 'Breeding pigeon peas for high yield, stability and adaptation'. Paper presented at the annual ICRISAT Research Planning Meeting for Improvement of Pigeon Pea in Eastern and Southern Africa. Mimeo.

Table 1. Key informants on pigeon pea pest management and trade

No.	Persons interviewed	Village	EPA	Description
1	Mai Malonda	Chiwinja	Mombezi	OFT participant
2	Mai Namvenya	Jonathan	Mombezi	Non-OFT participant
3	Mai Muhemwe	Lidala	Mombezi	OFT participant
4	Mai Chipakula	Lidala	Mombezi	OFT participant
5	Bambo and Mai Makolo	Makawa	Mombezi	Non-OFT participant
6	Bambo and Mai Dick Wesere	Lidala	Mombezi	Non-OFT participant
7	Mai Ayimu	Lidala	Mombezi	OFT participant
8	Mai Mpenda	Lidala	Mombezi	OFT participant
9	Mai Ng'omba	Chiwinja	Mombezi	Non-OFT participant
10	Bambo Mangani	Gumbi	Matapwata	OFT participant
11	Mai Chisanga	Pindani	Matapwata	OFT participant
12	Bambo Matchawa	Pindani	Matapwata	Non-OFT participant
13	Mai Phambala	Pindani	Matapwata	OFT participant
14	Bambo and Mai Mankhanamba	Pindani	Matapwata	OFT participant
15	Bambo Chabila	Pindani	Matapwata	Non-OFT participant
16	Mai Irene Msusa	Makalani	Mombezi, Mbulumbuzi Market	Farmer/trader
17	Mai Mitochi	Kachingwe	Mombezi, Mbulumbuzi Market	Farmer/ trader
18	Mai Bvayala	Juwa	Mombezi, Mbulumbuzi Market	Farmer/trader
19	Mai Sapanga	Kachere Township	Mombezi, Mbulumbuzi Market	*Chipere* trader
20	Bambo M. Mijali	Ndalama	Matapwata, Mangunda	Small trader
21	Bambo Eni Mawere	Muhura	Matapwata, Mangunda	Small trader

Table 2. Farmers' perception of pod damage from insect pests

Pod damage characteristic		Harvested with good pods for home use		Harvested to feed livestock		Left in the field	
Pod sucking bugs		N	%	N	%	N	%
1	Partly shrivelled pod with one or two unfilled seeds	9	60	2	13.3	2	13.3
2	Partly shrivelled pod with Three or more unfilled Seeds	7	46.7	2	13.3	7	46.7
3	Completely shrivelled pod with all seeds unfilled	3	33.3	2	13.3	9	60.0
Pod boring caterpillars							
1	Mature pod with one Visible hole	5	33.3	4	26.7	6	40.0
2	Mature pod with two or Three visible holes	2	13.3	4	26.7	9	60.0
3	Mature pod with many Visible holes or sections Missing	2	13.3	3	20.0	10	66.7

Table 3. Farmers' perceptions of seed damage from insect pests

Seed characteristic level of damage	Alternative uses of damaged pigeon pea seed									
	Planting		Sale		Cooked for food		Feed for livestock		Not Usable	
Pod sucking bugs	N	%	N	%	N	%	N	%	N	%
1 Mature seeds with slight discoloration or small dent. When cut open, 10-15% of seed surface is necrotic.	12	80.0	11	73.3	5	33.3	1	6.7	-	-
2 Mature seeds clearly dented and discoloured. When cut open, more than 30% of seed is necrotic.	7	46.7	2	13.3	7	46.7	7	46.7	2	13.3
3 Undeveloped or mature seeds seriously dented and discoloured. When cut open, more than 60% of seed is necrotic.	-	-	-	-	-	-	13	86.7	2	13.3
Pod boring caterpillars										
1 Slight damage (<30% seed volume consumed)	-	-	-	-	12	80.0	3	20.0	-	-
2 Medium damage (31-60% seed volume consumed)	-	-	-	-	12	80.0	4	26.7	-	-
3 Serious damage (>60% seed volume consumed)	-	-	-	-	2	13.3	12	80.0	2	13.3
Seed coating splitting	2	13.3	5	33.3	15	100	2	13.3	-	-

Table 4: Pigeon pea varieties grown by farmers in Matapwata and Mombezi EPA

No	Local name(s)	Source	Description	Maturity	Cooking Time	Taste	Marketability	Other Remarks
1	*Nandolo wamakolo wang'ono* (also called *Kaning'indi* in ChiYao in Mombezi	Mainly Mombezi	Seed coat white with orange speckles, seeds are small and round	Late	Cooks late	Not as Good	Small seeds are not as marketable as others	Higher yield than the big local variety - sometimes referred to as *Chinese wang'ono* for this reason.
2a	*Nandolo wamakolo wa Chilinga*	Both in Mangunda and Mombezi, but mostly Mombezi	Maroon round seed with white and black speckles; or plain maroon seed.	Fastest-maturing variety before Chinese	Cooks fast	Some describe the tastes as that of velvet beans. Better than Chinese	Marketable	- Up to three or more harvests per season. - Some farmers do not like the black colour of the soup when cooked. - Nicknamed *Mchotsa Njala* because it matures fast. - An early dry spell affects yield because flowers dry up
2b	Locally nicknamed *Nakutema*, implying fast maturing.	Mangunda only	Black round seed with violet speckles	Same as No. 2a	Same as No. 2a	Good taste but many do not like the black soup when cooked	Not as popular	Mostly eaten green because it matures much earlier than any other variety.
3	*Nandolo wamakolo wamkulu*	Both Mangunda and Mombezi	Seed coat white with deep orange speckles, seed big and flat; pod colour whitish	Matures late	Fastest to cook	The best pigeon pea to eat. Good flavour and palatable.	Rated first for marketability and for food, but weighs less than Chinese	Farmers keep this variety for future consumption. Some likened its good taste to that of beans.
4	*Nandolo wamakolo wa Nazombe*	Both in Mangunda and Mombezi	Medium seed size, seed coat creamy colour with scattered orange speckles	Matures late but earlier than No. 3	Cooks fast	Tastes sweet. Some like to eat as *makata* because the pods are big	Better than Chinese.	Does not do well in poor soils. It has big pods.

4/3

Table 4 (Cont).

5a	*Nazikambe Nakachilinga Anampweleni*	Lidala and Makawa villages in Mombezi. and Mangunda	Medium seed size. seed coat whitish with black speckles/ or red speckles/ or dotted black spots	Matures after Chinese	Usually cooked with other types of pigeon peas.	Tastes like 'nkhungudzu'	Marketable	- Up to two harvests a year: - Farmers think it originated from Mozambique. - Currently grown in mixtures with other local varieties. - One farmer said it can survive a dry spell of up to 3 weeks
5b	*Nazikambe/ Nakachilinga/ Anampweleni*	Lidala and Makawa villages in Mombezi, and Mangunda	Medium seed size, seed coat whitish with red speckles	"	"	"	"	"
5c	*Nakachilinga/ Nazikambe*	Lidala and Makawa villages in Mombezi, and Mangunda	Small seed size, seed coat whitish with dotted black sports	"	"	"	Sold mostly mixed with other varieties	"
6	*Ndewelewe*	Mostly found in Mombezi (Lidala and Jonathan villages)	Looks like No. 3, seed is big and disc shaped; pod colour is brownish	Matures late	Cooks fast	Good taste	Marketable	The name *Ndewelewe* is given because of the high yielding characteristic of this variety
7	Unidentified local	Mangunda	Looks like No. 3 but different pod characteristics, seed not as wrinkled as No. 3.	Matures late	Cooks fast	Good taste	Marketable	
8	Unidentified local	Mombezi	Looks like No. 6; seed is flat and disc shaped; pod colour yellowish with brown stripes	Matures late	Cooks fast	Good taste	Marketable	

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Table 4 (Cont).

9	Unidentified local	Mangunda	White seed coated with brown colour plus one or two maroon spots. Matured seeds show seed coat splitting.	Matures late. later than the other well known local	Cooks fast	Good	Marketable	
10	Unidentified local	Mangunda	White seed coated with orange colour.	Matures late	Cooks fast	Good	Marketable	
11	Unidentified local	Mangunda	Small and flat violet coloured seed	Matures late	First time growing the variety	First time growing the variety	First time growing the variety	First time growing the variety
12	Unidentified local	Mangunda	Same colour as No. 4 but with distinct oranges spots.	Matures late.	Cooks fast	Good, like No. 4	Marketable	Bought seed from Mulanje, Mozambique border
13	Unidentified local	Mangunda	Looks like No.10, big seed with deep orange colour	Matures late	Cooks fast	Good	Marketable	
14	Unidentified local	Mangunda	Big seed, cream in colour with orange spots, big eye	Matures late	Cooks fast	Good	Marketable	Said to be grown in Mozambique
15	Unidentified local	Chiradzulu	Small round seed, looks like No. 6, Pod is yellow with brown stripes	Matures late	Cooks more slowly	Good, like No. 6	Small types are not as Marketable	
16	Unidentified local	Chiradzulu	Same appearance as No.15, seed look oval shaped	Matures late	Cooks more slowly	Good	Marketable	
17	Unidentified local	Mangunda	Same as No. 1, light orange speckles	Matures late	Cooks more slowly	Not so good	Not so marketable	Small seeds usually not marketable
18	ICP 9145/ Chinese	Both Mombezi and Mangunda	Plain white coloured seed	Matures fast	Cooks more slowly	Not so good	Marketable for its weight	

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Table 5. Pigeon pea prices by marketing channel in Mombezi and Matapwata EPA local markets, 1998/99 Season

(Mk/kg)

Market	Mombezi EPA, Mbulumbuzi market				Matapwata EPA, Mangunda market				Factory pigeon pea prices[1]		Intermediate buyers price	
Pigeon pea grade	Farmers' selling price (plate basis)		Small/medium buyers' price (scale basis)		Farmers selling price (plate basis)		Small/medium buyers' price (scale basis)		Trans-globe		Mkando market	
	Harvest time	Planting time	Harvest time	Planting time	Planting time	Harvest time	Harvest time	Planting time	Harvest time	Planting time	Planting time	Harvest time
1 Ungraded Pigeon Pea, sold in mixtures	10.15	20.30	6.50	10.50	19.20	9.60	7.00	12.00	12.00	18.00	15.00	10.00
2 Graded Pigeon pea, sold by variety	15.22	30.44	6.50	10.50	25.20	14.44	7.00	12.00	12.00	18.00	15.00	10.00
Price differential (%)	33	33	0	0	24	33	0	0	0	0	0	0
1 *Chipere*[2] or dhal (coarse)	12.60	18.90	-	-	-	-	-	-	9.60	9.60	-	-
2 *Chipere* or dhal (fine)	10.44	15.66	-	-	-	-	-	-	6.00	9.60	-	-
Price differential (%)	17	21	-	-	-	-	-	-	38	0	-	-

[1] Factory prices are those reported by traders who sell pigeon peas to processors or businesswomen who buy dhal from the factories.
[2] Businesswomen in Mbulumbuzi Market only sold Dhal. Neither small/medium trader nor Intermediate buyer was involved in dhal marketing.

Appendix 1: Checklist for farmer interviews

Pigeon pea varieties commonly grown by the farmer

Variety	Characteristics			
	Maturity	Cooking time	Taste	Marketability
1				

Seed management

1 How did you first get the seed for the varieties you grow?

2 Do you keep your own seed for next planting or else you rely on purchase?

Uses of pigeon peas

1 Why do you grow mixtures of pigeon pea varieties?

2 Forms in which farmers eat pigeon peas and at what time? (May differ by variety)- fresh *ndiwo*, *makata, chipere, ndiwo*-dried, etc..

Pigeon pea Marketing

1 If farmer sells some pigeon peas, are they sold as mixture or separate?

2 If separate, is there price differential?

(a) At harvest
(b) At planting

Farmers' perception of pigeon pea pod damage (show samples)

Farmers' perception of pigeon pea seed damage (show samples)

1 Do farmers notice any variety differences in these damages?

2 What methods does the farmer use to control pod and seed damage?

(a) pod sucking bugs

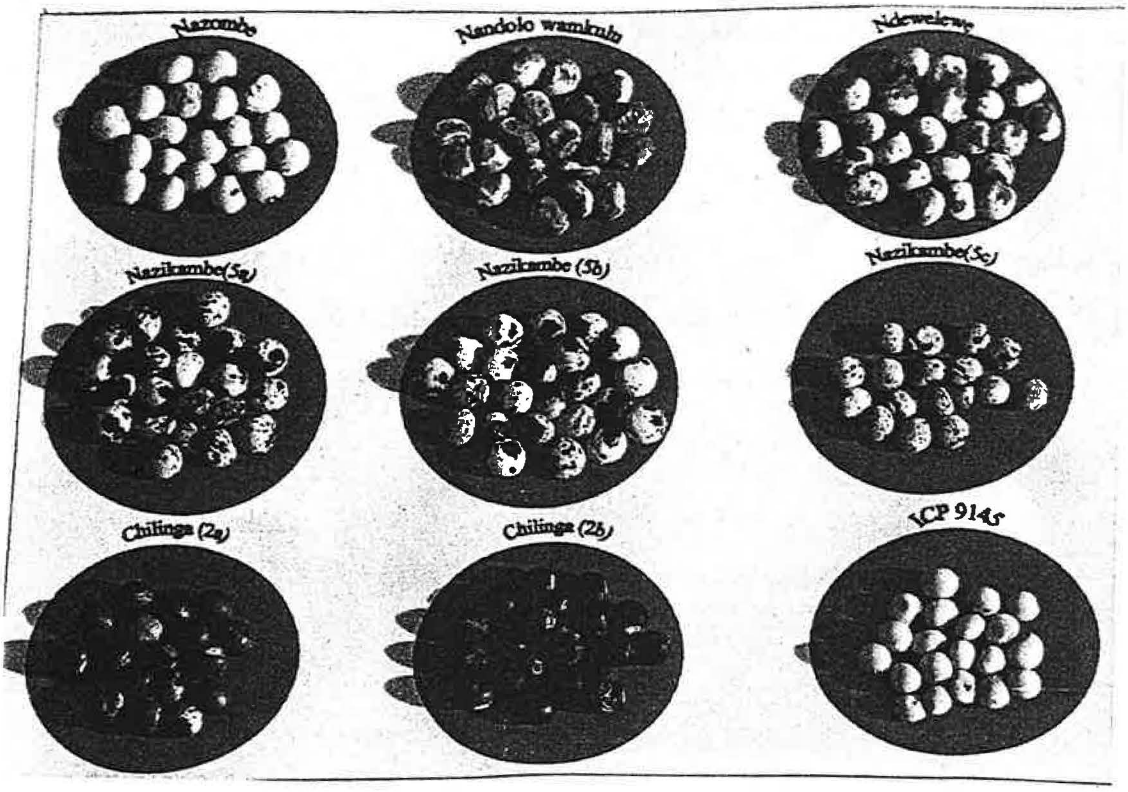
(b) pod boring caterpillars

3 Apart from pod and seed damage losses from pests, is *Fusarium wilt* also a major pigeon production constraint for the farmer?

4 Has he/she noticed any variety differences in the attack of *Fusarium wilt*?

5 Does the farmer have any control strategies for *Fusarium wilt*?

Appendix 2: Farmer Selections of local pigeon pea



Key to photograph:

(Numbers in parentheses refer to Table 4)

Top row (reading left to right)

Nazombe	(4)
Nandolo wamkulu	(3)
Ndewelewe	(6)

Middle row (reading left to right)

Nazikambe	(5a)
Nazikambe	(5b)
Nazikambe	(5c)

Bottom row (reading left to right)

Chilinga	(2a)
Chilinga	(2b)
ICP 9145	(18)

The accidental strategists: how farmers avoid bean pests and diseases without even trying.

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15 September, 1999

Abstract

OFTs by the FSIPM Project in Blantyre Shire Highlands RDP show that Kaulesi, a local variety, *performs better than* Chimbamba, Napilira *and* Nagaga, *three varieties released by the national bean programme. Circumstantial evidence suggests that* Kaulesi's *early maturity shortens its exposure to insect pests and diseases. Twenty-four landraces of beans were identified in local markets and farmer's stores. Farmers identified three other early-maturing varieties* – Nyadanawo, Mashunga, *and* Nambewe tikhwasule. *Farmers did not perceive any connection between early maturity and reduced crop losses from pests. Instead, they grew early-maturing beans because they provided food and cash to buy food in February when most households have run out of maize. In terms of pest management, therefore, farmers are accidental strategists. Choosing bean varieties that enhance food security may also, by a happy coincidence, be effective pest management. This hypothesis may be tested in OFTs conducted by the national bean research programme. Early maturing beans are best seen not as an IPM but as a crop management recommendation, that stresses the visible economic benefits (food security, cash income, marketability) with which farmers are already familiar.*

Introduction

The common bean (*Phaseolus vulgaris* L.) plays a dual role in the smallholder farming system in the Blantyre Shire Highlands. Beans are a source of food, providing protein in the critical hungry months before the maize harvest. More importantly, they are a source of cash. Bean production in the Shire Highlands is highly commercial. Most farmers buy seed; they select varieties for marketability; they sell most of their crop; and they consider beans their most important cash crop (Ferguson *et. al.*, 1992). The main markets are in Blantyre-Limbe (pop. 0.75 million) and surrounding estates which employ permanent workers.

In Africa as a whole, scientists recognise eight key insect pests that cause damage to beans. All are ranked as 'important' or 'very important' in Malawi (Ampofo, ed., 1993). The major insect pests of beans in Blantyre Shire Highlands are the bean foliage beetle (*Ootheca bennigseni*), the striped bean weevil (*Alcidodes leucogrammus*) and bean stem maggot (BSM) (*Ophiomyia* spp.). Farmers elsewhere in Malawi also rank BSM and the bean foliage beetle as major pests (Malawi Bean Improvement Project, 1997). OFTs by the FSIPM Project over four bean crops in two crop seasons have shown low average levels of damage to beans from insect pests, the exception being *Ootheca* in 19987/98 (Abayesekera, 1999). This has made it difficult to draw any firm conclusions about varietal resistance from these trials. In both seasons, however, there have been significant yield differences between varieties, with *Kaulesi* out-performing three varieties recently released by the national bean programme. *Kaulesi* outyielded *Chimbamba* in 1996/97 and *Napilira* and *Nagaga* in 1997/98. Higher yields from *Kaulesi* may be associated with early-maturity, which shortens exposure to pests and diseases. Despite higher yields from *Kaulesi*, however, FSIPM trials have not shown a clear and consistent advantage for this variety in terms of reduced damage from insect pests.

The general objective of this study was to determine the role of early maturing varieties in farmers' pest management strategies for beans. Our specific objectives were to determine:

(1) the diversity of varieties grown by farmers;
(2) the reasons for growing early-maturing varieties; and
(3) farmers' perceptions of the link between early-maturity and losses from pests.

Methods

We interviewed a sample of 11 farmers representing five groups identified through cluster analysis (Orr and Jere, 1999). Table 1 gives details of cluster membership. In addition, we interviewed three farmers who had supplied seed (Mai Ng'omba, Chiwinja village) or who were reported to use early-maturing varieties (Bambo and Mai Chinyama, Kambua village, and Mai Maseya, Magomero village). We also interviewed several bean traders on market days at Mbulumbuzi (Mai Ester Basikolo, Mai Dorothy Maliro, and Mai Luwemba) and Bvumbwe markets (Mai Mtembo). Traders were asked about the prices of *Kaulesi* and *Chimbamba* at three different periods during the 1998/99 season. The quantity sold for these prices was bought and weighed. Finally, we visited Mr. Munthali, in charge of the Matapwata site for the Bunda Bean Programme, to assist with identification of bean varieties.

Interviews with farmers were made using a checklist (Appendix 1). Wherever possible, we interviewed women, since they are responsible for the selection, storage, and sale of beans. (Men may help choose which varieties to plant but usually it is the woman's opinion that counts). We showed farmers samples of 10 bean varieties to aid identification, and samples of adult *Ootheca* and adult *Alcidodes* to assist discussion of farmers' strategies for these pests. All these interviews were made between 16 – 23 August, 1999.

Results and discussion

Diversity

With over 2,000 landraces, Malawi is a centre of genetic diversity in beans (Bean Research Program, 1998). Socio-economic research on beans has stressed the importance of diversity in reducing production risk for small farmers (Ferguson, 1993; Voss, 1992; Jiggins, 1996). Farmers in east and central Africa usually plant a mixture of bean varieties rather than one or two pure lines. This finding has influenced national breeding programmes. In Malawi, breeders have released 15 varieties (9 by Bunda, 6 by CIAT) suitable for a wide range of growing conditions (Makato, 1997).

Farmers in the Shire Highlands grow fewer varieties than elsewhere in Malawi. A survey made by the Bunda Bean Programme in 1990-91 revealed that farmers in Matapwata EPA grew an average of 2.29 bean varieties compared to a national average of 2.56 (Ferguson *et. al.*, 1992: 63, 96 Table 38 [Chi-square = 49.003, Sig. at 1% level]). This lack of diversity may partly reflect the timing of the Bunda survey. Households in both Matapwata and Mombezi EPAs told us that a drought in 1985/86 had wiped out the stock of many local varieties and some had not yet managed to replace them. Minor local varieties were most difficult to replace. For example, Linny Mpenda reported losing stock of four varieties in this drought, and Mai Beni reported losing seed for two varieties. According to Mr. Munthali of the Bunda Bean Programme, the drought hit early-maturing varieties just at flowering.

The degree of diversity depends on whether one defines a bean as a 'variety' or as a 'landrace'. [1] Table 2 lists the 24 types of bean that we collected from local traders or from farmers. Of these, 11 (46 %) consisted of four widely-grown varieties which farmers subdivided according to seedcoat, growth habit, maturity, and taste. Farmers classified *Nanyati* into four landraces (Nos. 13-16); *Chimbamba* into three landraces (Nos. 9-11); and

Kayera and *Kaulesi* into two landraces (Nos. 17-18, 20-21). (A third landrace of *Kayera*, with a distinctive red dot on the seedcoat, which was reported to mature as quickly as *Kaulesi*, was not found in the markets we visited but was reported to be common further south in Phalombe.) Thus, farmers who grow *Kaulesi*, *Chimbamba*, *Nanyati*, and *Kayera* may grow only four bean 'varieties' but 11 landraces. Landraces of the same variety are usually sold as mixtures and sorted by farmers before planting. Appendix 2 shows photographs of the landraces of *Chimbamba* and *Nanyati* listed in Table 2.

The relative lack of varietal diversity in the Shire Highlands has been attributed to land scarcity (Ferguson *et. al.*, 1992: 66). Of the 14 farmers we interviewed, however, only two specifically mentioned land shortage as a reason for not planting other varieties. The majority had not planted enough beans to fully cover the area planted to maize. Diversity was reduced by two factors. First, lack of effective demand: many farmers could not afford to buy seed because they had not enough cash. Second, farmers deliberately narrowed the range of varieties that they grew in order to meet market demands:

- Diversity was not a problem of supply. Farmers recognised varieties that they did not plant. Mai Chinyama had seen four varieties (Nos. 3, 5, 6, and 7) in the local market but did not plant them. Mai Mazinga had seen four varieties (Nos. 2, 3, 5, and 7) but had not planted them. Four varieties (Nos. 7, 8, 22, and 23) available in the market were found hard to identify even by knowledgeable traders.

- Farmers also obtained a wide range of varieties through relatives, work, and travel. Four varieties (Nos. 1, 5, 6, and 24) were grown by only a few farmers. Mai Chinyama in Kambua had obtained *Nakakhaki* (No. 5) from her daughter in Chirimba, who had bought it in Chiradzulu. Bambo Chimwaza had obtained *Nakakale* (No. 6) from Chigafa estate, Thyolo, where he once worked. Tereza Luwera had got *Kankhope* (No. 1) from traders in Mangochi. Mai Ng'omba had got what she called *Kanzama* (No. 24) from a relative in Chitera who obtained it from a friend in Khonjeni village. Another source of seed was the children's game *njuga.* Children get seed to play with by gleaning bean fields after harvest. Each player puts a number of seeds of the same variety into a basin, which is then shaken out. If one type of bean jumps out from the heap the owner wins all the beans in the basin. If more than one type of bean jumps out, they play again. Round-seeded varieties jump further than straight-seeded ones. Mai Ng'omba acquired *Nakakhaki* and the Chimwazas acquired *Mashunga* in this way.

- Varieties acquired through these informal channels were not grown for sale, but in small amounts for food. Tereza Luwera prized *Khankope* for its taste; Mai Ngomba preferred the taste of *Kanzama* over *Chimbamba*; and Bambo Chimwaza liked *Nakakale* because it provided fresh beans later than *Chimbamba.*

- Farmers stopped growing certain varieties because they were difficult to sell. Thus, Mai Chinyama knew about *Nambewe* – an early-maturing variety – but did not grow it because people didn't buy it. She knew a neighbour called Mai Maseya who grew *Nambewe*. When we spoke to Mai Maseya, however, she told us that she had discontinued growing this variety because so few people knew about it that it was not saleable. These varieties are either eaten not sold, or appear in the market for a very short period after harvest and before planting.

We suggest that the preference our sample farmers showed for growing fewer varieties is best seen as a rational response to market demand. Where consumers lack information, markets discourage diversity and promote loyalty to a few familiar brands. Where beans are grown as a cash crop, therefore, the rationality of the market overrides the rationality of diversity that prevails where beans are grown chiefly for food. The loss of diversity caused by commercialisation has led to calls for price controls and other measures to promote bean mixtures and discourage farmers from growing pure lines (Voss, 1992: 47). To farmers, however, the benefits of specialisation presumably outweigh the costs otherwise they would still plant greater mixtures.

Early maturity

We defined 'early' and 'late' varieties with reference to *Kaulesi* and *Chimbamba*, respectively. During the main growing season, *Kaulesi* produces fresh beans after 90 days and dried beans by 120 days, while *Chimbamba* produces fresh beans after 120 days and dry beans within 150 days. Field duration is longer for the second crop because of less favourable growing conditions. Table 2 shows that farmers identified three early-maturing varieties besides *Kaulesi*. These were:

- *Nyadanawo*. Farmers had slightly conflicting views on time of maturity. It was described by one household (Bambo and Mai Chinyama) as maturing one week before *Kaulesi* and by another (Mai Mazinga) as maturing two weeks after *Kaulesi;*

- *Mashunga*, that matured at the same time as *Kaulesi*; and

- *Nambewe* or *Nambewe tikhwasule* that matured within a few days of *Nyadanawo*.

Appendix 2 shows photographs of these three varieties along with *Kaulesi*. Although *Kaulesi* was known everywhere, the others were quite location-specific. Among our sample farmers, only those from Matapwata EPA knew *Nyadanao* and *Nambewe,* while only those from Mombezi EPA knew *Mashunga.*

The value farmers give to early maturity is illustrated by the high price premium of *Kaulesi* over *Chimbamba.* Table 3 shows that the price differential between these two varieties was highest at planting of the main crop, reaching 40 % in Mbulumbuzi and almost 70 % in Bvumbwe. In local terms, this was equivalent to MK 5 for a flat No. 10 plate of *Kaulesi* compared to Mk 2-3 for the same plate of *Chimbamba.* Prices dropped dramatically following the harvest of the main bean crop, but recovered again by the harvest of the relay crop (*mbwera*). At all three periods, the price differential was highest at Bvumbwe where farmers grow a second bean crop.

If early beans are so valuable, why do farmers bother growing late-maturing varieties?

- Farmers prefer to eat fresh beans for as long a period as possible. Dry beans are less favoured as a relish. To ensure a supply of green beans over a long period, therefore, farmers select varieties with different maturity dates. The latest-maturing variety – *Kavera wang'ono* – was prized not just for its supply of late fresh beans but for its leaves, which were reported to be tastier than those of any other bean variety.

- The late maturing variety *Chimbamba* is highly marketable (*malonda*). It cooks into a thick red paste with a meat-like flavour. Sprinkling water over *Chimbamba* keeps the beans fresh for a week, whereas *Kaulesi* will shrivel within a few days. This helps in marketing.

- The higher cost of *Kaulesi* means that farmers can often only afford to buy long-duration varieties. According to Linny Mpenda, the price of *Kaulesi* has halved in the last 7 years, when it was MK 10 for a No. 10 plate at planting time compared to Mk 5 today, but it remains two-thirds more expensive than *Chimbamba.*

Why do farmers grow early-maturing varieties?

Asked about the advantage of early-maturing varieties, most farmers answered 'food' or 'food security' (*mchotsa njala*, 'removing hunger', *kuchilila njala*, 'giving relish where there was none'). Names for some early maturing varieties capture this criterion well. *Mashunga* (No. 3) is nicknamed '*Msunga banja'* or 'Tying the family together' because it provides wives with relish to feed their husbands when relish is scarce, while '*tikhwasule*' as in *Nambewe tikhwasule* means 'Can be eaten without *nsima*'.

Early-maturing beans are eaten in various forms:

- *Khwanya* (cooked bean leaves). Leaves are ready to eat about three weeks after planting and are eaten until the plant starts to flower. Farmers wait until the plant has grown sufficient leaves before picking. *Khwanya* is not a favourite dish unless made from the variety *Kayera* that has tender leaves. By comparison, the leaves from *Kaulesi* are tough.

- *Zithebule*. Households can begin to eat unripened beans from *Kaulesi* after one or two months. These are cooked and eaten in the pod, usually mixed with some other relish such as pumpkin leaves. They can be boiled or cooked with oil or groundnut flour. *Zithibule* is eaten as a relish with *nsima* and not as a main meal.

- *Zitheba*. At this stage the beans are riper but are still cooked and eaten in the pod. *Zitheba* is eaten as a relish with *nsima* and not as a main meal.

- *Makata*. After two-and-a-half or three months, beans from *Kaulesi* can be eaten as *makata*. Beans are cooked in the pods but these are removed before eating. *Makata* is eaten as a main meal in place of *nsima* when households have run out of maize.

- *Nyemba*. Beans are eaten fresh before fully dried. The beans are sold in the pod but these are removed before cooking. They are eaten as a relish with *nsima*.

The households we interviewed said that green beans from *Kaulesi* ripened three weeks before those from *Chimbamba*. Estimates varied as to how frequently households ate beans during this period. If the harvest was good, Mai Beni might harvest three times a week for each of these three weeks or two times a week if she wanted to be sure of keeping some seed. Mai Mazinga said she might harvest only once a week, and spread out consumption by mixing the beans with other types of relish. At the maximum, therefore, early-maturing beans might supply a household with nine meals over a period of three weeks.

Alternative forms of relish to eat with maize were scarce at this time. Farmers mentioned pumpkin leaves, okra, cowpea leaves, and weeds such as *chisoso* (*Bidens pilosa*) and *bonongwe* (*Amaranthus* spp.). The only households that did not report a shortage of relish at this period were *dimba* households that ate mustard leaves from their own gardens or had sufficient cash from the sale of *dimba* vegetables to buy relish.

Other farmers deliberately grew *Kaulesi* for the market. Selling *Kaulesi* in February when prices reach 40 MK/kg meant that they maximised their revenue from beans. Mai Sitima reported that she started selling *Kaulesi* a full four weeks before *Chimbamba*. At this time her household had run out of maize and the maize planted in November had just started cobbing. The cash she earned from *Kaulesi* was used to buy maize from ADMARC. Bambo and Mai Chinyama, an elderly couple, used cash from the sale of *Kaulesi* to hire labour for harvesting and shelling maize.

Figure 1 sets early bean varieties in the context of food security, prices, and pests. Beans are intercropped with maize. Planting occurs with the first rains at the end of November and the crop is harvested in March before maize. In Matapwata, where the growing season is longer, beans are also planted as a relay crop (*mbwera*) in mid-March and harvested in June-July. Farmers perceive drought, insect pests, and diseases as the most important production risks (Ferguson *et. al.*, 1992: 114 Table 56). Drought may take the form of prolonged dry spells that affect the main bean crop, or an early cessation of rains that affects the relay bean crop.

Beans from early maturing varieties (*Nyadanawo, Kaulesi*) become available between mid-February and mid-March. This period is critical for household maize supplies. Most households have run out of maize at this point and must rely on market purchases. Green maize does not become available until mid-March almost two months before the harvest of mature maize in early May. Market prices for bean varieties reflect this. At Bvumbwe market, main crop *Kaulesi* sells at 40 MK/kg or 40 % above the price of *Chimbamba*. Households that plant early varieties have both a source of food and a source of cash with which to buy maize. Three weeks or more after the harvest of *Kaulesi*, the late-maturing varieties *Chimbamba* and *Kayera wang'ono* ripen and provide households with a further supply of fresh beans. Early-maturing varieties have the additional advantage of allowing the relay crop to be planted as early as mid-March. Seed to plant a relay crop of *Chimbamba* does not become available until mid-April.

There are marked differences in the timing of pest damage:

- Damage from BSM appears three weeks after planting but heavy rainfall usually prevents severe damage to the main crop by killing the flies. There is a resurgence of BSM in mid-March when drier weather allows the population to build up.

- Damage from the striped bean weevil occurs later than BSM but may persist until harvest, with a second build-up during the relay crop.

- The bean foliage beetle attacks about midway through the vegetative growth stage until flowering. Unlike BSM and the striped bean weevil, it attacks only the main crop.

- Foliar diseases (including common Bacterial Blight, Angular leaf spot, *Ascochyta* blight, Anthracnose) build up slowly throughout the main crop. Heavy rainfall and the maize canopy create a humid micro-climate that encourages the rapid spread of infections.

In the main crop, therefore, early-maturity reduces exposure to the striped bean weevil, the bean foliage beetle, BSM, and a range of foliar diseases. In the relay crop, early maturity reduces exposure to BSM and the striped bean weevil.

Early maturity and pest management

Of the 14 farmers we interviewed, only three saw any connection between early-maturity and reduced damage from pests. One (Bambo Nangwale) thought that, at the time *kunyala* attacked *Chimbamba, Kaulesi* had already produced a yield. He also believed that *Chimbamba* suffered more damage from leaf-eating beetles than *Kaulesi*. Another (Mai Beni) thought that *Kaulesi* had better powers of recovery after an attack of *Ootheca* than *Chimbamba*. Mai and Bambo Muthowa agreed that *Kaulesi* generally performed better than *Chimbamba*, but did not link this with pests.

Other farmers believed either that there was no difference in pest damage between early- and late-maturing varieties, or that it was impossible to tell. Mai Mazinga noted that although *Kaulesi* flowered earlier, it developed leaves at the same time as other varieties, and so was equally vulnerable to attack from leaf-eaters. Mai Luwera said that all varieties grew leaves, and she couldn't distinguish differences in damage by leaf-eaters. Others observed that the location of pest attack varied within a single field, making it difficult to compare the effects on different varieties. All varieties suffered equally if they were planted in a *kunyala* 'area'. This finding is not unusual. A survey of 182 bean growers in the central and northern region reported that: 'Very few farmers voiced any opinion on varietal susceptibility to attack by this pest [BSM]', and that only 17 farmers (9 %) could identify a variety that avoided *Ootheca* 'to some degree' (Bean Improvement Project, 1997: 62). Among our sample, the only strategies used to control bean pests were hand-killing, not planting in areas of the field where *kunyala* was common, and crushing the bean foliage beetle in the belief that the smell deterred others.

We suggest two reasons for farmers' inability to see differences in pest damage between varieties. First, farmers may be unable to identify pest damage correctly. Most are unaware that BSM (which attacks the plant roots, causing the plant to wilt) is actually a pest. They attribute swollen, cracked stems to disease rather than insects (Riches *et. al.*, 1993). They may also attribute wilting to physical causes (*chisanu*, cold, or *mphepho*, wind) rather than to BSM. Distinguishing between wilting caused by BSM or moisture stress is difficult even for scientists armed with a microscope. Similarly, an evaluation showed that farmers in FSIPM trials perceived their most important problem in growing beans as 'too much rain' (Abeyasekera *et. al.*, 1999: 18 Table 20). This reflects their inability to recognise disease symptoms, which they attribute to physical causes.

Second, beans are attacked by a wide spectrum of pests; average damage levels are low, but highly variable, differing between fields, landtypes, and seasons. In this uncontrolled environment, comparing varieties for resistance to pests and diseases is difficult for researchers. For farmers, it is all but impossible. They simply lack sufficient information on which to base comparisons. The OFT simulates a Newtonian world where land type, plant population, variety, are controlled and amenable to statistical analysis. Where bean pests are concerned, farmers inhabit a non-Newtonian world where reality is much messier, a world that refuses to stand still and escapes precise specification. A scientific frame of reference allows researchers to see a pattern in data where farmers see none. To see the same pattern, farmers need not just more information about pests and diseases but a new frame of reference.

On this evidence, it is impossible to claim that farmers use early-maturing beans as a deliberate pest management strategy. Not all strategies need be conscious or planned, however. Mintzberg and Waters (1998) contrast *deliberate* strategies – such as plans - and *emergent* strategies, or strategies which are consistent but originated with little formal intent. The OFTs conducted by the FSIPM Project were designed to test varietal resistance to bean pests and diseases. Early maturity only suggested itself as a pest management strategy when *Kaulesi* produced a higher yield than longer-duration varieties. Thus, early-maturity remains an *emergent* strategy. It will only become a *deliberate* strategy when researchers explicitly design OFTs that measure the effect of early maturity on bean yields.

As a deliberate strategy, early maturity has much to recommend it. It spares breeders the challenge of breeding bean varieties that are resistant to a wide spectrum of pests. There is a parallel here with Japanese business strategy. Rather than compete head-on with powerful foreign rivals, Japanese firms developed relative superiority in products or services where competitors were weakest. In the words of one writer, '... the principal concern is to avoid doing the same thing, on the same battleground, as the competition" (Ohmae, 1982: 40). Whereas varietal resistance meets pests in head-on competition, early maturity exploits their weaknesses by producing a yield before pest populations become large enough for losses to reach the economic threshold

For farmers, who cannot see any connection early maturity and crop losses from pests and diseases, it is unlikely that early maturity will ever become a deliberate pest management strategy. This would require farmers to see this connection and include 'controlling pests' as a criterion for growing early-maturing varieties. Given the variable nature of pest damage to beans, this seems improbable. Farmers will continue to grow early maturing beans for other reasons. In terms of pest management, therefore, farmers remain accidental strategists or strategists despite themselves.

Implications for the FSIPM Project

IPM recommendations

Recommendations 'sell ' strategies. Where the benefits are immediately obvious, the sale is straightforward. In the case of beans, however, the benefits from early-maturity or varietal resistance in reducing damage from pests may not be visible. Farmers cannot judge the effectiveness of these strategies for themselves because the environment in which they operate is too chaotic to give a clear and consistent picture of differences in pest damage between varieties. Suppose breeders released a variety with tolerance to – say – BSM. It is questionable whether farmers who grew this variety would notice any improvement in yields. Reduced damage from BSM - which farmers can't identify anyway - would be subsumed by a myriad other influences on bean yields, such as other pests, climate, edaphic factors and so on. Similarly, farmers cannot reasonably be expected to see a connection between reduced damage from pests and early maturing varieties.

Early-maturing beans are therefore best seen as a *crop management* and not as an IPM recommendation. The primary emphasis may be laid on the benefits that are already familiar and visible to farmers. These include food security, marketability, cash income, and (for the relay crop) avoidance of moisture stress. The (hypothesised) benefit of higher yields from reduced crop losses from pests and diseases is then subsumed in the wider benefits from growing early-maturing bean varieties.

Seed multiplication

Demand for early-maturing beans exceeds supply at a price most farmers can afford. An IPM recommendation to grow early-maturing beans must therefore be accompanied by efforts to increase the supply of these varieties. Multiplication of bean seed is of no interest to the private sector since the crop is self-pollinated. Farmer seed-multiplication groups have been used successfully to increase the supply of recommended bean varieties. In 1998/99 the Project gave seed of *Kaulesi* and *Nyadanawo* to three farmer groups. The *Mwayi wathu* group successfully grew 16 kg of *Kaulesi* and saved 5 kg for planting next season. Hence there is potential for farmer groups to multiply early-maturing seed, complementing the varieties they already grow. *Nambewe* or *Mashunga* may prove difficult to sell at first because consumers are unfamiliar with these varieties, but this should not pose a problem for *Nyadanawo*, which sells as *Nanyati* in areas like Mombezi where it is not well known.

Varietal testing

In the medium term, the national breeding programme may conduct OFTs to test the relationship between early maturity and damage from pests and diseases. If these trials show promise, efforts may also be made to identify other early-maturing varieties in the southern region and elsewhere in Malawi. As a start, the FSIPM Project may assist by buying samples of early maturing varieties at planting time when they appear briefly in local markets.

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Footnote

[1] A variety is defined by the International Code of Nomenclature of Cultivated Plants as "an assemblage of cultivated plants which is clearly distinguished by any characters (morphological, physiological, cytological, chemical, and others) and which when reproduced (sexually or asexually) retains its distinguishing characters". The scientific dictionaries that we consulted gave no definition of 'landrace'. In this report, we use landrace to mean a type of bean that farmers habitually distinguish from others when selecting seed.

References

S. Abeyasekera (1999). IPM strategies for intercropped beans. FSIPM Project. Mimeo, 7 pp.

S. Abeyasekera, J. M. Rithie, C. S. M. Chanika, S. J. Ross, J. Lawson-McDowall, A. T. Daudi, C B. K. Mkandawire, T. H. Maulana, E. R. Shaba and T. T. K Milanzi (1999). Researcher and farmer assessment of performance of common bean varieties in relation to pest damage and yield under smallholder management in Blantyre Shire Highlands. FSIPM Project, September. Mimeo, 29 pp.

J. K. O. Ampofo (ed.) (1993). 'Participative Planning Process', Pp. 100-101 in *Proceedings of the Second Meeting of the Pan-Africa Working Group on Bean Entomology*, Harare, Zimbabwe, 19-22 September. Network on Bean Research in Africa, Workshop Series, No. 25. CIAT, Dar Es Salaam, Tanzania.

Bean Research Program (1998). Annual Report, 1995/96. Bean/Cowpea CRSP/Bunda College of Agriculture. Mimeo, 160 pp.

A. Ferguson (1993). Common Beans and Farmer Managed Diversity: Regional Variations in Malawi. *Culture and Agriculture Bulletin*, 45.

A. Ferguson, P. Kambewa, and R. Mkandawire (1992). *Bean production and use practices: results of the 1990-91 socio-economic research in the three regions of Malawi.* The Bean/Cowpea Collaborative Research Support Program (CRSP). Mimeo, 121 pp.

J. Jiggins (1990). Crop Variety Mixtures in Marginal Environments. Gatekeeper Series No. SA19. IIED.

C. J. A. Makato (comp.)(1997). *A Description of Crop Varieties Grown in Malawi.* Department of Agricultural Research and Technical Services.Ministry of Agriculture and Irrigation. Revised edn., July.

Malawi Bean Improvement Project (1997). Annual Report 1996-97. Chitedze Agricultural Research Station, Lilongwe.

H. Mintzberg and J. Waters (1998). 'Of strategies, deliberate and emergent'. Pp. 20-35 in S. Segal-Horn ed., *The Strategy Reader*. (Oxford: Blackwell).

K. Ohmae (1983). *The Mind of the Strategist*. (Penguin: Harmondsworth).

A. Orr and P. Jere (1999). 'Identifying smallholder target groups for IPM in southern Malawi'. *International Journal of Pest Management*, 45 (3): 179-187.

C. R. Riches, L. J. Shaxson, J. W. M. Logan and D. C. Munthali (1993). *Insect and Parasitic Weed Problems of Southern Malawi and the Use of Farmer Knowledge in the Design of Control Measures*. ODI Agricultural Administration (Research and Extension) Network Paper No. 42. July.

J. Voss (1992). 'Conserving and increasing on-farm genetic diversity: farmer management of varietal bean mixtures in central Africa'. Pp. 34-51 in J. L. Moock and R. E. Rhoades eds., *Diversity, Farmer Knowledge, and Sustainability*. (Ithaca: Cambridge University Press)

Table 1. Key informants on early-maturing beans, FSIPM survey sites.

No.	Persons interviewed	Cluster [a]	Description
1	Mai and Bambo Muthowa	Stable female-headed	Elderly. *De facto* female-headed because of shiftless husband
2	Mai Tereza Luwera	Stable female-headed	*De facto* female-headed. Husband businessman, possibly polygamist. Employs two permanent labourers; field in Chitera dambo
3	Mai and Bambo Chimwaza	Stable male-headed	Field in Chitera dambo
4	Mai Sitima	Stable male-headed	Husband is UDF Party chairman
5	Mai Mazinga	*Dimba*	Husband is village chief; *dimba* grower
6	Bambo Nangwale	*Dimba*	*Dimba* grower
7	Mai Baluti	*Dimba*	Two *dimba* gardens, one in distant Goliati
8	Mai Dorothy Ayimu	Burley	Widowed. Burley grower
9	Mai Linny Mpenda	Burley	Separated from husband. Lives with mother and three children. Burley grower
10	Mai Beni and daughter	Vulnerable	Elderly widow; lives with unmarried son and daughter; one hillslope and one upland field
11	Daina Chilinkhonde	Vulnerable	Elderly, divorced. Lives with small son. Field in Chitera dambo

Notes
[a] Orr and Jere (1999).

Table 2. Bean varieties grown by farmers in Matapwata and Mombezi EPAs, Blantyre Shire Highlands RDP.

No.	Local name (s)	Source	Description	Type	Maturity	Remarks
1	*Kankhope / Nakadiso*	Lidala village, Mombezi	Seedcoat white with brown speckles, large round seed.	Climber	Same as *Chimbamba*	Grown by two farmers in Lidala village, one of whom bought the seed in Mangochi. May originate from Mozambique.
2	*Nyadanawo*	Matapwata	Seedcoat pale tan with brown speckles, round seed	Bush	Matures 1 week before/ 2 weeks after *Kaulesi*	*Nyadanawo* not known by traders in Mbulumbuzi who wrongly identified it as *Nanyati wang'ono.*
3	*Mashunga / Nanzeze / Khwangwala*	Mombezi	Zebra stripes on dark grey background	Climber	Same as *Kaulesi*	From the Mombezi area. Farmers in Matapwata confused it with *Nambewe*, which has the same zebra stripes but on a white background.
4	*Kachiata / Nakantedza*	Mbulumbuzi market	Red seedcoat, speckled, round seed	Bush	Matures 1 week after *Kaulesi*	Traders at Mbulumbuzi market said this variety came from Mangochi/Ntcheu.
5	*Nakakhakhi / Nakazikambe*	Lidala village, Mombezi	Greenish seed coat, white eye, roundish seed.	Bush	Slower than *Kaulesi*, quicker than *Chimbamba*	One farmer growing this variety in Lidala. Traders at Mbulumbuzi said it is commonly grown in Dezda and Ntcheu where it is known as *Kachansana*. Traders from Mangochi said resembled *Duduzi,* but seed was smaller.
6	*Nakakale / Kakale /Bwenzilaana*	Lidala village, Mombezi	Yellow seed coat, roundish,with medium seed size.	Climber	Late, like *Kayera wang'ono.*	Farmer in Lidala obtained from estate in Thyolo. Traders at Mbulumbuzi market say variety is found in Ntcheu and the north. Mr Munthali (Bunda Bean Programme) identified it as the Bunda variety *Bwenzilaana* released in 1980.
7	*Sugar 48/ Nakazama*	Mbulumbuzi market	Tan seedcoat with brown speckles, roundish shape	Climber	Same as *Chimbamba*	Hard to identify. Not widely grown. Identified by Mr Munthali (Bunda Bean Programme) as one of 500 local varieties included in an observation trial in 1995/96. Variously identified by farmers in Mombezi as *Kaulesi wa maluwa, Kanzama,* or *Nanyati wang'ono.*
8	*Mawanga* (Mbulumbuzi)/ *Namilonje* (Bvumbwe)	Mbulumbuzi and Bvumbwe markets	Small round seed, seed coat brown with speckles.	Climber	Late, like *Kayera wang'ono*	Hard to identify. Not widely grown.

Table 2 (cont.)

9	*Chimbamba*	Matapwata, Mombezi	Red kidney, seed big and long, curved shape.	Bush	Matures within 16 weeks	Usually sold mixed with Nos. 10 and 11 but planted separately to avoid shading-out. Bunda released a hybrid variety called *Chimbamba* in 1993.
10	*Phalombe / Kandinyinthu/ Kanyilinyinthi*	Matapwata, Mombezi	Red kidney, seed straight not curved.	Climber	Matures 2 weeks after *Chimbamba* No. 10	Identified by Mr. Munthali (Bunda Bean Programme) as a local variety. Farmers identified it as a type of *Chimbamba*, a climber, which is planted together with Nos. 111 and 12.
11	*Namajengo*	Matapwata, Mombezi	Red seedcoat, small round seed with a white dot	Weak climber	Matures 3 weeks after *Chimbamba* No. 10	Identified by Mr. Munthali of the Bunda Bean Programme as two Bunda varieties released in 1980. Farmers grouped these as one type of *Chimbamba.* One farmer called it *kaufiti* because it cooked slowly, tasted tough, and produced more seeds than others in the mixture; she separated it from Nos. 9 and 10 and did not plant it.
12	*Sapelekedwa*	Matapwata, Mombezi	Red seedcoat with white dot, small, straight seed	Climber	Matures 2 weeks after *Chimbamba*	
13	*Nanyati wankulu*	Matapwata, Mombezi	Seedcoat tan with brown speckles, long seed	Weak Climber	Same as *Kaulesi*	Mr Munthali (Bunda Bean Programme) said this was not *Nanyati*, which is maroon in colour.
14	*Nanyati wankulu*	Matapwata, Mombezi	Seedcoat light tan with brown speckles, straight seed	Climber	Late, like *Kayera wankulu*	
15	*Nanyati*	Matapwata, Mombezi	Seed coat light tan, brown speckles, straight seed	Climber	Late, like *Kayera wankulu*	Farmers dislike it because won't keep long after cooking. Not marketable if sold separately.
16	*Nanyati*	Matapwata, Mombezi	Seedcoat tan with brown speckles, long straight seed	Climber	Same as *Kaulesi*	Farmers said this was the highest-yielding type of *Nanyati.*

Table 2 (cont.)

17	*Kayera wamkulu*	Mombezi	White seedcoat, large curved seed	Climber	Matures with *Chimbamba* or 1 week later	
18	*Kayera wang'ono*	Mombezi	White seedcoat, small, roundish seed	Climber	Matures 2 weeks after *Chimbamba*	The slowest-maturing bean variety. Farmers reported that the leaves tasted better than any other variety. Mr. Munthali (Bunda Bean Programme) reported that despite vigorous growth yields in Matapwata were low compared to Dedza.
19	*Nambewe/ Nambewe tikhwasule*	Bvumbwe market	Zebra stripes on tan background	Climber	Matures within few days of *Nyadanawo*	Not generally known in Mombezi but one farmer recognised it as quick-maturing, called it *Kablanketi*.
20	*Kaulesi wamkulu/ Kablanketi*	Bvumbwe market	Grey seed coat, white eye, long seed	Bush	Same as *Kaulesi wang'ono.*	Only found mixed with *Kaulesi wang'ono*.
21	*Kaulesi (wang'ono).*	Matapwata, Mombezi	Mauve seed coat, white eye, roundish seed	Weak climber	Matures within 12 weeks	The most popular late-maturing variety.
22	*Nakablanket*	Bvumbwe market	Zebra stripes on grey background	Not known	Not known	Mr. Munthali (Bunda Bean Programme) said this local variety was included among 500 lines in an observation trial in 1995/96. Not known in Mombezi. Found in mixtures.
23	No name given	Bvumbwe market, Mombezi	Brown seedcoat, speckled, round seed	Climber	Matures 1 week after *Chimbamba*	Some farmers call this *Kanzama* because of its round shape. Bvumbwe traders said it was similar to *Nyadanawo* in maturity and yield. Despite its darker backgound, may be sold as *Nyadanawo.*,
24	*Kanzama*	Chiwinja village, Mombezi	Tan seedcoat, round seed	Climber	Later than *Kaulesi*	Resembles *nzama* (ground bean) in shape and colour. Not to be confused with Bunda variety of same name released in 1993.

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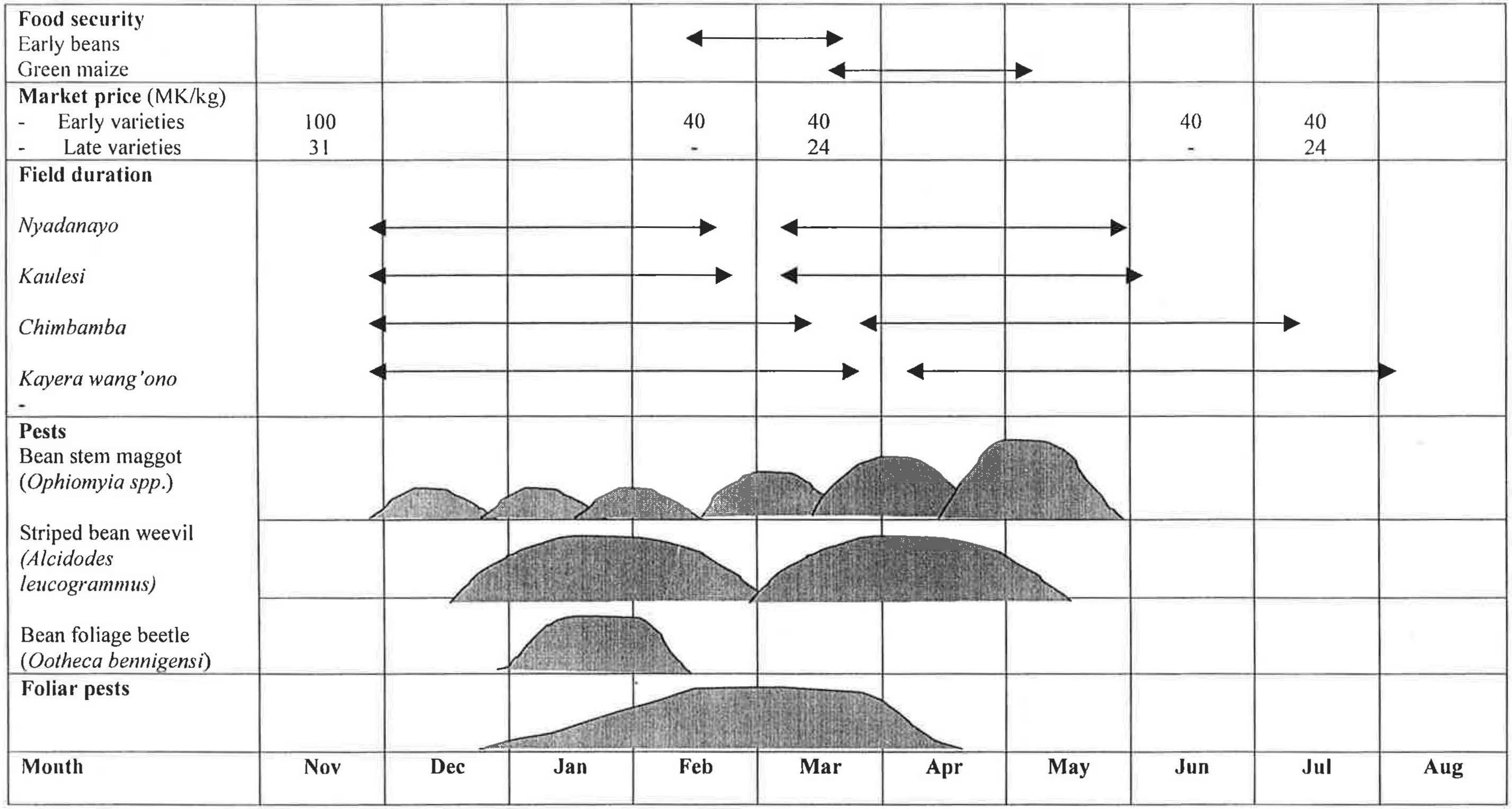
Table 3. Prices of *Kaulesi* and *Chimbamba*, Bvumbwe and Mbulumbuzi markets, 1998/99 season.

Market	Variety	Price at time of sale (MK/kg)		
		Planting	Harvest	*Mbwera*
Mbulumbuzi	*Kaulesi*	79	21	53
Mbulumbuzi	*Chimbamba*	45	16	30
Differential (%)		43	22	43
Bvumbwe	*Kaulesi*	100	40	40
Bvumbwe	*Chimbamba*	31	24	24
Differential (%)		69	40	40

Source: Bean traders, Mbulumbuzi and Bvumbwe markets

Figure 1. Field duration of bean varieties in relation to food security, prices, and pests. [a]



[a] Incidence of pests and diseases is shown diagrammatically.

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Appendix 1.

EARLY MATURITY AS A PEST MANAGEMENT STRATEGY FOR BEANS

CHECKLIST

1. In your household who decides which bean varieties to grow?

2. What bean varieties did you grow last season (1998/99)?

3. Which of these varieties do you recognise? (show samples).

4. Do you know any other quick-maturing varieties ?

5.What do you define as an 'early' or 'late' maturing bean variety ?

6.When do you grow early-maturing varieties?

7. Do you grow them in a row with other varieties?

8. What are the disadvantages of growing early-maturing varieties?

9.What are the advantages of growing early-maturing varieties?

10.What do you normally do with seed from early-maturing varieties?

11.What is your main source of seed for growing early-maturing varieties?

12.What types of relish are available to eat in February, besides quick-maturing beans ?

13. Do early-maturing varieties suffer less from these pests (show samples):

Kunyala
Mbozi in the stem (*Alcidodes*)
Tisirombo-tokuda (*Ootheca*)

14. What is the main reason you grow early-maturing varieties?

Appendix 2

KEY TO PHOTOGRAPHS

Numbers refer to Table 2.

Plate 1 (reading left to right)

Nyadanawo	(2)
Kaulesi	(21)
Nambewe	(19)
Mashunga /Nanzeze	(3)

Plate 2 (reading left to right)

Chimbamba	(9)
Phalombe	(10)
Namajengo	(11)
Saperekedwa	(12)

Plate 3 (reading left to right)

Nanyati wamkulu	(13)
Nanyati Wamkulu	(14)
Nanyati	(16)
Nanyati	(15)

ASSESSMENT OF ADOPTION AND DIFFUSION OF IPM STRATEGY FOR SWEET POTATO IN KATULI EPA, MANGOCHI[1]

Introduction

A trial on Crack sealing as a pest management stategy was initiated by the Soil Pest project in 1993-1995 after the Project had done intensive exploratory work on sweet potato. The Project at first was just looking at population and damage levels on sweet potato by Cylus. It was then decided that sealing of cracks on sweet potato ridges be experimented on small holder farms as a mechanism to control tuber damage by sweet potato weevil, *Cylas puncticollis*.

This trial was conducted for two seasons in four villages. First season had five farmers and the selection of farmers was by looking for any farmer who had grown sweet potatos that season of any variety. During the first season, the crack sealling was done by the research team helped by the owner of field every fortnight by using hands or hoes. In the second season the number was increased to ten to make sure that we had enough data for that season. In the second season the farmers were told that the technology was at least helping to control the cylas population and farmers were very happy with that news. By then people were growing a lot of sweet potatos compared to what is happening now at Katuli. There was no involvement of extension officials in most of this work and the researchers were dealing directly with the farmers.

Problems at that time were that the process demanded a lot of labour from the farmer and it was done when farmers had a lot of field operations in their fields hence less attention was given to the technology. Also when you select farmers in the village for field trials some farmers feel you are biased to pick them and they do not take what those farmers tell them.

Two years have passed since the trials stopped, so a trip was initiated to findout more about this practice in the area. This report is based on the findings of that trip. TheGeneral objective was to determine adoption of 'Sealing of cracks' as a pest management strategy against sweet potato weevil.

Specific objectives

1. to determine number of participating farmers still practising the strategy and those not practising

2. to determine adoption among non-participating farmers

3. to determine diffusion mechanisms and extent of diffusion

4. to determine farmer innovations and modifications to the strategy

5. to determine farmers' perceptions on costs and benefits associated with the strategy
   (e.g. yield, labor, pest damage differences with not using the strategy)

6. to determine possible adoption constraints

General Hypotheses

- Sealing of cracks is an appropriate PMS for improving sweet potato yield (quality ?) for small holder farmers

- Farmer involvement in on-farm trials and farmer-to farmer exchange of information help in enhancing adoption of IPM strategies.

---

[1] By Paul Jere, Alex Koloko & C.B.K. Mkandawire ,FSIPM Project ,30/5/97

Methodology

- Sources of information

Information was obtained from participating farmers to find out whether they are still practicing the technique as well as non-participating farmers to find out whether they had heard about it and are practicing it. The participating farmers were also interviewed on extension involvement in sweet potato growing.

- methods of collecting information

Semi-structured (informal) interviews were conducted with farmers who participated in the trials and some non-participating farmers. A checklist of key questions was developed to guide the discussion with the farmers. The process involved visiting the farmers at their houses and talking to them on the importance, extent, market potential and problems of sweet potatoes. If the farmer is growing sweet potato, the fields were visited. In the field the farmer was asked on the extent of the problem of sweet potato weevils since the trials stopped and whether the farmer was still practicing crack sealing. Field observations of farmer practices and sweet potato damage were done with the farmer in the field. In addittion to this, two traps were set in two sweet potato fields in two villages of kasanga and Ntotokalino to check presence of the sweet potato weevils. Each trap was baited with artificial pheromone septra to attract male sweet potato weevils. The traps were smeared with tangle foot to catch attracted males.

Results

Participating farmers Interviewed

- Mr Kabichi (Kasanga Village) participated in the trial for two seasons. He indicated that sweet potato is an important crop in the area as a source of food and cash. A lot of people are willing to be producing sweet potato on a large scale since there is enough land left by the people who went to settle in Mozambique but the main problems is lack of time and labour during the growing period. He indicated that there is much competition on labour and time between other crops and sweet potato.

  Mr Kabichi practised crack sealing for only one season after the Project left two season ago and he stopped because he had seen that in his field, Cylus infestation had gone down. On the technology said its a good one, it works and is prepared to resume practising when infestation will start again to be serious. Field observations showed that there were some sweet potato tubers damaged by the weevil. He further told us that he tried to share the technology with other people in the village but they are reluctant practice it because it is supposed to be done when people are busy in the field with different field operations hence not much time for it.

- Angawire Haji (Ntotokalino village) participated in the trial for two seasons and was very active on crack sealling. She stopped practising because soon after the Project she got sick and stopped active farming for two seasons since she does field operation alone and is very old. However she feels very reluctant to continue crack sealing because she feels crack sealling disturbs or hinders tuber formation. To her cracks is a sign of having big tubers so if you seal you are making tubers to stop growing very big. The other problem she pointed out is that it is labour intensive. She shared the information about crack sealing with Mr Abidu and when interviewed he indicated the same feelings of the practice hindering tuber growth.

- Esmie Idi (Ntotokalino village) participated in the trial for two seasons and was very active. He practiced crack sealing for one season after the project left and stopped because he felt it was not working to control cylas infestation in the field. He also said it is labour intensive and may be very difficult when you have a big field. He indicated that the people whom shared the information about the practice havent taken it because it is labor demanding and they dont think there would be differeneces in terms of cylas attack.

- Mr Akusamala (Katembo village) was involved in the trial for one season and he is a regular and sweet potato grower in the village. He practiced crack sealing for one season after the project and he stopped because he had seen reduced or no cylas infestation last season. He says he will resume practising when cylas infestation is observed again in his field. However in the field he was able to notice some tubers damaged by the weevil. He shared the information to a few friends (he couldnt remember the number except one Mr matola) but none is practising the crack sealing because they consider it labour intensive.

- Mr Alex Muha participated in the trial for one season. He never continued with the practice after the project left because he feels it is labour demanding and it coñcides with other important field operations so that he just leaves the sweet potato responsibility to his wife.

Participating farmers not interviewed

- -There were five more farmers who participated in the sweet potato trial but were not available in their villages because they have moved out of the area. Two have migrated to neighbouring countries of Mozambique, and Zambia respectively, two moved to Blantyre and one to a distant tobacco estate. It is unlikely that they are practicing the crack sealing whereever they are.

Non-participating farmers interviewed

- Three other farmers who did not participate in the trial were interviewed at random to findout whether they had heard about crack sealing. They all indicated not to have heard about the practice except one (Mr Medson)who remember having seen the research team setting traps in sweet potato fields of some farmers.

Results from the traps show that no sweet potato weevils were trapped over one night period. No conclusive explanation can be given for this considering that the traps did not stay long enough and they were only situated on two field. The pheromone septra used may also not be strong enough considering the long time it was kept before use.

Conclusion

The above discussion show that the technique has not been adopted by the farmers in the area. There are several several reasons which could have led to this situation. Firstly it seems that sweet potato is not given much priority by most people. It is grown as a secondary crop, mostly for home consumption with very little for sale except for few farmers. The crop is grown after other main crops and in small portions as such most of the farmers dont appreciate the effect of the sweet potato weevils. The technique demands additional labour because the farmers have to 'weed' the crop to seal the cracks several times thereby posing a labour constraint considering that the farmers have several other crops to take care. In most cases the farmers dont seriously weed sweet potato fields except for some hand weeding.

It has also been seen that the extension officials have not taken up the technology in the area and that they dont include sweet potato issues in their meetings. The farmers indicated that the extension officials concentrate on crops like tobacco and maize. Initially the extension officials were not involved in the running of the trials and the results of the trials were not disseminated to them as such they may not appreciate the technology.

Lastly, the number of farmers who participated in the trial was small as well as spread over a large area and some participated only for one season. It might be difficult for these farmers to see the effect of the technique over a short period of time and this small group could not effectively enhance diffusion of the technique.

FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

NETWORKS OF COMMUNICATION IN AGRICULTURE: PILOT STUDY

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NETWORKS OF COMMUNICATION IN AGRICULTURE: pilot study

Tasks
Checklist of questions: JLM
Administering questions: CC
Writing of report: CC & JLM

The following exploratory research was carried out as a pilot study of networks of communication and information flows among farmers. By using a checklist of questions to ask farmers which new varieties of crops or new agricultural activities they had tried, how they came to grow the crop or use a technique and with whom they subsequently shared either information or material, we hoped to establish a set of parameters which might help us design a more thoroughgoing study. Comments and suggestions concerning design would be welcome.

Methodology

- All farmers taking part in on-farm trials in Magomero village were visited for an interview on networks of communication in agriculture. Some of the farmers are missing because they were not available at the time of research and could not be revisited since the other activities of village stays were also taking place.
- Eleven of the sixteen farmers taking part in on-farm trials were interviewed, nine of these were female farmers which included four female headed households.

SUMMARY OF FINDINGS

- New varieties of staples which have been tried in the village by these farmers are:

Crop	**Variety**	**How many tried**
Maize		
	MH18	7/11
	MH17	2/11
	NSCM 41	7/11
	Chitute	1/11
Beans		
	Chimbamba (from Dedza)	1/11
	Kaulesi	1/11
Pigeon peas		
	ICP9145	8/11
Cassava		4/11
Sorghum		1/11

- Two out of eleven farmers shared information with friends or relatives.

- It was noted that most crops are named after the places of origin e.g. cassava from a research station is called research.

- It is mostly those farmers that are actively involved in vegetable growing who have new inputs in their farming such as application of pesticides.

- It was indicated by one of the farmers that the nearby estate (Ramus Estate) has an influence in the village e.g. putting of sand on vegetable seed bed to facilitate germination was learnt on this estate but this technique was originally used on Eucalyptus seed beds.

- Ten of the eleven farmers interview said that their source of agricultural knowledge is friends and or relatives and only one was relatives only.

- Eight out of eleven farmers (one male and seven female) said that they learn most in their own village because they become encouraged if a fellow friend is doing well right in the village. On the other hand three (one male and two female) said that they learn most through visits because they learn about things which are not in the village.

- All the farmers said that the extension officer used to visit farmers some years ago when some members of the village were part of demonstrations at the EPA. The village had also a farmer's club where members used to meet him. At present there is not anything of that sort.

- Seven farmers said that there is no problem with sharing of information in the village because they rely on friends. Three farmers disagreed and said that there were problems because it takes one's personal initiative to learn about something and there are also some selfish individuals who would not want to share information about a crop from which they are benefiting. Furthermore one farmer said that the problem is that an extension officer is not available in the village and as such most people rely on friends who mislead each other at times. On this isssue there was no difference in the way both men and women said.

A TABLE SHOWING NEW VARIETIES TRIED BY SOME OF THE FARMERS AND FARMERS' COMMENTS

Name and age	*House hold Head*	*Crop*	*Variety*	*Period used*	*Source*	*Comment*	*Are there any new activities and where did you learn this*	*With whom would you normally share innovations in crops or activities*	*Do you learn most in your own village or when visiting elsewhere*	*What is your best source of agricultural knowledge*	*Do you see the Extension officer and how often? If not, who does?*	*Are there problems with sharing information about new or better varieties or ways of doing things?*
Mai Lombola 50 years +	Female	Maize Pigeon peas Field peas	Malawi Hybrid 18 NSCM 41 ICP9145 Research (field peas)	1996-1997 1995 1997 1997	ADMARC ADMARC Local market Local market		Pesticide application is new in the area because there were no significant levels of pests in the past	With friends and relatives	In the village because it is where she has spent most of her time	Friends	No, and does not know who does	No problems because they visit each other in the village
Chief Magomero @65-70 years	Male	maize pigeon peas piripiri	MH18 MH17 NSCM 41 ICP9145 Local	1997 1996 1994 - 1995 1994 - 1997 1994 - 1997	ADMARC ADMARC ADMARC Local market Bought from friends	Had no specific reason for changing varieties, just wanted to try the other varieties Has seen new varieties on the Henderson Estate	Putting sand on bluegum nursery is a new activity in his farming, he learnt it from the Ramus Estate	With friends	In the village	Friends	In the past used also to rely on an extension officer He was one of the selected farmers for demonstrations at Matapwata EPA	There is no problem with sharing of information because they visit each others garden

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Name and age	House hold Head	Crop	Variety	Period used	Source	Comment	Are there any new activities and where did you learn this	With whom would you normally share innovations in crops or activities	Do you learn most in your own village or when visiting elsewhere	What is your best source of agricultural knowledge	Do you see the Extension officer and how often? If not, who does?	Are there problems with sharing information about new or better varieties or ways of doing things?
Bambo Chigomire elderly	Male	maize cassava sweet potatoes	MH 18 NSCM 41 Bakuni (research) research	1995 - 1997 1995 - 1996 1995 1996 - 1997	ADMARC ADMARC Bvumbwe Research Station Bought from a friend			Normally shares innovations with relatives	He learns more through visiting	His best source of agricultural knowledge is friends and relatives	He used to see the extension officer because he was one of the trained farmers in land husbandry and was teaching fellow farmers in the village	There are no problems with sharing of information
Mai Situma	Male	maize pigeon peas mustard cabbage	NSCM 41 ICP9154 Mayford (Hybrid) 41	1994 1997 1996 - 1997 1997	ADMARC ESIPM Project Local market Ambros store (Bvumbwe TC)		Pesticide application is new in their farming because there weren't high pest and disease incidences in the past	Friends	They learn most through visiting	Their best source of agricultural knowledge is friends	The extension officer used to advise them on the construction of marker ridgse but presently not	There is a problem in sharing of information in that some farmers would want to have more profitable crops/varieties by themselves
Mai Kazembe	Female	maize cassava sorghum	MH 18 NSCM 41 Matapwata Matapwata	1996 - 1997 1991 - 1994 1995 - 1997 1995 - 1996	ADMARC ADMARC Matapwata EPA Matapwata EPA	 Shared cuttings		Friends and relatives	Learns most in the village because she gets encouraged if a fellow farmer is doing better	Her best source of agricultural knowledge is friends	She used to see the extension officer when she was one of the selected farmer for demonstrations at the EPA	There are no problems with sharing of information because it takes personal initiative for one to learn about something

Name and age	*House hold Head*	*Crop*	*Variety*	*Period used*	*Source*	*Comment*	*Are there any new activities and where did you learn this*	*With whom would you normally share innovations in crops or activities*	*Do you learn most in your own village or when visiting elsewhere*	*What is your best source of agricultural knowledge*	*Do you see the Extension officer and how often? If not, who does?*	*Are there problems with sharing information about new or better varieties or ways of doing things?*
Mai Kalonga 36 years	Male	maize pigeon peas sweet potatoes rape chinese cabbage	MH 18 NSCM 41 ICP9145 Research Giant Chinese	1996 - 1997 1996 - 1997 1995 1996 1997 1997	ADMARC ADMARC Local market Bought from a friend Shop Shop	Gave seed to her mother		Friends and relatives	She learns most in the village	Her best source of agricultural knowledge is friends	She does not see the extension officer	There are no problems with sharing of information
Mai Mazinga 50-60? years	Female	maize beans pigeon peas field peas	MH 17 NSCM 41 Chimbamba ICP9145	1990 - 1997 1988 - 1997 1992 1993 - 1997 1993 - 1997	ADMARC Farmers' club Local market Local market Local market	There was no need to share seeds, each was getting for own field	Seed dressing is a new activity due to the high pest and disease incidences, learnt from friends Mulching is also new and it came in use due to lowering of water table.	Friends	She learns most in the village	Best source of agricultural knowledge is friends	He used to see the extension officer during farmers' club meetings which are no more	There is a problem with sharing of information in the village in that farmers depend on each other and sometimes they mislead each other
Mai Simeon Magomero 25 years	Male	maize pigeon peas sweet potatoes	NSCM 41 ICP9145 Research	1992 - 1997 1992 1995 - 1997	ADMARC Relative Friend (free)			Friends and agemates	Learns more in the village	Best source of agricultural knowledge is friends	Nobody sees the extension officer	There are no problems with sharing of information

Name and age	*House hold Head*	*Crop*	*Variety*	*Period used*	*Source*	*Comment*	*Are there any new activities and where did you learn this*	*With whom would you normally share innovations in crops or activities*	*Do you learn most in your own village or when visiting elsewhere*	*What is your best source of agricultural knowledge*	*Do you see the Extension officer and how often? If not, who does?*	*Are there problems with sharing information about new or better varieties or ways of doing things?*[+]
Mai Marichi @70 years	Female	maize beans cassava sweet potatoes mustard field peas	MH 18 Kaulesi -Research -Hybrid (Sri-Lanka) Research Zimbabwe	1993 - 1997 1993 - 1997 1988 - 1997 1983 - 1997 1994 - 1997 1993 - 1996 1993 - 1996	Bought from a friend Bought from a friend Same as above Free Free Shop Local market	Might share after first year when there was enough seed	Application of pesticides is new in her farming and is associated with hybrid vegetables	Normally share innovations with friends and relatives	Learns more in the village because one gets encouraged if a friend is doing better	Friends	She does not see the extension officer	It takes personal initiative to learn about a new activity or crop
Mai Muthowa @ 60 years	Male	maize sweet potatoes pineapples	MH 18 Research Local	1997 1997 1996 - 1997	FSIPM Project Friend (free) Friend (free)			She normally shares innovations with friends -	Learns most in the village	Her best source of agricultural knowledge is friends	She does not see the extension officer	There are no problems with sharing of information
Mai Matemba 32 years	Male	maize pigeon peas cassava mustard chinese cabbage	Chitute ICP9145 Research Zimbabwe Hybrid	1997 1997 1992 1991 - 1995 1996 - 1997	ADMARC Local market relative Friends (bought) Friends (bought)			Normally share innovations with friends and agemates	Her husband learns more through visits	Best source of information if friends	Does not see the extension officer	No problems with sharing of information

+ Note Some farmers mentioned local varieties as new because of the limited time period for which those varities have been available to the farmer and/or in the village

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FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

NETWORKS OF COMMUNICATION: HOW FARMERS LEARN ABOUT INNOVATIONS IN AGRICULTURE

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EXECUTIVE SUMMARY

Knowledge and skills are crucial human resources for successful agriculture. The means by which farmers gain and exchange information about new agricultural practices and technologies are an integral part of any farming system. Formal and informal networks of communication vary from place to place in their constitution and effectiveness. A study was conducted in the four villages where the FSIPMP has been working since 1996 to determine the status of existing formal and informal networks of communication and their potential utilisation in the dissemination of IPM strategies. Smallholder farmers in the on -farm trials took part in group discussions to explore their views on the current state of extension services and on informal means of communication of agricultural messages. Local extension workers and a senior officer at Extension headquarters were interviewed. To provide a case study, information was collected concerning local knowledge of pest management strategies. It emerged that subsistent smallholder farmers in these areas have either limited or no contact with the formal extension services. Radio alone plays a useful role in dissemination. Information about agricultural innovations also comes through friends and relatives, from farmers' own experimentation and from observation of other peoples' fields but these sources are limited in their effectiveness. Farmers stated that they need frequent group meetings with extension workers to have direct contact with someone who understands local agricultural problems. By contrast, the extension officers had found that farmers have no interest in meetings or training unless they are also able to access input and credit packages. All agreed that the extension services were currently in decline and that farmers had been better served in earlier years.

1.0 Introduction

This report focuses on innovation in agricultural technology and practice, an element of all farming systems, and explores how, in four villages of southern Malawi, farmers meet their need for knowledge about agricultural innovations. The topic is of particular interest to the FSIPM Project since it is attempting, in participation with selected farmers in these villages, to develop a set of integrated pest and crop management technologies that will, in due course, be suitable for dissemination elsewhere in the area. In order to lay the groundwork for this process, it is necessary to understand how information is sought and received in order to assess which routes and media would best serve to reach the resource-poor farmers who constitute the target group for the work of the project.

We begin with a summary of the rationale and context of the study followed by an account of the methodology. The results of farmers' and Farming Assistants' perceptions and experiences of the extension services at the village level are then presented and discussed. This is followed by a summary of views on other formal and informal methods of communication. Sources of knowledge and means of communication are then examined through the example of local knowledge of pest management.

1.1 Rationale for research

The original rationale for the research is specified in the Project Memorandum:

'The [...] social anthropologist [...] will study the formal and informal communication networks between farmers and between villages and the way they are structured by gender, ethnic group and socio-economic status. This information will be used to assess the capability of utilising existing traditional networks to spread the knowledge of project activities, findings and recommendations and to develop low-cost methods for improving access to information for the different categories of farmers.' (Project Memorandum, 1995)

As the project continues, there have been seen to be benefits to be gained from looking at communication network, beyond assessing capability. How farmers learn is a dimension of the farming system about which little has been learnt through other project activities. This study therefore complements other project work by extending our understanding of smallholder farming systems in the target area.

A further knowledge gap exists with regard to the reach of current extension work. The project is expected to assist with the preparation or improvement of extension materials for dissemination by formal extension networks. For this purpose, it is necessary to have some sense of what formal extension currently takes place. This information will assist the project in identifying what materials or media may be appropriate.

As a pest management project, a focus on communication networks concerning some of the pest management techniques most commonly employed by smallholder farmers seemed most relevant for a case study of innovation. These techniques had been identified by earlier project diagnostic work but had not been explored in depth. It was useful therefore to record data on current models of pest management in the hope that these concrete examples might shed light on the project's experience with on-farm trials.

The objectives of this research were therefore:

1. To identify existing means of communication between farmers and between villages with particular regard to innovations in agriculture, partly through a case study of three existing pest management practices (chemical, cultural and a resistant variety).

2. Following a desk study on extension in Malawi, to discuss content and implementation of extension with the local Farming Assistants (FA) and ADD managers and to explore impact from the farmer's perspective in the four project villages.

3. To assess the capability of formal and informal networks of communication for dissemination of project activities

1.2 Knowledge and the farming system
What is the role of information networks in the farming system?

> 'Farmers' capacity to control their environment is the result of the resources at their disposal: among these, knowledge and skills are key components. In order to understand a farming system, it is just as important to understand its communication networks as it is to understand its environmental situation or changes in its market place.' (Ramirez, 1997:3).

Farmers in any agricultural system must respond to changing circumstances, whether alterations in their natural or human capital endowment, market opportunities, the introduction of new inputs and technologies or the broader policy environment. In order to do so, they need information: individuals 'interact constantly, seeking to negotiate and create opportunities to fulfil their needs and pursue their interests'. (Ibid.) These patterns of communication and information exchange make up an agricultural knowledge and information system which is an integral part of the broader farming system. Since such systems or networks are dynamic and derived from multiple sources within and outside of the rural society, innovation will be enhanced or impeded by how efficiently the information is picked up by and moves between the individuals who make up the strands of the net (Ramirez, 1997:3; Warburton and Martin, 1998:3; Reijntes, 1992:52). (Innovation may, of course, be impeded in a number of other ways, for example, by lack of resources: farmers who cannot afford new varieties may not try them out).

Networks of communication have both formal and informal elements. In developing countries, formal networks of communication are generally considered to be those originating from government institutions such as the agricultural extension service, its agents, publications, posters and radio broadcasts but also material or activities produced or organised by NGOs, relevant industries, marketing boards and donor projects. Informal networks of communication are, effectively, anything else: communication between farmers, through traditional societies, between farmers and traders. A final source of information that is considered here is learning through one's own or another's observation or experimentation.

Access to information through both formal and informal means may be differentiated according to gender, age, ethnic group, education and socio-economic status.

'Knowledge and access to knowledge are not spread evenly through a community: people have differing objectives, interests, perceptions, beliefs and access to information and resources. Knowledge is generated and transmitted through their interactions within specific social and agroecological contexts' (Warburton and Martin, 1998: 3).

There are examples from elsewhere of categories of knowledge being 'tied to economic or cultural roles within the community' (Reijntes, 1992:52). Men and women may have knowledge of different crops or different agricultural activities. For a local example, Malawian men predominate in the growing of high value cash crops such as vegetables or tobacco while many women have greater expertise in the cultivation of legumes. It should not, however, be taken for granted that knowledge is differentiated in this way in every context. Every farming system has its own properties and must be investigated in its own right.

2.0 Background

Below we discuss the elements of the formal and informal networks of communication concerning agriculture that may be available. The distinction between formal and informal in the context of this research should not be exaggerated. The formal components consist firstly of the contact between two Field Assistants, the local frontline government extension officers, and four villages. Secondly, extension messages on the radio, in pamphlets, magazines or on posters have also been counted as 'formal' means. The contrast becomes rather clearer when considering how farmers learn informally about innovations in agriculture. Informal learning comes through conversation and observation of knowledge gleaned from any source and particularly what has been learnt through farmers' own agricultural experience and experimentation.

2.1 The Project and study region[1]

The FSIPM project has been working since 1996 in Chiradzulu North (Mombezi) and Matapwata Extension Planning Areas (EPAs) of the Blantyre Shire Highlands Rural Development Project (RDP). The staple cereal of the area is maize. Maize is intercropped with pigeonpea *(Cajanus cajan)*, beans *(Phaseolus spp.)* and a variety of other legumes, tubers and vegetables. This maize ecology is representative of 40% of the area planted to maize in Malawi (Heisey and Smale, 1995, cited in Orr and Koloko, 1998). Low average yields (836kg/ha for local varieties and 1765 kg/ha for hybrid semiflint varieties) reflect poor soil fertility and low use of inorganic fertiliser. The main cash crops are burley tobacco and dimba garden vegetables (grown for the markets of Blantyre and Limbe). Sixty percent of land holdings in this area are under 0.5 hectares. Women head thirty-eight percent of households in the RDP.

The project objective is to improve the welfare of poor farm families by reducing crop losses from pests, weeds and diseases. Participatory research methods are used to develop appropriate pest management strategies, sustainable within the constraints of the smallholder farming systems, to reduce crop losses (FSIPM Project Memorandum, 1995). In order to ensure that these constraints are recognised, it has been an priority of the FSIPM Project to understand the farming system as a whole.

2.2 Formal networks of communication

Models of extension in Malawi

The aim of the extension services is to disseminate new ideas, methods, practices or techniques which provide the means of achieving sustained increases in farm productivity and income (FAO, 1985). In order to set the context, a brief description is provided below of the model of extension implemented in Malawi.

[1] The information in the following paragraph is taken from Orr and Koloko, 1998.

The extension services in Malawi adopted the Training and Visit (T&V) model in the 1970s[2]. The T&V model was designed to overcome the problem of poorly trained and ill informed extension workers who were reluctant to leave their offices, based in areas where large numbers of farmers cultivated small farms, with low level technology and traditional methods. The answer to this was to impose a rigid structure of extension visiting of individual farmers and demonstration plots, backed up by regular training for extension personnel. Attention was to be focused on the major crops of an area and on those few aspects of their production which offered greatest scope for increasing incomes, through simple techniques requiring little or no cost increase in inputs (Rivera, 1986).

Malawi modified the T&V system in the 1980's when the Block Extension System (BES) was introduced. The BES, by recognising that there were too many farmers for individual visiting and the establishment of farmer groups, was thought to be better suited to Malawian circumstances. This system was implemented in BLADD in the 1987/88 season.[3] The field assistant was to sub-divide his section into units called blocks (normally corresponding to a village or a similar natural division) to be co-managed by farmer committees. Farmers, the committee, the field assistant and local leaders would together identify a 'progressive' farmer who could provide land or unused communal land on which the FA could set up a plot on which new agricultural technology and practices could be demonstrated. The farmer members of the block were to provide the labour and the inputs. The produce would be sold and the proceeds used to finance further block activities. All smallholder farmers in the block were to be invited to meet the officer fortnightly to observe the demonstration through the agricultural season (BLADD, 1993). The progressive farmer who owned the land where the demonstration plot was cultivated was to be the 'contact farmer': he would be the local expert on what was being done on this plot and it was envisaged that he would be a resource person for his fellow block members. Over time, this system was modified yet again. Rather than have one block centre for demonstration plots, there were to be a number of demonstration plots spread at roadsides throughout the block area within easy walking distance of each farmer. Effectively the block was subdivided into more manageable and natural units. The land, inputs and labour would be provided by the owner (thus biasing the programme towards better off farmers) but the agricultural practices would be supervised by the FA and both the farmer and the FA would act as extensionists for the technologies demonstrated in the plot.

A survey carried out in 1993 by Blantyre ADD found, however, that there was less contact between farmers and extension workers under BES than under the T&V system and that this was resulting in poor dissemination of extension messages. Results showed that around eighty percent of farmers did not attend block meetings and sixty percent had never attended or viewed an on-farm demonstration. The report also queried the content of extension messages as unsuitable for farmers with land holdings below one hectare and for resource poor households including poor female headed households. These two categories of farmers form the majority in the area (BLADD, 1993). The report recommended further developing on-farm demonstration plots with more relevant material.

Various non-governmental organisations (NGOs), such as the Christian Services Committee, work in the project areas and may also carry out their own extension work.

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[2] This system was developed by Daniel Benor, Director of Extension for Israel, 1950-1965.

[3] The following description of the Block Extension System is taken from the BLADD Extension Monitoring Survey 1993 and from personal communication with Mrs Msiska, the Senior Agricultural Extension Officer at BLADD.

Radio
Another instance of a 'formal' network of communication in Malawi is radio. The Malawi Broadcasting Corporation has a number of programmes containing agricultural extension messages. However, evidence from a number of extension studies detail the limitations of radio for extension messages. It is not, for example, a good medium for the transmission of long or complex items of information. Furthermore, people tend to listen to the radio in a casual way, while they are doing something else or while carrying on conversations. There may also be gender differences in access to radio based extension messages. Women are more likely than men to be involved in the performance of domestic tasks while listening to the radio because women are responsible for a greater proportion of domestic tasks and have less leisure time. (FAO, 1985) Radio extension cannot, in other words, be expected to substitute for a local agent: it cannot offer personal advice and support, teach practical skills, deal with small-scale problems or answer questions on the spot.

Written material
Extension messages are usually released as written material, whether in magazine, booklet or poster form. Printed media can combine words, pictures and diagrams to convey accurate and clear information. The great advantage of written material is that it can be studied for as long as the reader requires and can be referred to whenever necessary. This makes literature a useful permanent reminder of extension messages. (FAO, 1985) However, written materials are only widely useful in areas where a reasonable proportion of the population can read. In Malawi, illiteracy, particularly female illiteracy, is very high: male illiteracy was estimated at about 57% and female at 85% in 1988. (Pryor, 1988:62 and Green and Baden, 1994:55)

2.3 Informal networks of communication
Informal networks of communication exist between one individual and another in a context where there is no organised training or sharing of information taking place. Informal networks are between friends and relatives, from farmer to farmer and farmer to small scale trader. Farmers' own observations are included in this section as a non-formal source of information.

Learning through trying things out or observing
Most farmers have learnt about farming from their parents, family and friends through the actual practice of farming from childhood onwards. Only a few have received formal training through extension work or from elsewhere and only a few have benefited from reading about agriculture. Most have learnt through experience and observation and have what is known as 'tacit knowledge'. This means that thanks to their experience, by examining a crop, the soil or the surroundings in the context of their knowledge of the area and climate, farmers are able to reach a wide variety of complex conclusions unavailable to those without such localised and practical experience. This knowledge enables farmers to respond (however successfully) to climatic and micro-environmental problems as they arise. Even literate farmers in the villages where we work will have learnt most of what they know in this way. This type of learning particularly applies to crops that have been grown for some time and are viewed as 'traditional' crops. Crops primarily intended for subsistence often fall into this category. Communication between farmers about this type of knowledge is, therefore, a fundamental source of learning about agriculture but may be easier to elicit from observation and interrogation of training and practice than through interviewing.

Discussions with friends relatives
Farmers communicate along the various types of networks that exist in their daily lives and activities. Walking to and from fields, drawing water from wells, visiting relatives and friends, going to markets, attending church, funerals, school meetings and many other such occasions are all opportunities for discussing problems and exchanging information about agriculture and other topics. However, there are limits to the efficacy of such informal communication. Information often passes through several channels before it reaches a particular individual and is rarely transmitted in exactly the same words in which it was received. New technical information is particularly liable to be distorted as it goes from one person to another.[4]

Farmer Experimentation
Learning by doing is not limited to the repetition of what farmers have been taught. Farmers not only make observations but they make create opportunities for observation, that is, they experiment.

> "When trying to make decisions about their farming, most farmers take time to explore possibilities and carefully integrate knowledge from various sources. Apart from adaptations of innovations introduced from elsewhere, farmers may themselves routinely make careful observations and carry out small-scale trials of new ideas such as the germination tests of seeds and trials of new procedures or work methods. Problems or changes perceived by the farmers e.g. poor harvests, new pests, migration to new areas or availability of new crops, all stimulate a search for useful alternatives or new options" (Reijntjes et al. 1992).

3.0 Data and methods

3.1 Preliminary work and hypotheses

Pilot Study
This study began with a pilot study in Magomero village, Matapwata EPA, between May and June 1997. Eleven farmers were interviewed about how they had learnt of agricultural innovations. Ten of the eleven farmers interviewed said that their best sources of agricultural knowledge were friends and/or relatives. All farmers said that the extension officer used to visit farmers some years previously and that certain members of the village had been part of the agricultural demonstration activities at the EPA. At present, however, there was little extension activity relevant to their needs. The results of the pilot study suggested that it would be worthwhile carrying out a further study in all four villages where the project operates to see how typical were the Magomero experiences.

Library Search
The main study was supported by a library search for literature on communication networks in agriculture and extension models in Malawi in order to provide background and context for the study.

Hypotheses
The two hypotheses explored in this work, therefore, were developed from the pilot study and from the literature on extension in Malawi.

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[4] The FSIPM project has had direct experience of technical information being wrongly passed on when farmers have discussed research plot management with one another. Especially in earlier years, when project-farmer communication was weaker, our own extension poorer and the project less trusted, there were several examples of an incorrect message being transmitted e.g. that there was no need to weed plots or that all plots should be banked.

1.Networks of communication between farmers and villages are primarily informal, that is, farmers experiment and observe the agricultural activity around them and results are shared with friends, family and the curious.

2.Extension officers in the target area face considerable logistical difficulties in the implementation of ambitious programmes and concentrate on cash crop or credit clubs whose members are a wealthier and primarily male minority.

3.2 Methodology

Focus Group Discussions
The field work took the form of two sets of focus group discussions held in Lidala, Chiwinja, Magomero and Kambuwa villages. Focus groups were chosen in preference to individual interviews in order to generate information about common experience. Where there are disagreements, it was possible to explore the reasons why and to see what this reveals of differences in situations or requirements. In each village, men and women met separately to ensure that each group was able to express their views freely and to see if there was any difference in access to information due to gender. The groups were limited to a maximum of ten members in order to encourage all members to take part. The first set of meetings took place in September and October 1998 and the second set in March 1999. The meetings took place in two rounds so information from the first set of meetings could be analysed before being re-presented to farmers for basic ranking and scoring.

Scoring and ranking
Participants were asked to both rank and score sources of information about agriculture in order to see what the different methods revealed. Ranking is a relatively easy exercise (particularly where pictures of the sources can be placed in a column as they were in some of the discussion groups) but does not indicate what gaps might exist between the ranks and is less legitimately quantified. Scoring is generally a more difficult exercise (although beans were used as counters with some groups) but permits more accurate comparison of data. Clarification of issues that were not fully understood after the first round were sought where necessary in the second round.[5] It turned out that 1998-99 was a dynamic year in terms of credit club formation for these villages so that a higher level extension related activity was found in March 1999 compared to October 1998.

Interviews with Extension Officers
To cross-check information and to ensure that a full picture of the situation in these villages was presented, extension staff responsible for the research sites were also interviewed in two rounds. The two Farming Assistants concerned were asked how the four villages fitted into the block or demonstration plot systems and what sort of agricultural recommendations they had recently been disseminating. Particular attention was paid to the difficulties the extension workers face in meeting and transferring these messages to farmers. Finally, to provide a wider context for this information, a meeting was held with the Senior Agricultural Extension Officer, Mrs Msiska, at ADD headquarters in Blantyre.

[5] The scoring and ranking results do not include the second round men's focus group discussion for Magomero where attendance was poor (only three out of eight of those invited turned up) and where participants spent most of the meeting stating their need for inorganic fertiliser.

3.3 The sample

Farmer

It was originally intended that all farmers should be on farm trial participants. However, in Chiwinja and Lidala villages, the majority of participating farmers is female. In order, therefore, to hear male views, husbands of participants or farmers taking part in a 1998-99 sweet potato crack sealing trial were invited to join the discussion. Where possible, the selection included farmers included in the FSIPM Baseline Survey list so that background information, if necessary, would be available. The participating farmers who took part in the first round of discussions were those who were available on the day. Farmers from the first round were invited to take part in the second round. Out of the sixty-six participants who attended the meetings, only fifteen participants were not part of the on-farm trials.

Actual participation was as follows:

Table 1: Participation in focus group discussions by village, gender and participation in FSIPM trials

VILLAGE	MEN	WOMEN	ON FARM TRIAL FARMER	NON-ON FARM TRIAL FARMER
LIDALA	8	10	18	0
CHIWINJA	6	9	12	3
MAGOMERO	7	7	10	4
KAMBUWA	9	10	16	3
Total	**30**	**36**	**55**	**10**

The farming households represented in these groups varied according to socio-economic status. This reflects the heterogeneity found in Malawi among households classified as resource poor. A study carried out by FSIPMP socio-economic section suggests that farming households in the four villages where the project works may be stratified into five broad socio-economic groupings (Orr & Jere, 1998) and these are:

Table 2: Types of households represented in the focus group discussions

Household type	**Represented in focus groups**
1. Dimba households with access to land suitable for production of high value vegetables (from Matapwata EPA)	15
2. Stable male headed households producing neither vegetables or burley tobacco but with sufficient resources to be relatively food secure	13
3. Vulnerable households with low food-security (which do not grow burley tobacco and lack access to dimba).	11
4. Burley households with a high level of food security (from Mombezi EPA)	3
5. Stable female headed households producing neither burley tobacco nor dimba vegetables but which are reasonably food secure.	12

The results of the discussion therefore reflect a range of socio-economic situations.

4.0 Results: sources and networks of information about agriculture

Discussion group participants were asked to comment on their contact with the local extension officers while officers were interviewed about how the target villages fit into local extension work. The FA's were also asked what means of dissemination they use, what problems they face and the content of the extension messages that they are disseminating this season. To assist group members with their recall of past and present extension services, we asked about different aspects of extension activities such as the block meetings, demonstration plots, commodity and credit clubs. The issue of whether men and women have equal opportunities to receive advice from FA's was then explored. Continuing with questions about more formal means of extension, the discussion with both extension officers and farmer participants moved onto radio ownership and use followed by access to written materials.

4.1 Scoring and ranking

In the first round of discussions, group participants were asked to list the various sources from which they obtained information about agriculture. In the second round, participants were asked first to rank and then to score (out of five) these sources of information in order that the results might be (approximately) quantified.[7] Summaries of the rankings and scorings are given for men and women separately in the tables below. Both rankings and scores have been averaged over those groups for which results were recorded.

Table 3: Scoring and ranking by women of sources of information about agriculture

WOMEN	SCORE	RANK
FSIPM Project	5	1st
Radio	3.7	2nd
Friends	3	3rd
Written material	2.7	5th
Extension worker	1.8	4th
Own experimentation	1.8	5th
Other places	1.5	6th

Table 4: Scoring and ranking by men of sources of information about agriculture

MEN	SCORE	RANK
Radio	4.3	1st
Friends	4.3	3rd
Extension worker	4	2nd
Other places	4	4th
Written material	3.3	2nd
FSIPM Project	3	6th
Own experimentation	1.7	5th

[7] Results by individual discussion group are given in Appendix F

Ranking and scoring compared

When aggregated, ranking and scoring produced similar results. For the women's groups, the same three sources of information, FSIPM project, radio broadcasts and friends, came first under both classifications. In the men's groups, the same four sources (radio, friends, extension worker and other places) appeared in the top four of each list. Men gave very similar scores to most sources of information: six out of seven sources scored between 3 and 4.3 out of five. Only own experimentation fell outside of this cluster, with a score of 1.7. Given that men had ranked the seven sources of information from first to sixth, the closeness of the scoring suggests that not too much weight should be placed on the ranking. The scoring by the women's group ranged from 1.5-5 and for the most part better reflected the ranking order than the men's group.

In some cases, participants seemed to use ranking as a normative tool (to indicate the importance that different sources of information should have) and scoring to indicate experience. This was the case in Kambuwa with the men's discussion group where the extension worker was ranked second but given a score of 2/5 because there is currently no FA for this section. Similarly, in Magomero, the women's group gave radio second place in the ranking but only 2/5 as a score since not enough people have radios for this to be a practical source of information.

Comparison of men and women's scores

Men consistently gave higher scores than women to most sources of information as can be seen from the table below. While we should not read too much into these figures, the differences are supported by the group discussions below. (Men are more likely to own radios and have time to listen to programmes. Men are more likely to be able to read so are able to make use of written material. Similarly, men have greater access to the extension worker through the crops they grow or clubs they join and are more likely to visit other places where they have opportunities to compare agricultural practices).

Table 5: Comparison of scores by men and women

SCORING	WOMEN	MEN
FSIPM Project	5	3
Radio	3.7	4.3
Friends	3	4.3
Written material	2.7	3.3
Extension worker	1.8	4
Own experimentation	1.8	1.7
Other places	1.5	4

Table 6: Comparison of ranks by men and women

RANKING	WOMEN	MEN
FSIPM Project	1st	6th
Radio	2nd	1st
Friends	3rd	3rd
Extension worker	4th	2nd
Written material	5th	2nd
Own experimentation	5th	5th
Other places	6th	4th

Men and women agreed on the importance of the wireless and of friends as sources of information about agriculture. There was also a consensus that it is not so easy to learn from own experimentation.

The most striking disagreement concerned the value of the FSIPM project. Women gave the project a high rank and score while for men it was of little importance. There are several possible explanations for this discrepancy. It is likely that women are more involved in the project than men since the bulk of our research focuses on crops (maize and legumes) for which women are primarily responsible. As a result, women might be more interested than men in the project work. It also appears, was we will discuss in the next section, that women receive little else in the way of formal extension so give greater weight to the FSIPM intervention. Finally, it is possible that women felt more obliged than men to show their respect and appreciation for our work by giving the project a high rating or score. This would be in keeping with local norms of politeness.

Men and women also disagreed about the usefulness of the local extension services. Men placed the extension worker a joint second and women placed him fourth, the respective scores were 4/5 and 1.8/5. This result contradicts both men's and women's groups assertions (discussed below) that there is no discrimination between men and women when it comes to access to the extension officer. Men also rated written extension material more highly than women, giving a rank of second place and a score of 3.3 to women's fifth place and score of 2.7. Finally, superior male mobility is reflected in a high male score of 4/5 for learning from other places compared to women's 1.5/5 and respective rankings of fourth and sixth. This result was qualified by men in Kambuwa who pointed out that it is not possible to learn much from places with very different climatic conditions. Women in Magomero took the discussion back to the extension services by suggesting that the best places to learn from are those where the FA is working.

4.2 Formal sources of information

4.21 Contact with the Field Assistant

The FA for this Chiwinja and Lidala section is Mr Kadalinga. He covers twenty-three villages in which there are approximately 1860 households. The size of his section and the large numbers of groups that he facilitates (two groundnut seed multiplication groups, three income generation management groups, five chilli groups, three vegetable growing clubs and twenty burley clubs) mean that he concentrates providing training and inputs to these specialist groups.

This situation was reflected in farmers' comments. In the first round of discussions, men and women in the groups in Chiwinja and women in Lidala said that they had no regular contact with their FA since he was only concerned with credit clubs and commodity clubs such as burley and chilli groups to which they did not belong. Only one group out of eight, the men's group in Lidala, said that they had regular contact with their FA. Members of this group had consulted the FA concerning problems of maize and tobacco and received satisfactory assistance. The group included an acting chief and members of the local burley tobacco club organised by the FA. Other group members in Chiwinja and Lidala said, however, that were they to have a problem, they could go and ask the FA for advice or help and he would do his best. Most meetings are held at the FA's house rather than in the village. Women in Lidala said that they would not want to go to see the FA to discuss a problem in case other people gossiped (they were worried about being accused of chasing after the Extension worker). This group added that they are normally suspicious of outsiders and this too would inhibit them from seeking the FA's help. The Lidala men's group pointed out that the FA has to cover a large area so it is up to individual farmers to seek him out if they have a problem.

The FA for Magomero and Kambuwa is a caretaker FA. Mr Kapeleta. who inherited responsibilities for this second section when the previous FA resigned in August 1998. Mr Kapeleta has seven villages in his own section and between eight and ten in the section which includes Magomero and Kambuwa. Although promised incentives to look after this second section. they have not materialised and Mr Kapeleta admits that his contact with this section has been limited. The groups in Magomero and Kambuwa confirmed this information. saying that they had no regular communication with the FA because he is just a caretaker. Although the caretaker FA is supposed to be running various credit clubs. he had not been seen in either village for the last four months at the time of the first round of interviews in October. Both men and women said that this FA is not interested in helping them even if they go to see him with a particular problem.

Farmers in all four villages told us that there had been much more extension work in the past when Farmers Clubs existed. At this time. it had been possible to get hold of literature and even to see films about agriculture at mobile cinemas but all this had come to an end in the late 1980s and early 1990s.

Block meetings

The FA's confirmed that there are no functioning block committees. plots or meetings in any of the villages. The block centre in Lidala has been inactive since 1993 and an unresolved conflict between Chiwinja and another village as to the site of the block plot meant that the project was abandoned. Both Magomero and Kambuwa should have block plots and committees but do not.

Women and men in Chiwinja and Kambuwa and women in Magomero had no recollection of block meetings in their village or area. The women in Chiwinja had only heard about the block system on the radio. The men and women's groups in Lidala and the men's group in Magomero knew that there had been block meetings and demonstration plots from the 1980s to the early 1990s. Members of these three groups knew some details of how the block demonstration plot functioned (the provision of land. inputs. work and the distribution of produce etc.) but believed that the plots were only for credit club members. Only two interviewees. from the Lidala men's group. had been members of credit clubs while the block plot system was working.

When asked about the block system the FA's had criticisms to offer. Each FA has an unrealistic visiting schedule given the large area they cover. They lack transport (apart from bicycles) and equipment for rough and often wet terrain (boots. waterproofs and hats). Farmers have no interest in coming to group meetings unless there is a chance for them to get inputs and credits. Most farmers feel that they already know how to carry out what they see as basic farming of food crops and say that their greatest need is for inputs. The FA's blamed local leadership for not encouraging farmers to take more interest in the block system. There were also some problems with the structure of the block demonstrations. If the land was provided from common land by the chief. then inputs and labour were donated by the group and profits from the produce went to the group or into the club account. If the land was donated by an individual farmer. even if inputs and labour were provided by a group. he or she (usually he) kept the produce.

Demonstration plots
The FA's and the Senior Agricultural Extension Officer all told us that FA's were supposed to mount 300 demonstration plots in each section. There were only three plots in the four villages, suggesting that the extension officers are not meeting this target. There was a plot in Magomero to demonstrate ridge alignment and plant spacing.[7] As it turned out, neither of the Magomero groups knew about this plot. In Chiwinja and Kambuwa, the men's groups mentioned demonstration plots in the 1998-99 season. These were planted on a villager's land under the FA's supervision to demonstrate ridge and plant spacing, using the farmer's own inputs and labour. The Chiwinja and Magomero women's groups said that the only demonstration plots were the FSIPM plots. The other groups could cite examples of demonstration plots but outside their villages.[8]

From the local extension worker's point of view, Mr Kapeleta told us that the demonstration plots are not very successful because the farmer concerned regards the plot as the property of the FA rather than as his own enterprise. As a result, the farmer works on his other plots and neglects the demonstration plot unless closely supervised by the extension officer.[9]

Commodity clubs
In Chiwinja, Magomero and Kambuwa, the groups said there were no commodity clubs. A tobacco club had failed in Kambuwa and a chilli club was initiated but not continued in Chiwinja. Only in Lidala were there two burley tobacco groups with sixteen men and three women. These groups met fortnightly and provided training, credit, inputs and registration at the auction for their members. Membership cost MK50. Men were more likely to grow tobacco more than women. Men and women both said that tobacco was a lot of work for women and was much harder than growing maize. The membership fee was also a lot of money for a woman.

Mr Kadalinga also said that he spent most of his time with various commodity clubs but that there were none in Chiwinja and only burley and tobaco in Lidala. He explained that the burley clubs target those of 'medium economic status' who can afford to pay the club fee and 16% of the cost upfront for each bag of fertiliser they get on credit from the Malawi Rural Finance Company (MRFC). He added that the chilli growing groups were spread across several villages and met at his house.

Credit groups
In Chiwinja and Magomero, there are no credit groups. Men's group participants for Chiwinja said that in their opinion, some farmers do not want to join farming clubs because they fear the penalties for failing to repay credit and, given the recent unpredictability of the weather, they cannot be sure of enough harvest to repay loans. The Kambuwa women's group said that the problem was worst for women because they were more worried than men about taking loans that they might not be able to pay back. Women in Chiwinja were offered the chance to form a burley tobacco club but were only willing to take credit for maize growing. In all villages, farmers emphasised that credit for fertiliser would be the most useful agricultural intervention that they could think of.

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[7] On land owned by the largest landowner in the village.
[8] Men and women in Lidala had seen plots, marked by posters along their boundaries, at Namadzi and Mkhumbe. There had been a demonstration plot for a women's domestic activities group in Kambuwa but the tobacco and cassava crops had failed.
[9] The FSIPM Project has encountered similar attitudes regarding ownership of the trials among some participants.

In Lidala and Kambuwa, successful albeit limited initiatives were taken with credit this year. In Lidala, both men and women formed a group to try and get credit and training through the Mudzi Tikolole ('Let the village harvest') and the Mudzi Tilime ('Let the village cultivate') initiatives.[10] The women's group with eighteen members succeeded in meeting the criteria, taking the training and passing the tests while the men's group failed. The men in the Lidala discussion group said that they were at a disadvantage since the government these days has no interest in helping men, only women. They pointed out that if one listens to the radio, all one hears about is 'Women in Development' and there is nothing for men in development. The women's group's explanation for the failure of the men's group was that men were a bad risk for credit since they would borrow money that they could not afford to repay and then run away from the debt. It was interesting to hear from Lidala women's group, in the second round of discussions, that they were no longer so shy of the FA thanks to this programme. In Kambuwa, the Agricultural Productivity Investment Programme, run through ADMARC, began this year.[11] The chief was invited to nominate twenty candidates for loans and chose five women and fifteen men (his criteria were not known).

4.22 The content of extension messages

The table below contains a summary of current extension messages made by the two Field Assistants. Although, as both extension officers and group participants have told us, these messages are not currently reaching the majority of farmers in the four target villages, we wanted to see how relevant this information might be.

Table 7: The content of extension messages in Mombezi and Matapwata EPA

CROP	ISSUE	RECOMMENDATION	AREA
Maize	Fertiliser application	basal dressing 35:10:0 +2s top dressing 69:21:0 +4s	Mombezi
Maize	Pests (grasshoppers, caterpillar, aphids, armyworm)	hand picking spraying	Mombezi
Maize	Spacing	90 cm between planting stations	Matapwata
Maize, pigeon pea, sorghum	low yields/ late maturity	plant hybrids	Matapwata
Burley tobacco	Pests (grasshoppers, nymphs)	spraying, field hygiene, hand picking	Mombezi
Beans	Pests (beetles, caterpillars)	killing manually, spraying	Mombezi
All crops	low fertility/ lack of land	Intercropping	Matapwata
All crops	soil erosion	"A frame" on water entry points	Matapwata

[10] The Mudzi Tikolole and the Mudzi Tilime are part of the Mudzi Window initiative launched with assistance from the World Bank, IFAD and various NGO's to provide collateral free loans to resource poor farmers to improve food security. Under the Mudzi Tilime scheme, farmers, in groups of fifteen or more, receive a loan to grow hybrid maize on 0.2 hectares of land. Under Mudzi Tikolole, the idea is to grow either tobacco or soya beans to provide a crop to be sold for cash and reduce post-harvest maize sales. Training, group formation and screening through tests aim to weed out high risk borrowers and improve repayment rates.

[11] The Agricultural Productivity Investment Programme was established to provide loans to farmer groups formed through extension activities to which the MRFC was unable to fund in the 1998-99 season.

Comment

The recommendations above appear to have little significance for a resource poor smallholder as they require resources that the farmer is unlikely to be able to obtain or deploy. Many farmers are unable to afford the cost of both basal and top dressing fertiliser. indeed a significant proportion of farmers cannot afford any fertiliser. Monitoring surveys by the FSIPMP suggest that most farmers are well aware that best practice in fertiliser application is to apply a basal and a top dressing. the problem they face in implementing this is economic. Most smallholder farmers are also aware of the contribution intercropping and hybrid crops can make to food security but. as with recommendations for fertiliser usage . cash constraints limit adoption of hybrids or expansion of intercrops. The recommendations on hand picking and manual killing of insects are also problematic because they are labour intensive and difficult to effect on a large scale. Resource poor households tend to be short of labour during the agricultural season. particularly during the 6-8 weeks post planting. The FSIPMP encountered significant resistance from farmers to IPM strategies that were labour intensive. (Orr and Jere. 1997:70) The 'A' frame is seen as technically complex and farmers may not be sufficiently aware of this method or convinced of its utility to invest the time to learn how to use it.

4.23 Gender differences in access to the extension services

All the discussion groups thought that men and women had the same opportunities to use the extension services. What made a difference was individual attitude and intelligence. When asked if it would be easier for women to talk to a female FA. they said that the sex of the FA was immaterial.

There were. however. some important qualifications to this answer. Women in Magomero said that women are more willing to cooperate in groups than men as one sees from church attendance. The implication of this was that women could benefit more from extension work in groups. In Kambuwa. women said that women are disadvantaged only because they are shy. They also illustrated this statement with the example of church attendance but to make the point that although more women than men attend church. men take the lead in worship and administration. Men in Kambuwa argued that the main problem is that women are not interested in participating in groups or clubs and are happy to let men run meetings and ask the questions. They pointed out that men are more used to public roles than women so find this easier. According to this group. if men had not been actively encouraging women farmers. the FSIPM trials in Kambuwa would have failed since the female participants were very suspicious about our intentions. The men's group in Magomero suggested that women might be short of time to visit the FA. They also said that men might be advantaged in learning about agriculture because they were more mobile but when women travelled to markets they also had opportunities for observation and conversation. The men's group in Lidala said that in the past it was harder for women to use the extension services but that "Zonena za mamuna ndi mkazi ndi zimodzi ndi gender yabwerayi.". that is. the coming of gender equality has changed all this. They also pointed out that in Lidala. the FSIPM project works mostly with women so that probably more women than men are involved in agricultural groups.

Interestingly enough. both FA's thought that women might benefit more from group meetings than men. Mr Kadalinga said while men and women have the same difficulties in gaining access to information about agriculture. the main problem is a lack of commitment to attending block meetings. However. more women than men attend meetings not only because there are more women than men in the area but also because men show less interest than women. The FA in Matapwata agreed with this. He said that in his experience. women actually faced fewer problems than men in gaining access to information because more women attend meetings about agricultural improvement than men. Many men send their wives to meetings in their place. In his view. this means that the wife rather than the husband receives the extension message and there is no guarantee that the husband will take the trouble to find out what his wife has learnt or that she will pass on the message correctly.

On the issue of leisure time, all groups agreed that men had more spare time than women. When a couple come back from the field, a woman must draw water, cook and clean while her husband can wait for his bath water and his lunch[12].

4.23 Pest management

Farmers were asked if they had ever received a formal message concerning pest control. When asked if the FA had ever provided assistance regarding pest management, the women in Lidala said that in the past he had recommended certain pesticides to deal with whitegrubs, green grasshoppers and termites but that the assistance was limited to recommendations as to what the farmers themselves should buy. This had disappointed our participants who had been hoping that pesticides might be provided. Men and women's groups in Chiwinja said that at one time, there had been a serious outbreak of army worms and the FA had mobilised government assistance to deal with this problem (in keeping with government pest protection policy). The men's group in Lidala and all group members in Matapwata EPA said that they had not received any extension messages on pests.

Both FA's told us that there are currently no pest management messages being disseminated to the farmers beyond the use of pesticides or hand killing. When farmers have problems of caterpillars, beetles, stalkborers and grasshoppers, all they can do is recommend a pesticide or suggest they kill the insects manually. Most farmers cannot afford pesticides because they are expensive and must wait for heavy rains to wash away the pests. [13]

4.24 Radio ownership

Following the discussion on access to the extension services, farmers were asked about access to information on the radio: who owned radios, who listened to the broadcasts, whether information heard in this way was readily shared and how easy it was to make use of a relative or friend's radio. Our interest was to see how widespread radio listening is amongst the participating farmers and their families in order to understand what role radio based extension might play. The scoring and ranking exercises both emphasised the importance of the radio as a source of information about agriculture. Agricultural extension messages are broadcast early in the morning and also in the afternoons, several days a week, on MBC Radio One. There are also advertisements for new agricultural technologies such as seeds. The importance of radio as an extension tool has been recognised by government agencies and NGO's. Credit groups are being given wind up radios to meet as a group to listen to relevant extension programmes (members are supposed to take turns in keeping the radio at their homes).

Respondents were asked how many radios and how many households there were in the cluster of related households where they lived (the mbumba). Out of 125 households, 76 (61%) owned radios. It was generally agreed that radios were mostly bought and owned by men since they were more likely than women to earn sufficient cash. The men's group in Chiwinja was the exception in that they said that radios were for the use of the whole household so should be seen as a household asset. When it came to listening to the radio, the groups in Magomero, women in Chiwinja and men in Lidala thought that men spent more time listening than women. Women in Magomero said that men even carried their radios around with them so that they could listen as they travelled or worked. The men and women's groups in Kambuwa said that they thought that women had greater access to the radio since men tended to be out at work while women stayed at home where they could listen to the radio.

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[12] Men in Lidala said that women accept this situation because they respect their husbands as the head of the family while the women's group said that the men just sit idle (mbwii).

[13] For particular pests, such as army worm, if the problem constitutes an outbreak, an FA must refer the problem to the RDP/ADD for assistance.

Information might or might not be shared. The more important or novel the information, the more likely it was to be shared.[14] When asked if they could listen to a friend or relative's radio, participants said that they could only do this casually. It is not possible to go to a friend's house specifically to hear a radio programme. First of all, this might be inconvenient for the other person, secondly, if visiting, one should talk to one's host.

All but two groups (women in Chiwinja and men in Lidala) complained that batteries are expensive, unreliable, and often difficult to obtain in rural areas which means that farmers cannot always listen to a particular programme. These six groups estimated that they would have batteries for 2-3 weeks out of the month. A further problem is that there are few repair facilities for radio sets that break down.

Respondents in all groups said that some of the new techniques or technologies currently being tried out have been learnt from the radio. Examples cited of information heard on the radio were how to grow soya and groundnuts, early harvesting of maize to avoid weevil damage and the importance of crop diversification to reduce vulnerability in recent periods of drought.

However, discussants pointed out that there are technical and economic constraints to receiving information from the radio. Women in Magomero said that although ownership is more widespread than it used to be, resource poor farm households are still limited in their capacity to listen to the radio. Respondents in the women's group in Lidala who had heard useful agricultural messages from the radio said that they had done so not from their own machines but while listening to a neighbour's or a friend's radio so had not been able to concentrate properly. Furthermore, radios are not flexible. Participants in our meetings in Kambuwa, Lidala and Chiwinja said that a radio cannot deal with individual problems in the way that a person can. A farmer cannot stop a radio programme and go back to a point that s/he did not quite understand or had not heard properly or ask a question. After the broadcast, all that the farmer can rely on for details of what s/he has heard is his/her memory. (Presumably, a literate farmer who possessed pen and paper could take notes but this possibility was not mentioned). Women in Magomero said that the extension messages that they hear on the radio often require a considerable cash outlay that they cannot afford, for example, the recommendations for fertiliser application. The Magomero men's group also complained that they miss the useful programmes because they are busy in the fields when the programmes are on the air.

4.25 Written Material

Written material is scarce these days according to the discussion groups and the extension workers. There was a magazine called Za Achikumbe[15] ("Farming issues") which farmers said was useful but the farming assistants complained that they do not receive copies these days. Even when they did get the magazine, they would only receive ten copies to be shared amongst nearly two thousand farming households. There are advertisement posters at ADMARC giving information about new seeds and pesticides. Farmers said that it was much easier to get extension literature in past when they still had credit clubs where they met the extension agent regularly.

[14] Several groups mentioned how quickly news had spread of the President's separation from his wife as an example of how useful the radio was for news.

[15] An agricultural magazine produced by the Agricultural Communications Branch of the Department of Agricultural Extension and Training.

In the ranking and scoring exercises, written material was ranked fifth (out of six) by the women's groups and scored 2.7 out of 5. Men, by contrast, put written material in second place but only gave it 3.3 out of 5. The groups were asked who would benefit from written extension material and, in particular, whether there were substantial differences between men and women. The groups told us that with the older generation, boys were clearly preferred to girls when it came to education. Parents were happy to pay school fees for boys who might go on to get jobs but they feared that their daughters would be morally corrupted at school and fall pregnant. The men's group in Lidala said that in their area all the schools had been Roman Catholic so that Muslim parents feared to see their children converted. With the current generation and the younger generation, more women and girls are able to read thanks to adult literacy campaigns and the drive to get girls to school. Both the men and women's groups in Kambuwa commented that despite the improvement in ratios, there were still more boys in school.

When asked about how those who cannot read might benefit from written extension material, participants said that this was not a problem. If the parents cannot read then their children can read and translate information for them.

As an example of the utility of written extension material, participants were asked about the information sheets about the trials, written in simple Chichewa, that were distributed to all participants in the first year of the project. A follow up survey in 1998 asked farmers 'How was the text that was handed out - were you or someone in your family able to read it?' Only 38% of men and 21% of women interviewed said that they had both read and understood the document (Lawson-McDowall et al. 1999). Thirty-eight members of the discussion groups had taken part in the 1996-97 trials. In contrast to the findings of the survey, twenty-six (77%) said that they had found the literature useful as a reference point.[16] Six women who could not read had asked relatives to read it for them. Four women said that they had not read the sheet or asked anyone to read it for them. Most said that they had not shared the information either because it was specific to the trials and not of general interest or because they thought that copies were being generally distributed.

4.3 Less formal sources of information

The discussion then moved onto learning about innovations by less formal means than the extension services. Farmers told us that they learnt from fellow farmers and also by observation of their own and others' fields. In the second round of interviews, participants were asked to explain further with whom they might share information and under what circumstances.

4.31 Learning from friends and relatives

The questions in this section asked with whom villagers would readily share information or whose fields they might observe. In the first round of discussions, participants told us that friends and relatives were the people with whom they would share information about improvements in agriculture. Scoring and ranking moved friends and relatives to third place for both men and women in terms of importance of learning about innovations. Men gave a score of 4.3/5 and women 3/5. Participants stressed that if something works for a friend in a similar situation, it will probably work for you too. In the second round, we were also keen to clarify further who these people were and what barriers to communication might exist.

[16] It is interesting that a higher percentage of participants in the discussion group than in the survey said that the handout was useful. In the discussion groups, 60% (15 out of 25) women and 85% (11 out of 13) men said that the handout was useful but in the survey only 21% of women and 38% of men said this. The most plausible explanation of this disagreement in results is that farmers were reluctant to admit publicly that they had not used this material. Such an admission would be particularly difficult when most were encouraging project staff to recommend written materials for extension.

Men and women said that relatives are kin by blood or marriage. Group members emphasised that it is not enough to be related or acquainted with someone, one must be on good terms with that person. This is a salutary reminder that rural communities suffer as much if not more than other communities from disagreements, jealousy and rivalries. When asked if there was any difference between relatives in villages of birth and marriage, men said that they were more respected in their wife's village. Men in Chiwinja and Kambuwa explained that the problem is that people at home have seen you grow up and as a result of this familiarity, they are jealous and do not want you to succeed. If a local boy makes good, his success throws others' lack of success into stark relief. Two illustrations of this point were given. Were a man to open a grocery store in his natal village, it would fail because his relatives and friends would demand credit and then refuse to pay. The second authority for this sociological fact was the Bible: Christ said that a man is not respected in his own land.

Friends are people that you have known for a long time, that you visit and chat to, who gives you good advice or helps when there is a problem. This is likely to be someone who is a neighbour or who works in a field that neighbours your own or a fellow member of an organisation such as a church or agricultural club. Women said that they had particularly good conversations when they met at the borehole.

The groups said that one would only talk to close and trusted relatives and friends about agricultural problems or innovations. Women in Lidala said they would share information with a relative before a friend. Men in Chiwinja said that if someone learns something useful from the radio, they would share the information within their family but not outside the family group. Furthermore, amongst this close group, we were reminded, only some are interested and open-minded enough to want to learn new things. Participants also pointed out that there are problems with learning from friends. Friends may not remember all the details of something they have been taught or have heard, for example.

Women's groups in Chiwinja and Magomero emphasised that one has to be careful when asking someone about what they are doing in their fields or with sharing information about one's own field. Many villagers would suspect the worst: that the questioner is spying out the land in preparation for a theft or witchcraft. In Kambuwa, the women said that they do not talk to fellow villagers who mocked them at the start of the project and taunted them that the foreigners would steal their land. It is, however, fine to discuss agricultural successes or problems with outsiders with a legitimate interest such as the FSIPM Project or the FA. Women in Lidala said that they found it easier to trust people from outside the village anyway as they were less likely to steal one's crops.

4.32 Observation of others' fields

The theme of witchcraft dominated answers to the next question: "Who can look at your fields and whose fields can you look at?" Participants said again that only those whom one trusts very closely or who have a legitimate purpose (such as the project members) are free to look at another's field. There is a general fear of either having your crop stolen or bewitched (<u>kukawa</u> or <u>kupininga</u>)[17] or of being suspected of having evil intentions towards another's crop. Even relatives may cast spells. Many protect their fields with charms to prevent this sort of damage. The men's group in Kambuwa told us FSIPM Project members should be careful not to inspect fields where there are no plots lest their interest be suspect.

Farmers also detailed what sort of issues they might ask others about. People are keen to talk to a person whose field appears to be doing particularly well in that season and to find out why this is and how the farmer came by the idea for the technique or the technology. Women in Magomero said that they might seek advice about dimba agriculture (vegetable growing), a relatively new enterprise and one dominated by men, but that for upland agriculture (maize and the various intercrops of the maize system), people tended to worked alone. It seems that farming of this nature is supposed to be familiar to everyone so that to ask questions would make one look foolish. The women went on to say that with 'ordinary farming', there would only be discussion on general issues such as whether there had been enough rain to plant or not or how well a new seed was doing.

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[17] <u>Kukawa</u> is a term applied specifically to the loss or mysterious reduction in yield at the time of harvest. <u>Kupininga</u> is a more general term for the casting of spells.

4.33 Own experimentation
Participants in all four villages said that some of the agricultural activities they practise were discovered by farmers themselves while in the process of trying things out in response to problems. Successful results can then be seen by family, neighbours and passers by or be passed on to others. A example of local experimentation, the result of which has now been shared widely, is the eradication of difficult weeds such as kapinga (*Cynodon dactylon*) by digging deep into the ground, removing the weeds, drying and burning them away from the field.

However, there are problems with learning in this way, and these were reflected in the low scores given by farmers to this source of knowledge. Men and women both ranked own experimentation fifth out of six places. Scoring was also very similar across the groups: men gave own experimentation 1.7 and women 1.8 out of five. Men in Kambuwa and Magomero said that the trouble with trying to discover things by oneself is how to be sure whether or not one has proved something. One participant said that trying something out for oneself is just a game of chance. This difficulty with knowing something for sure means that it is hard to persuade a friend that there is a genuine innovation. The men's group in Chiwinja disagreed with this view and said that friends are very useful when experimenting because they can help you confirm whether or not you have learnt something new.

4.4 Subjects for extension messages

The most common request from the groups was for information about crops that are grown predominantly for cash such as field peas, beans, groundnuts and soya beans for women and vegetables or irrigation farming for men. Several groups mentioned new maize varieties and the importance of information about the timing of agronomic practices. This suggests that farmers feel they need information about crops that they have started to grow recently but that they are also open to varietal improvements in the crops they regard as traditional and staple.

Discussion
Farmers in the focus groups and their local FAs agree that the extension service at present is failing to reach the majority of farmers in the target villages. The FAs face considerable problems in terms of resources and logistics. The extension messages and training that they offer appears to be of little interest to farmers unless a credit or input package is included. Extension on pest management has been restricted to the recommendation of chemicals or handkilling. The block system seems to have had little success and where it functioned in the past, to have favoured the small elite who could afford to be members of farmers' clubs. Although several credit or commodity groups have been initiated in the 1998-99 season, their scope is limited and the majority of households do not have access to credit. According to our groups, extension material and meetings are welcome but in the context of credit packages and when concerned with crops or new varieties that farmers want to learn about. The radio is widely recognised as a useful extension tool but its limitations mean it can only be one element in a broader strategy. Written material can also reach only a limited audience but our groups were enthusiastic about its potential.

The focus groups resisted the suggestion that women had less access to extension services than men and the two FA's said that they thought women attended meetings more readily than men. However, in practical terms, it appears that the FA's work mostly with male-dominated crops and groups and women have less time, fewer skills, less money and less confidence to try new crops or seek extension advice. Women also seem to have fewer opportunities or capacity to benefit from radio extension or written material. Significantly, women said that if something is important enough to them, such as a meeting, they make time for it.

When it comes to learning from friends and relatives or from one's own experimentation, farmers told us that while useful, these sources had definite limitations. It was hard to be sure of what one had learns through own agriculture practice. It is possible to seek confirmation from friends but proof is evasive. Group members confirmed that information is exchanged within networks joined by kinship, co-residence and friendship but warned us that within villages there are jealousies and schisms that may act as barriers to information flows. This makes it hard to look freely at another's crops without arousing suspicions of theft or witchcraft.

In the next section, we will look at some concrete examples of agricultural knowledge being communicated between farmers. This data demonstrates that whatever the barriers, useful information does appear to move along communication networks if given enough time.

5.0 A case study of the communication of local knowledge: pests and disease management

Alongside the assessment of formal and informal ways of communication in the villages concerned, in order to provide a case study and because this is an IPM project, we also wanted to assess the status and transmission of local knowledge of possible pest management strategies. Strategies for control of grain weevils, termites and pigeon pea wilt were chosen since methods for dealing with these pests are known to farmers. Participants in our meetings stated that they had never received formal extension information about pest problems apart from spraying (which few can afford) or handpicking: the extension officers confirmed this. Consequently, resource poor households have to rely on whatever knowledge of pest management is generated locally.

5.1 Chemical Control: the Grain Weevil (Sitophilus)

The most common pest problem for which farmers have a solution is a storage pest, the grain weevil (*sitophilus*), which affects maize, pigeon peas, beans, field peas and other legumes. Various methods are used to try and overcome weevil infestations. Farmers apply ash, mix the stored grains with crushed tobacco residues, hang the stored grains underside the roof in a kitchen in the hope that the smoke from the fire will reduce insect attack and apply Actellic (Pirimiphos-methyl) powder (a local pesticide).

Participants explained that ash has been used for many years not because it gives particularly satisfactory results but because farmers can not afford anything more effective. Similarly, mixing stored grains with crushed tobacco residues does have some effect but can only be done with a small amount of the stored grain kept for seed. The same limitations apply to the method of hanging a small amount of seed under the roof of a kitchen, it is not possible to store a large amount of grain using this method. The most effective method of control for the grain weevil is Actellic powder.

Actellic

The chemical, Actellic, has been available in Malawi since 1980 when it went on sale in the ADMARC shops. Via extension, radio announcements and posters, most people now know that they can reduce damage from weevils by applying Actellic dust to their stored grains. Actellic is bought from Admarc, shops, vendors and Oilcom filling stations. Others receive the chemical as a gift from friends, relatives or children. Interviewees found it difficult to estimate how much money they spent annually on Actellic. An 100g container of the chemical is K40.50 (December, 1998). Expenditure on Actellic therefore depends on the farmer's ability to pay and the amount of grain s/he wishes to protect and so varies considerably from farmer to farmer. An average figure of K100 per year was suggested.

Farmers have learnt how to use the chemical in various ways: by reading the labels of the container for those who are able to read. from advertisements on the radio and the morning agricultural information broadcast. through consulting friends and relatives and from the vendors at Admarc. However. the group commented that some people use the chemical in an idiosyncratic way. according to their own interpretation of the instructions. Opinions differ as to the effectiveness of the pesticide. Those who consider the chemical less effective said that they suspect that it is not as strong as it used to be or that the pest has developed resistance to the chemical.[18] Participants in Lidala village said that 'Actellic Super' (Permethrin–pirimiphos-methyl) is more powerful than the normal Actellic. Others pointed it out that the effectiveness of the chemical depends on the technical knowledge of the user: if the user fails to follow the instructions. he or she will not get the full benefit. Farmers who have seen that Actellic is effective have spread the news amongst their friends.

5.2 A cultural method of pest control: kukwezera against termites

Many farmers in the study sites regularly experience crop losses to termites in the fields. There are a number of cultural control strategies. handed down from the older generation. used in an attempt to avert termite damage. A common strategy cited in every village is the practice of weeding without banking. known as kukwezera . Since termites feed on the weeds which are buried during banking and in the process cut down the maize stalks in a banked field. not banking may reduce termite damage. However. there are some drawbacks to the practice of kukwezera . Men in the Magomero group and women in Lidala said that not banking the field reduces the overall yield. Men in Lidala said ridging in the following season is made more difficult if the field has not previously been banked.

Other well known local control strategies include planting two species of tree known as India and Nkhadze (Euphorbia tirucalli). These trees are believed to reduce termite damage because they contain a substance which repels the pest. Some participants said. however. that they thought that these strategies are not very effective. A direct control measure cited is to dig out and kill the termite queen or apply the chemicals such as Temik (Aldicarb) or Sevin (Carbaryl) to the anthill. Participants in Kambuwa said it was hard to persuade a neighbour whose termite hill was damaging your land to destroy a nest since the "flying ants/alerts" which emerge from anthills in December and January are a highly prized relish.

These pest management strategies for termites are regarded as 'local knowledge' and are passed from one generation to the other. Ridging has only been common in these areas since the 1940's and 1950's which means that knowledge of this variation to ridging to reduce termite damage has been disseminated during the last 40-50 years. This has been long enough to give the technique the status of 'traditional' knowledge.

5.3 Varietal resistance to control pigeon pea wilt (kunyala)

[18] According to GTZ newsletters. it appears that a substantial proportion of pesticides being sold do not have sufficient quantitities of the active ingredients. this is the most likely explanation for reduced efficacy.

The FSIPMP is exploring varietal resistance to pigeon pea wilt so farmer perceptions of this disease and ways of dealing with it are of interest. The focus group discussions provided an opportunity to revisit the subject with farmers. Participants agreed that pigeon pea wilt (kunyala) is a serious problem. In Chiwinja, participants said wilt is a less serious problem than termites while the male group in Kambuwa said that in their view that wilting has become a serious problem only recent years. In all the meetings, participants said that there is no control measure available for wilting pigeon peas (apart from not growing the crop), however, all said that they grew ICP 9145, (a wilt resistant variety). However, the reasons given for growing ICP 9145 were not directly related to the variety's wilt resistant qualities and there was no spontaneous observation of wilt resistance. ICP 9145 is valued because it matures earlier and yields more than the local variety (yield is of course in part a function of a variety's ability to resist wilt). Participants in all these sites said that they had not heard of a wilt resistant pigeon pea variety. When asked how the local and ICP 9145 varieties compare regarding wilt, participants said that on reflection, ICP 9145 perhaps appears to be less susceptible.

ICP 9145 was only released in the mid-1980s, how had farmers come to know about it? Participants said that they had come to know ICP 9145 through observing it in others' fields, that is, they saw the crop growing, recognised it as a new variety and took the initiative to ask the owner of the field about the crop. Others came across the seed in local markets, talked to vendors and decided to try it out.

Discussion

These examples suggest that information appears to spread reasonably fast about successful pest management techniques. Secondly, resources are a problem. Farmers are limited in their ability to buy pesticides and, were they to recognise a pest or disease resistant crop variety, would be similarly limited in their purchasing capacity. Next, it seems that the dominant model of pest control has become chemical: Sevin, Temic and Actellic were all cited as successful ways to control pests. By contrast, local techniques for controlling weevils or termites were viewed as inefficient or as having drawbacks. Finally, where the problem is not recognised as a disease, as with wilt, there are problems recognising that there may be a solution. Wilt, as the name implies, is not usually seen as a disease but as damaged caused by too much rain or too much sun. Without better understanding of the pathology of the disease, farmers will continue to attribute the problem to climatic conditions that they are unable to affect.

6.0 Conclusion

What, then, does this study tell us about formal and informal networks of communication in these four villages and what are the implications for planning dissemination of FSIPM project findings?

All agreed that the extension services were currently in decline and that farmers had been better served in earlier years. The evidence presented here suggests that extension work at present in these villages is only reaching a small percentage of better off male smallholder farmers who are members of specialist crop clubs such as burley tobacco or chilli clubs. While precise statistics are unavailable, Peters, in 1993, said there were 'extremely few' female members of burley clubs. (Peters, 1993:59) Those smallholder farmers who are not growing the cash crops targeted by the extension services appear to have little or no contact with farmers.

There also appear to be problems with relevance of the various extension messages being put out by the F.A.s. Much of this material is insensitive to the heterogeneity of the rural population in terms of their access to human and economic resources. Where farmers actually receive advice, they are told to buy and apply relatively large amounts of fertiliser, to use pesticides, to plant high yielding hybrid seeds and to intercrop many different crops, all of which require substantial investments of cash. Those recommendations that do not demand a financial outlay oblige the farmer to find extra time for activities such as handkilling pests during the peak work period. Clearly this advice favours those households with substantial endowments of capital and labour rather than the resource poor.

Farmers blame the extension services for a lack of commitment to smallholder farmers and, in return, extension staff attribute the problem to the farmers' lack of interest in anything other than credit or input packages. Certainly, most members of the focus group discussions took the opportunity to remind team members that their most pressing need is for credit for fertiliser. The most cheering note is that both farmers and extension officers agree that the solution to their problem is group meetings for training supported by written material. Whether farmers would attend without the incentive of a credit package, as in the days of the maize clubs, is not so clear.

The radio was generally agreed by farmers to be a good source of information but not one that could stand alone. Access to radios is patchy, many farmers do not own a radio or if they do, they may not be able to afford to 'run' it all the time. Nonetheless, the current reach of radio compared to other means of extension means that there is a strong case for considering radio as a medium for project crop and pest management technologies. However, he nature of the medium requires that reinforcement of the message in the form of extension advice or written materials is required.

The authors of this paper were surprised by the enthusiasm demonstrated for written materials given the low levels of literacy found in Southern Malawi. Both men and women farmers in the discussion groups were keen to see more Chichewa language pamphlets. It is understandable that extension officers would like to have pamphlets and booklets to hand out to interested farmers but it seems less likely that many farmers would be able to make proper use of this information. The project plans to produce written material in both poster and pamphlet form (in cooperation with the government extension communications section). It would be interesting to see if there is more detailed information available elsewhere that would help us to assess this enthusiasm against actual coverage achieved by written materials.[14]

Discussions with other farmers about experiences and experimentation and observations both on site and elsewhere were said by the majority of farmers to be a source of knowledge but one that was limited in application. Interestingly, traders and shops were not mentioned as a source of information.

Farmers said that they thought that there was little difference between men and women in their access to new information about agriculture. While this may be true of the informal networks of communication, farmers' own evidence suggests that there may be problems at the formal level. For example, farmers all agreed that the extension officers working in their villages met principally with those farmers who were members of specialist crop clubs. The membership of these clubs is predominantly male. It appears that a distinction is being made here between principle and practice. In principle, there is no reason why a keen female farmer should not be as capable as anyone else in asking for information. However, in practice, it may well be harder for a woman to approach the FA, a professional and 'outsider' male. In practice, women give more time than men to subsistence crops and to marketing, so that they have less time to grow cash crops. Similarly, women have a range of domestic duties to perform so have less time to sit and listen to the radio and fewer women than men are literate so fewer can read extension literature. These findings suggest that there are structural differences between men and women in their access to formal networks of communication in agriculture. Such differences would suggest that at the informal level, if more information is transmitted primarily from men to men and women to women, women would have less access to information gained through formal networks. This issue cannot be addressed here due to lack of data.

So what do these findings mean for the FSIPM project in disseminating its work to a wider farmer audience? The evidence from these villages suggests that the formal extension services are overstretched, underresourced and demotivated. There might, however, be some possibilities implicit in the success of the specialist crop groups. Specialist groups for farmers with particular pest problems have been formed for the 1998-99 on farm trials. Extension workers prefer to work through specialist groups, might the formation of 'termite' and 'whitegrub' groups by farmers provide a model of one way to access extension information?

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[14] Such information might be available from Ministry headquarters and also from other organisations working in agricultural extension.

Judging from the results of 1997-98 and 1998-99 monitoring work, the methodology of on-farm trials also appears to have been successful as a demonstration plot in a way that extension demonstration plots have not been. Farmers have shown considerable interest in the ridge spacing and plant spacing design of project plots. These spacings follow longstanding and common extension recommendations. Leaving aside the personnel and cost implications of the FSIPMP model (three seasons in farmer's own fields with 16-30 replications per village), farmers' preference to learn from their own and others' practice close to home appears clear. The success of our farmer field days also offers a useful model for farmer learning. There has been considerable farmer enthusiasm for seeing how things are done elsewhere and the opportunities this gives for fresh insights.

Finally, and reassuringly, it seems probable that if technologies or practices developed by the project are appropriate for the needs of resource poor farmers, information about them will pass from farmer to farmer.

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References

DUDLEY, E. (1993) *The Critical Villager: Beyond Community Participation*. Routledge, London. 85 pp.

FAO. (1985) *Guide to Extension and Training: Extension and Communication*. Rome: Food and Agriculture Organisation of the United Nations. 48-49 pp.

GREEN, C and BADEN, S. (1994) *Briefings and Development in Gender: Women and development in Malawi*. Report no. 23. Institute of Development Studies, University of Sussex, and Brighton. 55 pp

HAVERKORT, A.W. and ROLLING, N.G. (1990). *Strategies and Rural Extension: International Course on Rural Extension*. Workshop (iii) pp 3. International Agricultural Centre, Wageningen, The Netherlands.

LAURENS, V., WATERS-BAYER, A. and HENK, Z. (1997) *Developing Technology with Farmers: A Trainer's Guide for Participatory Learning*. Zed Books Ltd. London, UK.

LAWSON-MC DOWALL, J., KAUNDA, C. A. and CHINGWALU, F. (1999) *Report on Suspicions and Expectations Questionnaire* (in. prep) FSIPM Project. Mimeo.

MINISTRY OF AGRICULTURE AND IRRIGATION, BLANTYRE ADD (BLADD) (1993) *Extension Monitoring Survey*, 1992/1993, (Blantyre). Mimeo. 1.6.8 pp

ODA/GOM. (1995) *Project Memorandum for the Farming Systems Integrated Pest Management Project*. Lilongwe: ODA. Mimeo.

ORR, A. JERE, P. and KOLOKO, A. (1996/97) *What have we learned?* November. FSIPM Project. Mimeo. 13 pp

ORR. A. and JERE. P. (1998) *Identifying smallholder target groups for IPM in southern Malawi*. January. Mimeo. 7 pp

ORR. A. and KOLOKO. A. (1998) *Why don't they weed? Researcher recommendations and farmers' weeding decisions in southern Malawi*. August. FSIPM Project. Mimeo. 3 pp

PETERS. E. P. (1993) *Maize and Burley in the Income and Food Security Strategies of Smallholder Families in the Southern Region of Malawi*. Havard Institute for International Development. Mimeo 59 pp.

PRYOR F. L (1988) Income Distribution and Development in Malawi: Some Historical Statistics. In: *World Bank Comparative Studies. The Political Economy of Poverty, Equity, and Growth*. Research Paper no.1 Washington DC. USA 62 pp

RAMIREZ. R. (1997) *Understanding Farmers' Communication Networks: Combining PRA with Agricultural Knowledge Systems Analysis*. Gatekeeper Series no.66. London: IIED 3 pp.

REIJNTJES. C.. HAVERKORT. B. and WATERS-BAYER. A. (1992) *Farming for The Future: An Introduction to Low-External -Input and Sustainable Agriculture*. ILEIA. Leusden. Macmillan. Netherlands. 48. 50. 74 pp.

RIVERA. W.M. (1986) *Comparative Extension: The CES. TES. T&V and FSR/D*. Centre for International Extension Development. Occasional Paper Series no.1. College Park. Maryland. 6-7 pp

SCOONES. I. and THOMPSON. J. (eds.) (1994) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publishers Limited. London. IIED. UK.

WARBURTON. H. and MARTIN. A. (1998) *Local People's Knowledge: Its contribution to natural resource research and development*. Natural Resources Institute. Chatham. UK. Mimeo 3 pp.

APPENDIX A: Scoring and Ranking by Individual Villages

SCORING

WOMEN	Lidala	Chiwinja	Kambua	Magomero	TOTAL	AVGE
FSIPM Project	5	5	5	5	20	5.00
Radio		5	4	2	11	3.67
Friends		4	1	4	9	3.00
Written material		3	4	1	8	2.67
Extension worker	4	0	1	2	7	1.75
Own experimentation	1	1	2	3	7	1.75
Other places		2	1		3	1.50

MEN	Lidala	Chiwinja	Kambua	Magomero	TOTAL	AVGE
Radio	3	5	5		13	4.33
Friends	4	5	4		13	4.33
Extension worker	5	5	2		12	4.00
Other places		4	4		8	4.00
Written material	2	5	3		10	3.33
FSIPM Project		3			3	3.00
Own experimentation	1	3	1		5	1.67

RANKING

WOMEN	Lidala	Chiwinja	Kambua	Magomero	TOTAL	AVGE
FSIPM Project	2	1	2		5	1.67
Radio	3	2	1	2	8	2.00
Friends	3	3	3	1	10	2.50
Extension worker	1	7	4	3	15	3.75
Own experimentation	5	6	3	1	15	3.75
Written material		4	4	5	13	4.33
Other places	4	5	5	4	18	4.50

MEN	Lidala	Chiwinja	Kambua	Magomero	TOTAL	AVGE
Radio	4	1	1	1	7	1.75
Extension worker	1	3	2		6	2.00
Written material	1	2	4	1	8	2.00
Friends	2	6	3	2	13	3.25
Other places	3	5	5		13	4.33
Own experimentation	5	4	6		15	5.00
FSIPM Project		7			7	7.00

APPENDIX B First Round Focus Group Discussion Guide on Networks of Communication

FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

AIM OF THE STUDY:
FSIPM Project intends to conduct this study in order to determine existing formal and informal networks of communication and their potential utilisation in IPM dissemination strategies.
Your co-operation in this exercise will sincerely be appreciated. You must feel very free to express your ideas and opinions on the topics to be discussed. Be assured that whatever you will tell us will be handled confidentially.

1. ACCESS TO INFORMATION ON AGRICULTURE AND POSSIBLE CHANNELS

1.1 How do you acquire information in agriculture? [Probe. radio (who owns it). Farmers Guide books. Za Achikumbi Magazine. Mobile Cinema Van. Agricultural Shows]

1.2 With whom would you normally share information on innovations in crops or agricultural activities?

1.3 In which way do you learn most of the information? [Probe. village or elsewhere]

1.3.1 Give examples of what you have learnt

1.3.2 What is your best source of agricultural knowledge?

1.4 Do you have any contacts with the Field Assistant Farm Home Assistant?

1.4.1 How often do you meet him/her?

1.4.2 When did you last meet him/her?

1.5 Have you ever had an extension message on pests?

15.1 What was the message?

1.6 Have you ever consulted the Field Assistant/Farm Home Assistant on agricultural problems?

1.6.1 For what problem did you contact him/her?

1.6.2 How were you assisted?

1.7 Is there any difference in access to information and technology in agriculture between male and female smallholder farmers?

1.7.1 Why is that so?

1.7.2 How can this problem be solved?

1.8 What would you suggest to be the best way of communicating agricultural messages to you?

2. CHEMICAL USAGE FOR PEST CONTROL

2.1 Do people here have any problems of weevils in maize?

2.1.1 How serious is the problem?

2.2 What control methods you know?

[Probe: Actellic or Actellic Super]

2.3 Where did you get information on Actellic/ Actellic Super?

2.4 Where do you get it?

2.5 How much does it cost you per year? [MK]

2.6 Where did you get information on use?

2.7 How effective did you find it to be?

2.8 Did you tell others about it?

2.8.1 Whom did you tell?

2.8.2 If not why?

2.9 Do you use this chemical for something else?

3.0 Are you able to read the instructions on the container?

4. CULTURAL CONTROL OF PESTS

4.1 Do you have a problem of termites in your maize fields?

4.1.1 If yes, how serious is the problem?

4.1.2 If not. is there any other pest problems?

4.1.3 What are these problems?

4.2 Do you know any methods of controlling the problem?

[Probe to get details]

4.3 Where did you learn about these methods?

4.4 Do you use a way known as 'kukwezera' in controlling termites in your field or
Do you do this for another reason?

4.4.1 If not. why don't you use it? [FOR THOSE WHO HAVE NOT USED]

4.4.2 If you use this method. how effective has it been? [FOR THOSE WHO USE/ HAVE USED]

4.5 Have you told other people about it?

4.5.1 If yes. whom have you told?

5. VARIETAL RESISTANCE STRATEGY TO CONTROL PESTS

5.1 Do you have a problem of wilting on your pigeonpeas?

5.1.1 If yes. how serious is the problem?

5.2 Do you know any ways of controlling the problem?

5.3 Do you use this variety 'ICP 9145'? [Research. Chinese. '41']

5.3.1 If not, why not?

5.3.2 If yes, why do you use it?

5.4 Where did you learn about it?

5.5 Where did you get the seed?

5.6 Do you know any variety of pigeon peas which is resistant to this problem?

FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

Introduction:
We asked you to meet us a few months ago to tell us how you learnt about new agricultural inputs or practices. We have thought about what you told us and have come back to ask a few more questions on the same subject. We are interested in this subject because one of the jobs we have to do on the project is make recommendations about how what we have learnt can be shared with a wider audience.

1. Rank sources of information:
Place in order of importance:
extension services (govt and NGO)
radio
literature: pamphlets and posters
learning from friends.
learning by own experimentation.
learning from other places

2. Score sources of information when they have been ranked:
Scores out of five where five is important and one is not important

3. Explore existing networks of communication:

Block meetings:
what do people know about **block meetings?**
Do block meetings take place for the people of this village?

If yes, record who has attended a block meeting and when this was
Then ask:
where do they take place i.e. where is the block?
whose land?
what is being grown there?
who does the work?
who gets the produce?

Can you give an example of something you have learnt in this way?

what do people know about **demonstration plots?**
Are there any demonstration plots for the people of this village?

If yes, record who has seen a demonstration plot and when this was

Then ask:
whose land?
what is being grown there?
who does the work?
who gets the produce?

Can you give an example of something you have learnt in this way?

Specialist commodity groups
Most people said that they were not interested in the groups that grow crops such as chilli or tobacco. Is anyone here a member of such a group? (Count heads)

What specialist commodity groups exist in this village or area that these people could join?
Who joins them? (Men. women. young. old. rich. poor?)
How do the groups work? What conditions do you have to observe? E.g. do you have to pay for inputs or take credit

Do women join specialist commodity groups? If not. why not? (All the women in previous discussion said were not interested)

Can you give an example of something you have learnt in this way?

Gender differences
explore – be clear about whether are asking if women can talk to FA.s as easily as men or whether they have equal ease of access to agricultural information in general

With regard to the **extension services**:
is it as easy for women to talk to the FA as it is for men? If the FA was a woman. would this make a difference? Would it be easier for women and harder for men then?
If men belong to specialist commodity groups and credit groups more than women do. does this mean that men have better access to the FA because they are group members?

With regard to **radio**
Do men own radios more than women?
Do men have more leisure time than women to listen to the radio?
Does this mean that men and women don't have the same opportunities to listen to the radio?

With regard to **written material**:
Are there more men that can read than women?
Are there generational differences eg with older men and women?
If so. does this mean that men can benefit more from written material?

Who received written material from us in the first year? (Headcount)
How many people found it useful? (Headcount)
Did you read it yourself? (Headcount)
Did a relative read it for you? (Headcount)
Did you share the information with anyone? (Headcount)
Who was this (List people)

Friends and relatives:
People said that they learnt a lot from their friends and relatives. can you give us some more details.

Whom do you mean by this? (in your household or in your cluster or among your cousins? With your wife's relatives or your brothers-in-law?)
With whom would you not want to share information?

Who can look at your field?
Who do you not like to have look at your field?
Are you ever afraid to look at someone's field? What sort of person and why?

Can you give an example of something you have learnt in this way?

Radio ownership
Who owns a radio (Headcount)
How many radios are there in your mbumba? (Take count)
Who regularly listens to a relative's radio because they live next door? (Headcount)
Does anyone regularly listen to the radio at a friend's house? (Headcount)

If you have a radio, in the last month, for how many weeks has the radio had batteries in it? (Take count)

Can you give an example of something you have learnt in this way?

What topics might be useful for pamphlets or radio broadcasts?

APPENDIX D First Round Questionnaire for Extension Workers Networks of Communication

FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

INTRODUCTION
FSIPM Project intends to conduct this study in order to determine existing formal and informal networks of communication and their potential utilisation in IPM dissemination strategies.
Your co-operation in this exercise will sincerely be appreciated. You must feel very free to express your ideas and opinions on the topics to be discussed. Be assured that whatever you will tell us will be handled confidentially.

1. How big is your area?
   [Number of villages covered]

2. How many farm families are you covering?

3. How do you meet them?

4. How often do you meet them?

5. Do you meet a particular group of farmers?

   If yes, why is that so?

6. What agricultural activities do you meet them for?

7. What current agricultural recommendations are you communicating to the farmers?

Crop/Problem	Recommendation

8. What recommendations did you make last year?

Crop/Problem	Recommendation

9. Were there any particular problems with last year's extension work?

10. Do people have access to any written messages on agriculture?

11. Do you have any demonstration plots, if so, what for?

12. In your opinion, do men and women have the same or different problems in gaining access to information on agriculture?

12.1 What might these [problems] be?

12.2 How could these problems be solved?

13. Is there any difference in access to agricultural information between farmers growing different crops?

13.1 If yes, which crops and why?

14. What pest management messages are currently being disseminated to the farmers?

15. What are the current pest problems being faced by farmers in your area?

16. How do you assist them?

17.Do farmers consult you for assistance on any pest problems?

APPENDIX E Second Round Questionnaire on Networks of Communication for Extension Workers

FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

1. Interview Extension officers (more specific information on target villages)
2. How do the target villages fit into the block extension: where are the block plots for the target villages or where should they be?
3. Block plots: who owns the land, provides the inputs, does the work and gets the produce?
4. What is ADD policy about demonstration plots?
5. Are there any demonstration plots currently being run in either of these villages, if not, where are there demonstration plots that farmers from these villages could be going to see?
6. Are there any farmers in the target villages who have been part of demonstration or block plots?
7. Can you list any commodity groups (burley, chilli, tobacco groups) meeting in the target villages? If not, are there any groups these farmers could join if they wanted to?
8. What sort of people joins the commodity groups? (Men, women, young, old, rich, poor)
9. What conditions are there for being a member of the different groups?
10. What other projects are working in your area from which you or the farmers can learn?
11. Have you received any literature or posters recently?
12. Do you ever recommend radio extension programmes?

APPENDIX F Discussion Guide on Networks of Communication for Extension Services at the ADD

FARMING SYSTEMS INTEGRATED PEST MANAGEMENT PROJECT

1. What is current Extension Service model for Field Assistants to extend agricultural messages to farmers?
2. How did or does the Block System function?
3. Who got the produce?
4. What system was there before?
5. Who was the FA supposed to visit under the T&V?
6. What is the official policy about demonstration plots?
7. How many FA's are supposed to be in one EPA?
8. Is there any policy any specialist groups?

A RECOMMENDATION FOR THE RELEASE OF PIGEONPEA VARIETY ICEAP 00040 IN MALAWI.

SUBMITTED TO THE TECHNOLOGY CLEARING COMMITTEE OF THE MINISTRY OF AGRICULTURE AND IRRIGATION MARCH 2000

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EXECUTIVE SUMMARY

The pigeonpea industry in Malawi is facing a challenge from other producer countries in the region with lower production costs and rapidly increasing export production. To maintain and extend its market share, Malawi needs to meet the needs of existing and emerging markets by producing more pigeonpea of higher quality, suitable for the needs of the local tur dhal producers who constitute the largest grouping of dhal exporters in Africa.

Pigeonpea is largely grown by smallholders and is especially suitable for low-resource farmers because it can be intercropped with maize and requires no expensive inputs to produce a crop, while itself improving soil structure and fertility through the addition of nitrogen, phosphorous and organic matter. The pigeonpea processors can utilise many times more product than is currently available and the export market is currently almost unlimited. However smallholder yields are currently low and farmers lack access to improved seed which meets the quality needs of pigeonpea processors while giving improved yield.

The Farming Systems IPM Project has carried out two seasons of on-farm research in Blantyre Shire Highlands RDP and Thyolo RDP involving about 70 farmers from 3 sections in replicated trials of new pigeonpea varieties provided by ICRISAT (ICEAP 00040, ICEAP 00053). The varieties were selected for their wilt resistance, large seed size, pale seed colour and ease of de-hulling. The varieties were compared on each farm with ICP 9145, the only long-duration variety that is presently released, and with the farmers' local variety.

Yield and wilt resistance in ICEAP 00040 have been shown to be consistently as good as or better than in ICP 9145, while ICEAP 00053 has shown inconsistent yields over two seasons and a marked susceptibility to *Fusarium* wilt. Farmer satisfaction with yield in ICEAP 00040 is generally also as good as or better than for ICP 9145. Farmers prefer larger seeded varieties and varieties which mature earlier than the local variety. They also require that new varieties should provide a good yield of firewood. ICEAP 00040 meets these criteria.

Economic evaluation has shown that intercropped ICEAP 00040 can provide a return to investment comparable with that from ICP 9145 and superior to other medium and long duration varieties (except ICEAP 00073). Since ICP 9145 is small-seeded and difficult to dehull, it is recommended that ICEAP 00040 should be officially released and promoted in the pigeonpea-growing areas of southern Malawi. If adequate seed supply can be maintained, ICEAP 00040 is expected to yield increased income and food security for smallholder farmers while meeting the industry's need for improved seed characteristics to supply the export market.

CONTENTS

1. INTRODUCTION

1.1 Pigeonpea production in Malawi

Pulses, of which pigeonpeas are a major component, are the sixth most valuable export commodity from Malawi after tobacco, tea, coffee, sugar, and cotton (National Statistical Office, 1997). However, unlike these cash crops which are dominated by commercial estate growers, pigeonpea is still largely grown by smallholders.

Pigeonpea is consumed as fresh peas and as dried peas. The processing industry buys dried peas from producers and intermediate buyers to export to India and to other areas (principally the Caribbean, UK and North America) where people of Indian origin have settled. The dried peas are either exported whole or as split dehulled pigeonpea (*tur dhal*). Annual exports of whole pigeonpea and *tur dhal* from 1992 to 1997 varied between 17 and almost 25 thousand metric tons, with an estimated average annual foreign exchange earning value of US$ 6 million (Patel, 1998). Actual production levels estimated by the Ministry of Agriculture are up to three times higher than these figures (e.g. Table 1), implying considerable local consumption, but there appear to be no detailed figures for this (Patel, 1998). The proportion of exported pigeonpea sold as *tur dhal* has varied in recent years from about 40% to over 80%. This implies that there is scope for additional processing in Malawi to increase the value of the exported product from around US$250/mt to around US$500/mt. The milling capacity in Malawi is estimated at around 20,000 mt p.a. (Patel, 1998).

Table 1. Estimated Pigeonpea Production for Malawi 1998/99 season, by Agricultural Development Division (ADD). (Source: MOAI, 1999).

ADD	Area grown (ha)	Production (mt)
KARONGA	989	619
MZUZU	182	89
KASUNGU	0	0
SALIMA	2427	1636
LILONGWE	107	54
MACHINGA	37433	34308
BLANTYRE	78160	49491
SHIRE VALLEY	7196	5372
TOTAL	**126494**	**91569**

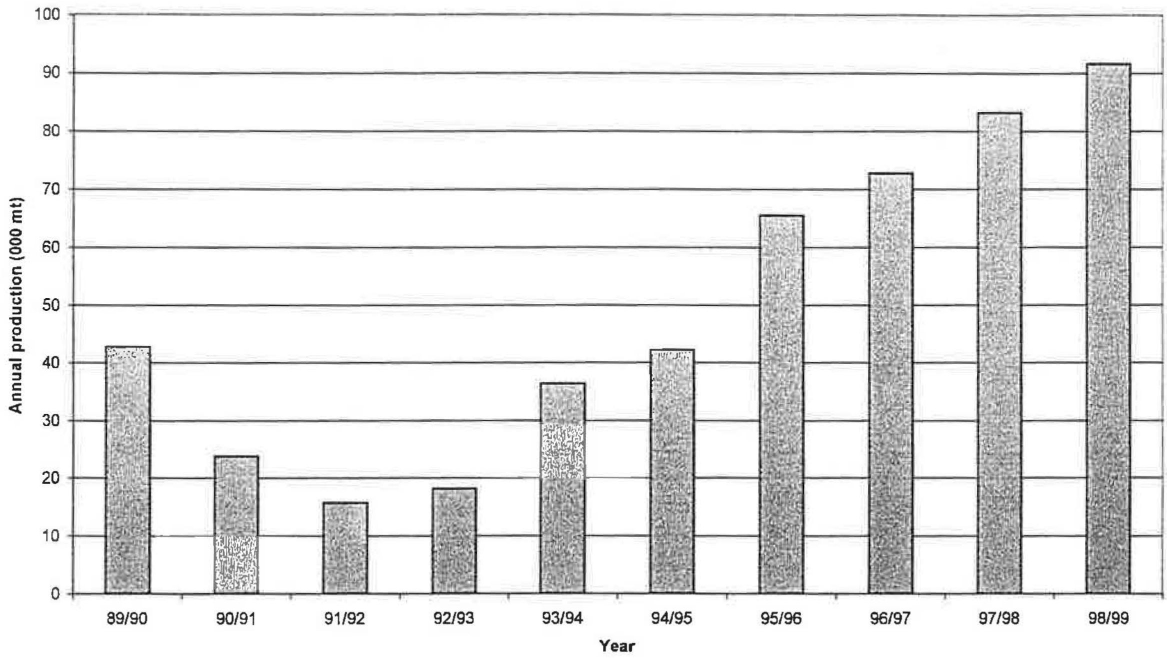
Malawi is the largest producer of pigeonpea in Africa (Fig. 2) but has made little progress in increasing production or area of cultivation in recent years by comparison to major competitors (Fig. 3). Kenya now has a larger area under pigeonpea cultivation than Malawi. A SWOT analysis of the pigeonpea industry in Malawi is shown in Box 1, based on information from Jones, *et al.* (2000). From this it is clear that the rapid release of new *Fusarium*-resistant, high-yielding varieties with easily removed seed coat and large spherical pale seeds is a critical element in the future success of the Malawi pigeonpea industry to enable farmers to obtain premium prices for their production and to enable the processing industry to increase the supply of high quality *tur dhal* to existing and emerging markets.

Box 1. SWOT Analysis of the pigeonpea industry in Malawi

Strengths	*Opportunities*
• Malawi is the largest exporter of *tur dhal* in Africa. • Pigeonpea is fully compatible with maize production by smallholders, maximising returns to land. • Malawi has excess processing capacity relative to current production of *tur dhal*. • Malawian processors have an established reputation and good market contacts in the world market • A Grain and Legume Development Association Ltd has been formed (1999) to promote effective collaboration among sectoral players (government, research, extension, industry, NGOs).	• India has a growing pigeonpea deficit and needs year-round supply to serve its processing industry. • Emerging markets in UK/N America and elsewhere for high quality, pale coloured, large round seeded pigeonpea and new processed products. • ICEAP 00040 can meet the requirement for a large pale seed with easily removable seed coat, offering high % recovery of *dhal* from whole grain. • Market for organic produce favours pigeonpea because of its soil fertility benefits when inorganic fertilizer is excluded.
Weaknesses	*Threats*
• Malawi still exports much unprocessed pigeonpea, losing potential added export value from *tur dhal*. • Malawi has higher freight charges for exporting pigeonpea than neighbouring countries. • The Malawian pigeonpea crop is only ready for export to the Indian market after mid-November when the domestic crop is harvested and prices are declining. • Currently there are no quality standards for pigeonpea in Malawi so price premiums cannot be paid.to farmers, so there is little incentive to invest in improved varieties like ICEAP 00040. • Out-of-date policies on mandatory varietal testing and approval processes are hampering access to new seeds.	• Recovery of the Mozambique pigeonpea industry, leading to declining sales of raw pigeonpea into Malawi • Growing market competition from other countries in the region. • Lack of a sustainable seed supply system will prevent smallholders from increasing production of quality varieties. • Lack of market information will prevent the market operating effectively to benefit farmers.

Source: Jones *et al.* (2000)

Figure 1. National Smallholder Pigeonpea Production 1989/90 to 1998/99
(Source: Annual National Crop Estimates)



Pigeonpea production in Malawi centres in the Southern region, especially in Machinga and Blantyre Agricultural Development Divisions (ADDs) which together account for over 90% of production (Table 1). Within Blantyre ADD production is especially strong within Mulanje, Mwanza and Blantyre Shire Highlands Rural Development Projects (RDPs) (Table 2). Overall annual production by smallholders has fluctuated widely in the last decade (Figure 1), in response to weather conditions, from 16 thousand to 91.6 thousand metric tons, but there appears to be a strong rising trend, possibly in response to the developing market for pigeonpea for processing into *tur dhal* for export, principally to India.

Table 2. Estimated pigeonpea production for Blantyre Agricultural Development Division, 1998/99 season, by Rural Development Project (RDP). (Source: BLADD, 1999).

RDP	**Area (ha)**	**Yield (Kg/ha)**	**Production (mt)**
Blantyre Shire H'lands	15715	522	8205
Thyolo	11653	587	6840
Mulanje	23050	606	13964
Phalombe	8235	559	4600
Mwanza	19507	814	15882
Total	**78160**	**611**	**47787**

Because of the high protein content of pigeonpea seed and the fact that its amino-acid profile complements that of cereals for human nutrition, it has become an important component of the diet of rural Malawians. Pigeonpea grows well as an intercrop with maize, without significant yield losses to either crop, and can withstand dry conditions better than most other legumes. It is also beneficial in fixing nitrogen and enhancing the availability of soluble phosphorous for the benefit of following crops. The crop provides a return of organic biomass to the soil and substantial amounts of firewood in areas where fuel wood is scarce.

Figure 2. Average annual production (000 mt) and area (000 ha) of pigeonpea in Kenya. Malawi, Tanzania and Uganda for the periods 1980-82 and 1995-97. Source: Jones *et al.*, 2000.

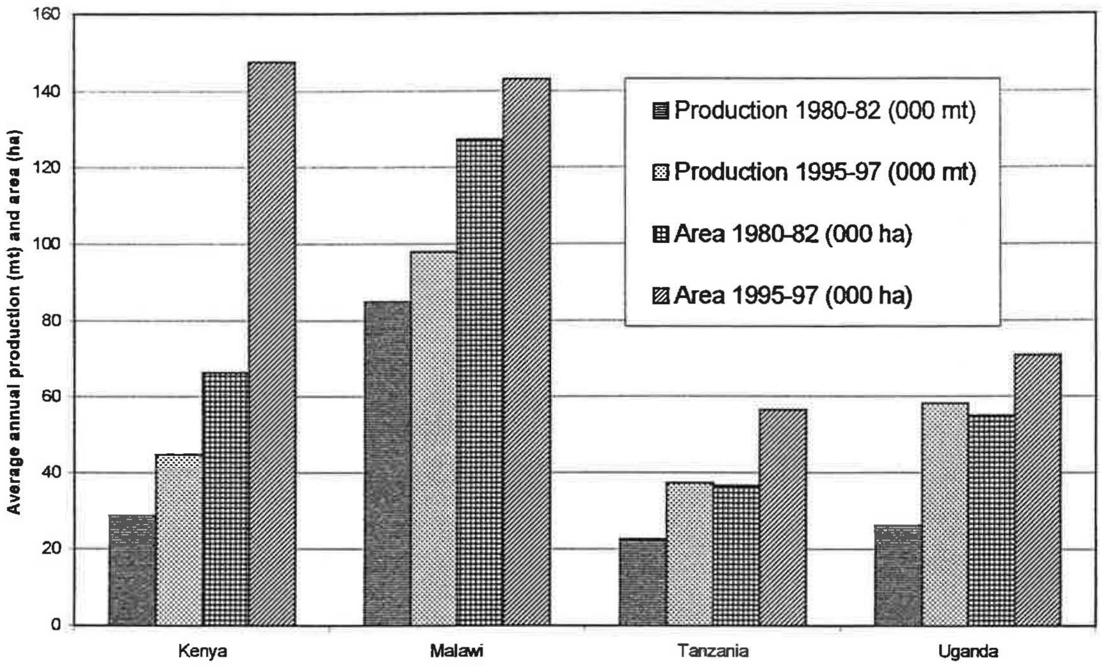
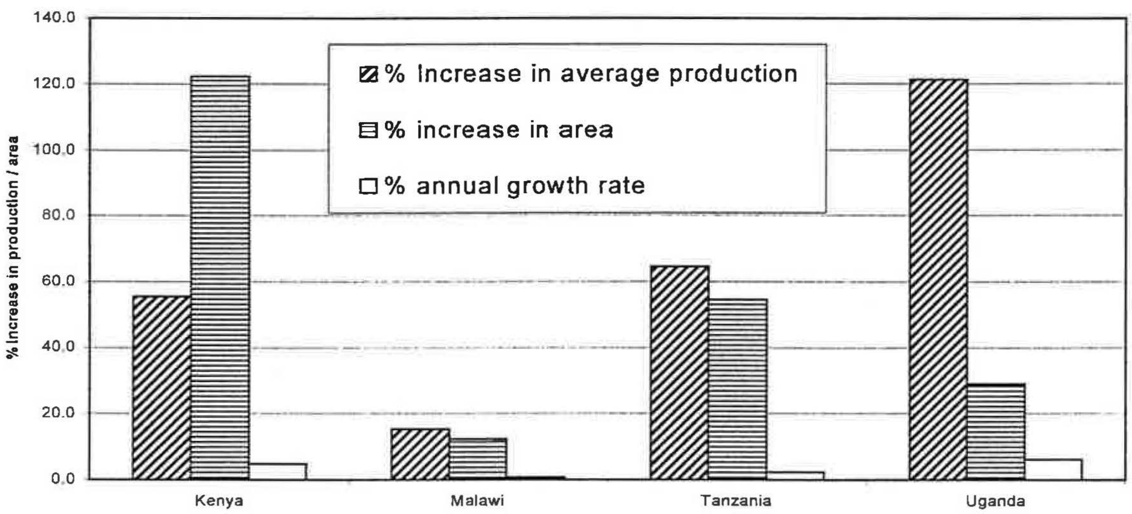


Figure 3. Pigeonpea: percentage increase in average annual production, area grown and annual growth for selected countries, 1980-97. (Source: Jones *et al.*, 2000)



1.2 Pigeonpea variety selection and pests and diseases

Traditionally pigeonpeas were a long-duration crop planted in November and harvested from August onwards. Recently short- and medium-duration varieties have been selected which can offer farmers fresh pigeonpea pods and dry seeds over a longer period than formerly. Although short-duration pigeonpeas are potentially very high-yielding, they are also especially prone to flower and pod pests which necessitate several sprays of pesticides over the season to protect the yield. This is not affordable by smallholders and short-duration varieties are also not suitable for inter-cropping with maize because of competition from the maize.

The main pest management research effort for pigeonpeas in Malawi since 1981 has been devoted to assessing the performance of wilt-resistant varieties. This led to the release in 1987 of the wilt-resistant variety ICP 9145 which remains the only variety officially recommended by the Ministry of Agriculture (Agricultural Communications Branch, 1994; Makato, 1997). Unfortunately ICP 9145 has relatively small seeds and the seed coat is difficult to separate from the seed, necessitating extra processing during dehulling (Patel, 1998). The variety is appreciated by farmers for its yield and marketability but not for its taste (Mwale *et al.*, 1999).

From the inception of the ICRISAT's Improvement of Pigeonpea Project in Eastern and Southern Africa in 1992, the institute has been collaborating with the Malawi national programmes to test a range of varieties developed by ICRISAT in Malawi. The objective of the collaboration was to introduce high yielding varieties with traits acceptable to farmers and the market. To this end pigeonpea improvement research, particularly for development of long-duration varieties, concentrated on the development of high yielding varieties with cream bold seed and with resistance to *Fusarium* wilt.

Since 1996 pigeonpea research groups in Malawi have evaluated wilt-resistance and yield in several long-duration varieties, including three that were identified as high yielding and wilt-resistant/tolerant (ICEAP 00020, ICEAP 00040 and ICEAP 00053). These varieties have also been tested in several countries in Eastern and Southern Africa where they have been found to give high yields (Annex 1). Varietal descriptors for ICEAP 00040 and ICEAP 00053 are provided in Boxes 2 and 3, respectively. ICEAP 00040 has been identified by the processing industry as having desirable qualities, including a high dehulling percentage (the ratio of the weight of dhal to the weight of whole seed before dehulling).

Initial trials with ICEAP 00020 in Mangunda section of Matapwata EPA in 1997/98 were promising (Abeyasekera, 1999) but owing to an error by the estate multiplying seed material for ICRISAT, no seed of this variety was available for on-farm testing in 1998/99. This report therefore deals only with the performance of ICEAP 00040 and ICEAP 00053, compared with the current recommended variety, ICP 9145 and material of the farmers' local variety purchased in local markets within the EPAs where FSIPM trials were carried out.

The main pre-harvest pest problems of pigeonpeas in Malawi are *Fusarium* wilt and flower and pod pests, especially sucking bugs and pod borers (Agricultural Communications Branch, 1994). Wilting is perceived as a serious problem by smallholders even though they do not well understand the biology of the causative agent, *Fusarium udum* (Kapulula and Lawson McDowall, 1999). Pod damage by insects is often perceived by farmers as the result of adverse weather conditions. However recent research in Malawi has shown that pod bugs are the major cause of pod damage, closely followed by a complex of pod boring lepidopteran caterpillars (Minja, 1997; Ritchie *et al.*, 2000). To date no varieties have been selected for their resistance to pod pests. The current recommendation for the control of these pests (Agricultural Communications Branch, 1994) is to spray with Carbaryl 85 WP using a knapsack sprayer. This is unlikely to be attempted by most smallholders because of financial constraints and the physical difficulty of spraying plants more than two metres tall by hand.

Box 2. Pigeonpea variety descriptors for ICRISAT long-duration pigeonpea variety, ICEAP 00040. (Source: ICRISAT, Nairobi).

Origin and development

ICEAP 00040 is a single plant selection from a local landrace collected from Kenya in 1992. Evaluation for yield and grain characteristics was started in the 1992/93 cropping season and screening for resistance to Fusarium wilt initiated in 1993/94 at Kiboko and Katumani in Kenya. It was tested further in Kenya, Malawi and Tanzania and found to be resistant to wilt. The variety is being tested in on-farm trials in Kenya, Malawi, Mozambique and Tanzania.

Plant characters

The plants of ICEAP 00040 are compact to semi-erect in growth habit. The variety is very plastic. When intercropped, the growth habit is compact and when grown as sole and under low population, it produces more branches and is semi-erect in growth habit. The stem is green and the leaves are large and green. The flowers of ICEAP 00040 are ivory-coloured. The flower does not open fully. The pods, which are green with purple streaks, are long and slightly curved, and are borne in clusters at the branch terminals. Plant height is influenced by temperature where plant is short under cool and tall under high temperatures. Temperature and day length influence time to flower and maturity. Low temperatures accelerates time to flower and maturity and warm temperature delays it. The variety flowers and matures early under short days. At high elevation near the equator it takes 120 - 130 days to flower and 160 - 180 days to reach maturity, and at medium altitude where temperatures are warm (21- 24°C) it flowers in 190 - 230 days and matures in 220 - 260 days. Away from the equator, the crop flowers and matures early (similar to high elevation near the equator).

Seed characters and grain yield

There are 5 – 6 seeds in a pod. The seeds are large with 100 seed mass of 20 – 22 g. They are round and white. ICEAP 00040 has desirable seed and consumer acceptability. It is resistant to wilt in Kenya, Malawi and Tanzania and produced higher grain yields than the local varieties in these countries.

Box 3. Pigeonpea variety descriptors for ICRISAT long-duration pigeonpea variety, ICEAP 00053. (Source: ICRISAT, Nairobi).

Origin and development

ICEAP 00053 is a single plant selection from a local landrace collected from Kenya in 1992. Evaluation for yield and grain characteristics was started in the 1992/93 cropping season and screening for resistance to Fusarium wilt initiated in 1993/94 at Kiboko and Katumani in Kenya. It was tested further in Kenya, Malawi and Tanzania and found to be resistant to wilt. The variety is being tested in on-farm trials in Kenya, Malawi, Mozambique and Tanzania.

Plant characters

The plants of ICEAP 00053 are compact and are erect in growth habit. Due to its compact growth habit it is an excellent companion crop for intercropping, and high plant populations can be used without causing significant yield reduction of cereals. The stem is large and green and the leaves are large and dark green. The flowers of ICEAP 00053 are ivory-coloured. The pods are green, long and curved, and are borne in clusters at the branch terminals. Plant height is influenced by temperature. Plants are short under cool and tall under high temperatures. Temperature and day length influence time to flower and maturity. Low temperatures accelerate time to flower and maturity and warm temperatures delays it. The variety flowers and matures early under short days. At high elevation near the equator it takes 140 - 150 days to flower and 150 - 190 days to reach maturity, and at medium altitude where temperatures are warm (21 – 24°C) it flowers in 200 - 240 days and matures in 260 - 300 days. Away from the equator, the crop flowers and matures early (similar to high elevation near the equator).

Seed characters and grain yield

There are 5 - 6 seeds in a pod. The seeds are large with 100 seed mass of 17 – 19 g. The seeds vary in shape from slightly flat to round. ICEAP 00053 has desirable seed and consumer acceptability. It is resistant/tolerant to wilt in Kenya, Malawi and Tanzania and produced comparable yields or higher grain yields than the local varieties in the three countries.

Serious post-harvest storage losses are caused by bruchid beetles which may infest pods left in the field and are a major reason for farmers to dispose of their crop rapidly after harvest

2. FSIPM PROJECT ON-FARM PIGEONPEA INTERCROP TRIALS 1997/98 - 1998/99

2.1 Purpose and context

The Farming Systems Integrated Pest Management (FSIPM) Project, was set up at Bvumbwe Agricultural Research Station to conduct research in the Blantyre Shire Highlands Rural Development Project area of Blantyre Agricultural Development Division in Southern Malawi. The aim of the project was to provide resource-poor smallholder farmers with acceptable and sustainable integrated pest management strategies that reduce crop losses by pests and diseases. Following a Stakeholder Workshop in June 1996, two villages in each of Chiradzulu and Matapwata Extension Planning Areas were selected as field sites for the project and farmers with a maize/bean/pigeonpea intercropping system were identified for the main on-farm experimental trials.

Diagnostic surveys and farmer focus group discussions were used to target priority pests of pigeonpeas, together with a survey of the relevant literature (cited in Ritchie et al., 1997), and findings from the Stakeholder Workshop (Ritchie, 1996). *Fusarium* wilt was identified as the main constraint in pigeonpea production

The following sections summarise the findings from two seasons of researcher-designed, farmer managed on-farm trials of pest management strategies (PMS) against *Fusarium* wilt in pigeonpeas and suggests varieties that are suitable for farmers growing pigeonpeas intercropped with maize in Blantyre/Shire Highlands. A fuller description of the trials is given by Ritchie et al. (2000).

2.2 Management strategies for *Fusarium* wilt

In the first crop season of the FSIPM Project (1996/97), pest management strategies (PMS) for pigeonpeas against yield losses due to *Fusarium* wilt, compared the use of one of two varieties (local and ICP 9145), and the use of one of two planting positions (ridge top and ridge side).

In 1997/98 and 1998/99 only varietal tolerance was investigated since it was felt that the use of resistant cultivars was the only viable technology for management of *Fusarium udum*. The local variety and ICP 9145 were again used, supplemented by two improved varieties offered by ICRISAT's Pigeonpea Improvement Project, ICEAP 00040 and ICEAP 00053. Along with ICEAP 00020 (not available in sufficient quantities for our trials) ICEAP 00040 and ICEAP 00053 are being promoted regionally by ICRISAT because of their high yield potential and large seed size. ICEAP 00040 is wilt resistant whereas ICEAP 00053 is only regarded as wilt tolerant in Kenya. It was important to investigate the performance of these two varieties under smallholder management in Southern Malawi.

2.3 Material and Methods

In each of the three seasons, experimental trials were carried out in Matapwata and Chiradzulu EPAs in cropping systems where maize is intercropped with pigeonpeas and beans planted in November-December. In 1996/97, a standard plot size, 10.8m × 10.8m gross, 9m × 9m nett, was used. In the two subsequent seasons, the plot size was halved to 10.8m × 5.4 m gross. The methods used in FSIPMP on-farm intercropping trials have been extensively documented by Abeyasekera *et al.* (2000) and Ritchie *et al.* (2000) and are not reported in detail here.

In 1996/97, 64 farmers participated in the trial, 16 each with fields in Matapwata dambo, Matapwata upland, Chiradzulu dambo and Chiradzulu upland. Harvest data were recorded for one experimental plot and one farmers' plot on each farm. Plant deaths due to various causes were recorded for just the experimental (research) plot. First year results confirmed the value of ICP 9145 as a wilt-resistant variety with a high yield compared to the local variety (Abeyasekera, 1998).

In the 1997/98 trial the varieties used were ICP 9145, ICEAP 00053, ICEAP 00040 and a local variety. All four varieties were grown in each farm, one plot per variety, so that farmers could observe varietal differences. A total of 61 farmers participated in the 1997/98 main intercrop trial, each farmer maintaining four research plots on one of his/her fields. The general form of the design was that of a randomised block experiment for each treatment factor with farmers being regarded as blocks. Factorial combinations between treatment factors were incorporated to ensure that the relevant two factor interactions could be estimated.

The follow-up trial in 1998/99 was carried out on the same set of plots and had substantially the same treatment structure as was used in 1997/98.

2.4 Pigeonpea variety yield performance

Two yield responses are considered for comparing yield performance across the four pigeonpea varieties in each of the two seasons. These are usable seed weight (kg/ha) adjusted for moisture content and mass of 100 randomly selected seeds (g).

2.4.1 Usable seed weight

2.4.1.1 1997/98 season

Mean yields for the four varieties across all locations and land types are shown in Figure 4. Analysis of variance (ANOVA) techniques applied to usable seed weight (kg/ha) showed that the variance homogeneity assumption was violated. The data were therefore transformed to logarithmic values and analysed. In this analysis, significant differences were found between the pigeonpea varieties with respect to the amount of usable seed weight (kg/ha) produced ($p<0.001$). EPA and land type differences were clearly significant ($p<0.001$) and there was also evidence of an EPA by land type interaction. There was some evidence that variety differences varied across land types - shown by a significant variety by land type interaction ($p=0.030$). However variety effects did not vary across EPAs ($p=0.417$).

The results are summarised in Tables 3 and 4 in terms of the log-transformed values as well as the results back-transformed to the original scale. Results of Table 3 clearly show that variety differences are largely due to ICEAP 00040 and ICP 9145 giving much higher yields than the local variety or ICEAP 00053, the differences on the log scale being particularly evident in dambo areas. Further analyses showed strong evidence of a difference between these two groups (se(diff)=0.27) in farms cropped in dambo land ($p<0.001$), but in the upland areas, the differences (se(diff)=0.22) were not so strong ($p=0.014$). In the uplands, ICEAP 00053 performed worst. Its yields were significantly lower than yields for ICEAP 00040 ($p=0.003$) and ICP 9145 ($p=0.054$). However yields of ICEAP 00053 were not significantly different to that of the local variety ($p=0.207$). There was insufficient evidence of a significant difference between ICP 9145 and ICEAP 00040.

Results of Table 4 show that farms in Chiradzulu get significantly higher pigeonpea yields compared to farms in Matapwata EPA. The difference between EPAs is larger in the uplands than in the dambo areas.

Table 3. Pigeonpea variety performance on the basis of usable seed weight (kg/ha) 1997/98

ariety	Seed weight means (log - scale)		Seed weight means (raw – scale)		Overall variety means
	Dambo	Upland	Dambo	Upland	
Local	2.88	4.91	17.8	136.0	49.4
ICEAP 00053	3.47	4.60	32.0	99.8	59.1
ICEAP 00040	3.98	5.35	53.6	210.0	107.8
ICP 9145	4.18	5.08	65.6	160.6	101.5
s.e. (diff)	0.25	0.24			

Table 4. Usable seed weight across land types and EPAs (1997/98)

Landtype	Seed weight (log-scale)		Seed weight (raw scale)	
	Chiradzulu	Matapwata	Chiradzulu	Matapwata
Dambo	4.04	3.05	56.6	21.2
Upland	5.71	3.39	301.6	29.7
Overall EPA means	4.95	3.20	140.9	24.6

2.4.1.2 1998/99 season

Mean yields for the four varieties across all locations and land types are shown in Figure 5. As in the previous season, there were clear differences between varieties (Table 5) and strong evidence of a land type by EPA interaction (Table 6). In this season, ICEAP 00053 performed much better than in the previous season but the mean yields under ICEAP 00053 were not significantly different to yields corresponding to the remaining varieties. Both the local variety and ICP 9145 were found to be significantly worse than ICEAP 00040. There was insufficient evidence of a difference between the two ICEAP varieties.

Results of Table 6 show the poor performance of pigeonpea in Chiradzulu dambo. Highest yields were found in Chiradzulu upland areas. It is clear from these results that northern Matapwata is not a suitable environment for pigeonpea production although farmers persist in wanting to grow the crop.

Table 5. Pigeonpea variety performance on the basis of usable seed weight (kg/ha) – 1998/99

Variety	Seed weight means (log - scale)		Seed weight means (raw - scale)		Overall variety means
	Dambo	Upland	Dambo	Upland	
Local	4.60	5.86	99.7	349.7	171.7
ICEAP 00053	4.84	6.08	126.6	435.3	213.8
ICEAP 00040	5.01	6.29	149.8	541.3	263.5
ICP 9145	4.61	5.73	100.6	309.2	164.8
s.e. (diff)	0.15	0.15			

Table 6. Usable seed weight across land types and EPAs (1998/99)

Landtype	Seed weight (log-scale)		Seed weight (raw scale)	
	Chiradzulu	Matapwata	Chiradzulu	Matapwata
Dambo	4.58	5.18	97.4	177.9
Upland	6.19	5.07	486.4	158.8
Overall EPA means	5.35	5.15	210.0	171.7

2.4.2 100-seed mass

2.4.2.1 1997/98 season

Analysis of data concerning the mass of 100 randomly selected seeds, carried out on the raw scale, showed strong evidence of differences between varieties ($p<0.001$). The mean values for the mass of 100 seeds across varieties and land types appear in Table 7. It should be noted that values for 100-seed mass were measured in the field and were not corrected for moisture content. They are therefore suitable for comparisons between varieties harvested together in one season but do not purport to provide absolute variety values.

2.4.2.2 1998/99 season

The 1998/99 season gave 100-seed mass values that were lower on average than those of the previous season but again there were clear differences between the varieties ($p<0.001$). The results are shown in Table 8 and are seen to be consistent with results in 1997/98. Again the two ICEAP varieties give higher 100 seed mass compared to the local variety and variety ICP 9145 ($p<0.001$). There was no evidence of a difference between the two ICEAP varieties, nor of a difference between the local variety and ICP 9145.

2.5 *Fusarium* damage during the season

2.5.1 Plot level incidence, 1997/98 and 1998/99 seasons

Chi-squared analyses were carried out to investigate whether the observed numbers of plots affected or not by *Fusarium* wilt and other causes through the cropping season, varied significantly across varieties. There was some evidence ($p = 0.042$ and $p=0.006$ in the two seasons) that the number of plots with deaths due to *Fusarium* differed across varieties (Table 9). In 1997/98 this appears to be due to ICEAP 00040 giving a slightly lower rate of incidence than the other three varieties. In the 1998/99 season, both ICEAP 00040 and ICP 9145 give lower plot incidence.

Table 7. Mean mass (gms) of 100 pigeonpea seeds (1997/98)

Landtype	Dambo	Upland	Variety means
Local	26.9	23.8	25.1
ICEAP 00053	29.5	27.3	28.2
ICEAP 00040	28.4	26.2	27.2
ICP 9145	25.1	22.1	23.5
s.e. (difference)	1.4	1.2	1.2

Table 8. Mean mass (g) of 100 pigeonpea seeds (1998/99)

Landtype	Dambo	Upland	Variety means
Local	18.0	19.4	18.7
ICEAP 00053	22.0	23.5	22.8
ICEAP 00040	22.3	23.7	23.0
ICP 9145	17.8	19.1	18.5
s.e. (difference)	1.01	1.02	1.02

Figure 4. Usable seed weight (kg/ha) across locations and varieties (1997/98)

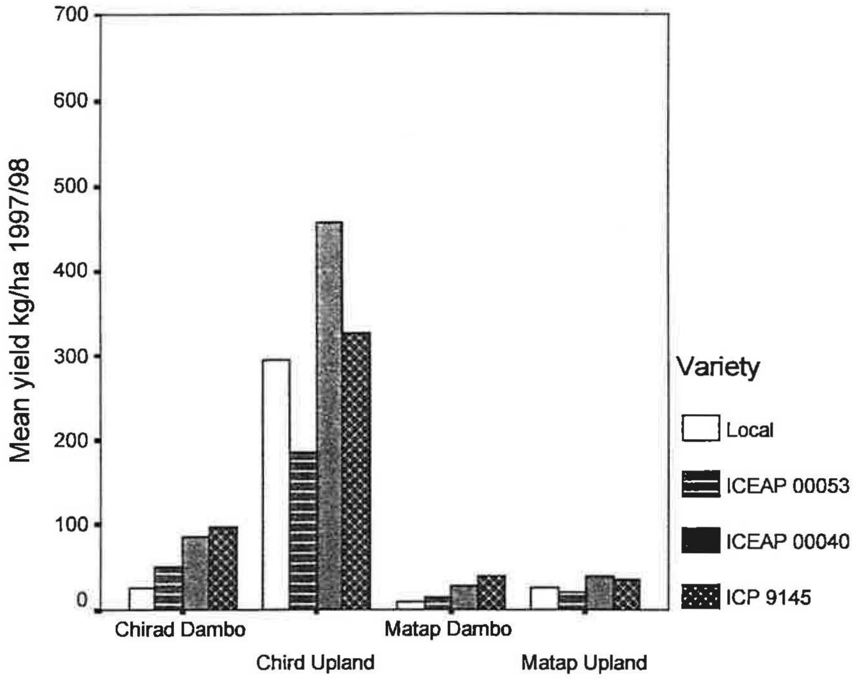


Figure 5. Usable seed weight (kg/ha) across locations and varieties (1998/99)

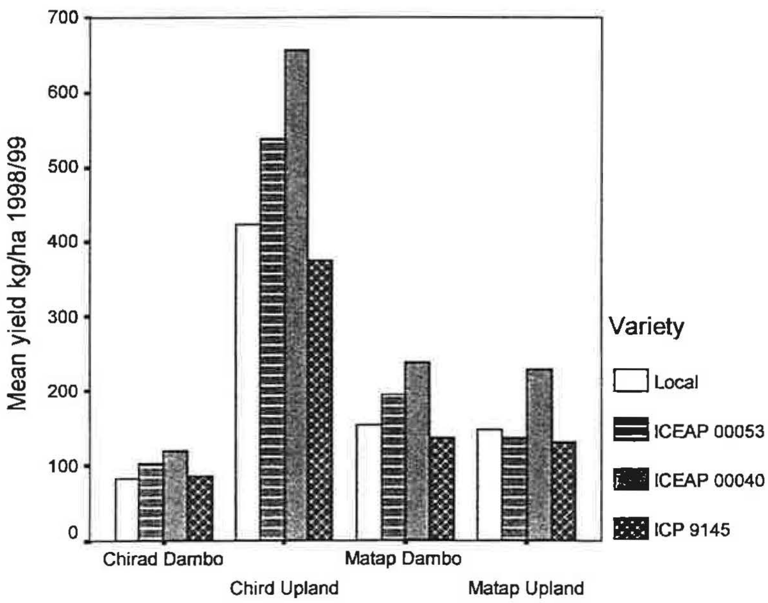


Table 9. Number (and percentage) of plots with plants dead by *Fusarium* wilt under each of the pigeonpea varieties (1997/98 and 1998/99)

	1997/98		1998/99	
Variety	Number of plots with Fusarium deaths	% of plots with Fusarium deaths (n=61)	Number of plots with Fusarium deaths	% of plots with Fusarium deaths (n=37)
Local	58	95%	30	81%
ICEAP 00053	57	93%	26	70%
ICEAP 00040	50	82%	18	49%
ICP 9145	57	93%	18	49%
Sig. Prob.	p = 0.042		P = 0.006	

2.6 Modelling percentage of plant deaths through the season

Generalised linear modelling procedures with a binomial error structure were used to investigate whether the number of plants affected by *Fusarium* wilt, considered as a percentage of the initial germination stand count, varied significantly across the treatment factors.

2.6.1 1997/98 season

In the 1997/98 season, analysis of *Fusarium* deaths showed strong evidence of an EPA effect and a land type effect ($p<0.001$) and some evidence of a land type by EPA interaction. There were also clear differences across varieties and evidence of a land type by variety interaction ($p < 0.001$ and $p = 0.007$ respectively). The results are shown in Tables 10 and 11.

Clearly *Fusarium* wilt is a much more serious problem in Matapwata than it is in Chiradzulu. Amongst the varieties, both the local variety and ICEAP 00053 show higher percentages of plant deaths than do the other two varieties. The differences are significant, but not large enough to be of practical importance.

Table 10. Model predictions of percent of *Fusarium* affected plants across EPAs and land types (1997/98)

EPA	Land type		Overall EPA effect
	Dambo	Upland	
Chiradzulu	6.1%	5.2%	5.6%
Matapwata	46.5%	38.5%	42.3%

Table 11. Model predictions of percent of *Fusarium* affected plants across varieties and land types (1997/98)

Variety	Land type		Overall variety effect
	Dambo	Upland	
Local	28.3%	20.9%	24.4%
ICEAP 00053	27.6%	23.2%	25.3%
ICEAP 00040	24.0%	18.9%	21.3%
ICP 9145	18.8%	17.4%	18.1%

2.6.2 1998/99 season

In the 1998/99 season, analysis of all plant deaths by diseases showed strong evidence of differences across varieties ($p<0.001$). There was also evidence that these differences varied across land types and EPAs ($p=0.004$ and $p<0.001$ respectively). Results are therefore presented in Table 12 below for each land type within each EPA. ICEAP 00053 shows least resistance to diseases in Matapwata. In Chiradzulu, both the local variety and ICEAP 00053 perform less favourably than ICEAP 00040 and ICP 9145.

Table 12. Plant deaths by all diseases (1998/99)

Variety	Chiradzulu		Matapwata		Overall variety means
	Dambo	Upland	Dambo	Upland	
Local	9.7%	8.8%	12.5%	12.5%	10.5%
ICEAP 00053	8.8%	9.2%	19.2%	21.8%	13.3%
ICEAP 00040	4.9%	3.4%	8.1%	6.3%	5.4%
ICP 9145	8.7%	5.3%	8.2%	5.5%	7.1%

Plant deaths recorded as deaths by *Fusarium* also demonstrate that ICEAP 00040 and ICP 9145 are more resistant to *Fusarium* than ICEAP 00053 ($p<0.001$). The differences between ICEAP 00040 and ICP 9145 are not significant. In Chiradzulu there is little difference between the local variety and ICEAP 00053, but in Matapwata, they are significantly different ($p=0.002$).

Table 13. Plant deaths by *Fusarium* wilt (1998/99)

Variety	Chiradzulu		Matapwata		Overall variety means
	Dambo	Upland	Dambo	Upland	
Local	7.1%	9.2%	2.9%	3.3%	6.1%
ICEAP 00053	6.4%	8.2%	8.4%	9.2%	7.9%
ICEAP 00040	2.5%	3.0%	3.0%	3.3%	2.9%
ICP 9145	3.3%	4.1%	1.9%	2.2%	3.1%

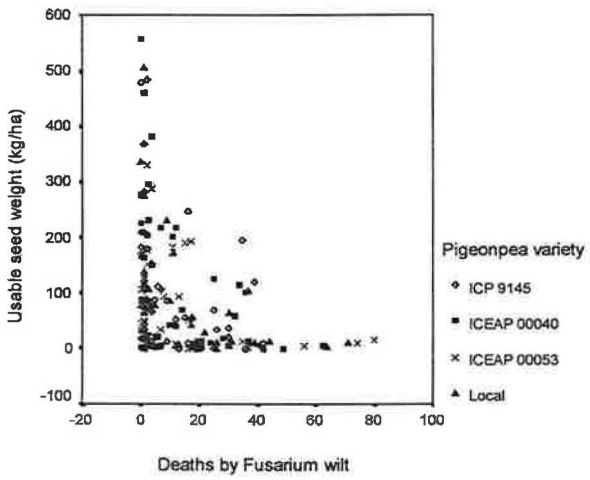
2.7 Relationship between yield and damage data (1997/98 season)

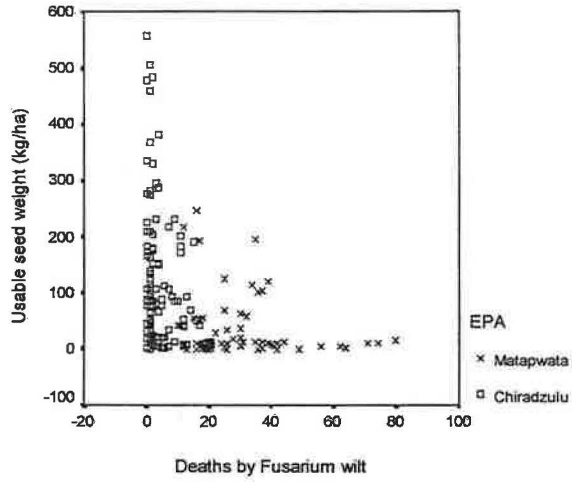
Damage data collected over the growing period in the 1997/98 season were investigated to see if usable seed weight was affected by pest and disease damage occurrences. The damage variables investigated were deaths by *Fusarium* wilt, stem/root rot, stem canker, termites, nematodes and whitegrubs. The relationship of yield with the total mortality was also considered.

Of all the damage data studied, evidence of an influence on usable seed weight was found only with respect to the mean numbers of deaths by *Fusarium* wilt ($p=0.003$) and total mortality ($p<0.001$). The latter was determined as the difference between plant stand at harvest time and the initial germination stand count. These effects did not vary significantly across the pigeonpea varieties included in the trial. Plots of mean seed weight against number of deaths and total plant deaths are shown in Figure 6.

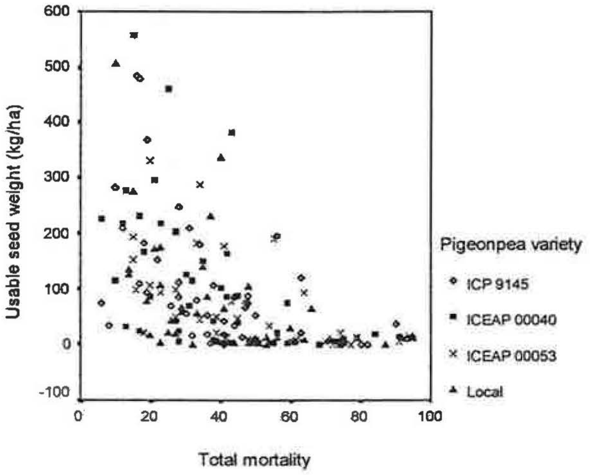
Figure 6. Usable seed weight against mortality by (a) *Fusarium* wilt and (b) all causes (1997/98)

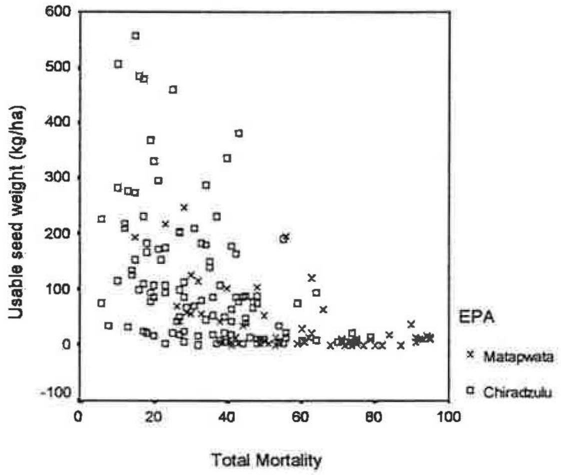
(a) Yield versus deaths by *Fusarium* wilt





(b) Yields versus deaths by all causes





2.8 Conclusions from pigeonpea intercrop trials (1997/98 and 1998/99)

In the main intercrop trials yields were consistently lower in Matapwata (25 kg/ha and 170 kg/ha in 1997/98 and 1998/99 respectively) than Chiradzulu upland (302 kg/ha and 486 kg/ha in the two seasons). Dambo fields in Chiradzulu are seasonally waterlogged with cracking clay soils. Here pigeonpeas do even worse than in Matapwata (<100 kg/ha).

Fusarium wilt incidence in all years was much higher in Matapwata than in Chiradzulu. Disease is likely to be a significant factor in the observed poor performance of pigeonpeas generally in the wetter colder conditions of Matapwata. There is some indication of a link between deaths due to *Fusarium* and eventual yields.

ICP 9145 was shown to be a reliable yielding pigeonpea with good wilt resistance. However seed size, although variable, is generally poor compared with the ICEAP varieties, being consistently slightly smaller than even the local.

ICEAP 00053 showed great variation in yield between years. Yields were intermediate between ICEAP 00040 and ICP 9145 in 1998/99 whereas in 1997/98 it yielded little more than the local. The average number of seeds per pod is consistently lower than the other three varieties. Seed size however is as big as ICEAP 00040. The main disadvantage of this variety lies in its apparent susceptibility to *Fusarium* which is comparable with the performance of the local variety.

ICEAP 00040 was consistently the best performer in 1997/98 and 1998/99 in terms of overall yields, deaths due to diseases (in general) and deaths due to *Fusarium*. The seed size is larger than any of the other varieties except ICEAP 00053 while the number of seeds per pod approaches levels found in ICP 9145.

3. FSIPM PROJECT ON-FARM PIGEONPEA TRIAL AT MANGUNDA (1998/99)

3.1 Introduction

In the 1998/99 season, an on-farm trial was carried out at Mangunda, with 5 farmers, most of whom had participated in a similar trial in the previous season. At an evaluation meeting after the 1997/98 trial, the farmers indicated that they did not wish to have a local check for the 1998/99 season as they could already evaluate the performance of local pigeonpea and considered it to be inferior to the research varieties. The aim of the 1998/99 trial was therefore to evaluate the performance of medium duration and long duration pigeonpea varieties in terms of their yield potential and resistance to *Fusarium* wilt disease. Mortality due to a few other causes, e.g. stem/root rot, termites, stem canker and *Sclerotium* were also to be investigated. For present purposes only the results relative to the long duration varieties are considered. A full report on the results of trials with medium and long-duration varieties is given by Abeyasekera (2000a).

3.2 Experimental design and data collected

The trial at Mangunda was designed by the FSIPM Project's Farming Systems Agronomist and comprised three main plots in each of the farmers' fields. Two of the main plots had the long duration pigeonpea varieties (ICP 9145, ICEAP 00040 and ICEAP 00053) grown on three sub-plots within each main plot. In one of the main plots, the pigeonpea plants were grown as an intercrop with maize. In the second main plot, they were grown as a sole crop. Varieties were randomly allocated to each main plot.

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3.3 Analysis of yield parameters

Three yield responses were chosen for analysis. They were: (a) usable seed weight (kg/ha), (b) weight of 100 seeds (g), and (c) average number of seeds per pod. One of the five farmers included in the trial experienced very high attack of *Fusarium* due to planting pigeonpea on the same site two years running. Hence all her plants died before maturity. The analysis was therefore restricted to yields based on results from the four remaining farmers. The three yield responses above were subjected to analysis of variance procedures, adjusting for block (i.e. farm) effects. The results are shown in Tables 14 and 15 for the long duration varieties.

Long duration varieties also differed significantly with respect to usable seed weight (kg/ha). In this instance the differences were due to ICEAP 00053 performing significantly worse than ICEAP 00040 and ICP 9145. The mean yield for ICEAP 00053 was around 100 kg/ha while the remaining two varieties had yields of over 400 kg/ha. There was no evidence of a significant difference between ICEAP 00040 and ICP 9145.

Long duration pigeonpea varieties showed no difference in yields according to whether they were intercropped with maize or not, despite the intercropped plots receiving fertiliser for the maize. For ICEAP 00040 and ICP 9145, the mean yields under sole cropping were slightly higher by about 40-70 kg/ha (see Table 16), while for ICEAP 00053 the yields were lower by about 50 kg/ha. These differences were not significant. There was insufficient evidence of an interaction between varieties and cropping pattern.

Results concerning the weight of 100 seeds did not reveal any differences between the long duration varieties. However there was a slightly higher mean number of seeds per pod for ICEAP 00040 compared to ICEAP 00053 ($p=0.003$).

Table 14. Mean values for yield parameters with respect to long duration pigeonpea varieties at Mangunda

Variety	Usable Seed weight (kg/ha)	Weight of 100 seeds (grammes)	Mean number of Seeds per pod
ICEAP 00040	432	20.0	5.2
ICEAP 00053	114	22.0	4.5
ICP 9145	457	19.5	4.9
s.e. (diff. in means)	82.6	1.7	0.214
Sig. Prob.	P = 0.001	p = 0.330	p = 0.017

Table 15. Mean values for pigeonpea yield parameters according to cropping pattern (long duration varieties) at Mangunda

Variety	Usable Seed weight (kg/ha)	Weight of 100 seeds (grammes)	Mean number of Seeds per pod
Intercropped	323	20.1	5.0
Sole cropped	345	20.9	4.8
s.e. (diff. in means)	87.9	0.73	0.219
Sig. Prob.	P = 0.808	p = 0.368	p = 0.527

Table 16. Mean usable seed weight (kg/ha) for long duration pigeonpea varieties at Mangunda according to cropping pattern

	Cropping Pattern	
Variety	Intercropped	Sole cropped
ICEAP 00040	396	468
ICEAP 00053	137	90
ICP 9145	435	478

3.4 Analysis of damage data during the season

Measurements had been made during the season of numbers of plants dead due to whitegrubs, termites, *Fusarium* wilt, stem canker and *Sclerotium*, at each of eleven sampling occasions.

3.4.1 Basic summaries of plant deaths by various causes

Plant deaths due to termites, *Fusarium* and *Sclerotium*, at each of the sampling occasions, appear in Table 17 for the long duration varieties. Termite deaths occurred throughout the season while *Fusarium* deaths occurred at later sampling occasions.

Table 17. Pigeonpea plant deaths at Mangunda over the season by various causes (long duration varieties)

Sampling Occasion	Deaths by Termites	Deaths by *Fusarium*	Deaths by *Sclerotium*
22 Dec 1998 & 2 Jan 1999	0	0	0
10 January 1999	8	0	5
21 – 23 January 1999	4	0	11
9 February	11	0	16
22 – 23 February 1999	15	0	14
10 March 1999	8	30	1
12 – 15 April 1999	1	62	13
13 May 1999	1	28	0
7 – 8 June 1999	1	37	0
14 – 15 July 1999	1	38	0
12 August 1999	2	14	0

3.4.2 Plot level incidence

Percentage of plots with plant deaths by any disease and percentage of plots with deaths by *Fusarium* were investigated. Results for the long duration varieties appear in Table 18 (across varieties) and in Table 19 (across type of cropping pattern). Here chi-squared analyses were carried out to compare the percent of plots having plant deaths across the varieties and across the type of cropping pattern. The analysis however did not demonstrate evidence of differences between varieties or between intercropping and sole cropping systems.

Table 18. Number (and percentage) of plots with pigeonpea plants dead by *Fusarium* wilt and by all diseases under each of the long duration varieties at Mangunda

Variety	Number of plots with Fusarium deaths	% of plots with Fusarium deaths (n = 5)	Number of plots with deaths by all diseases	% of plots with deaths by all diseases (n = 5)
ICEAP 00040	6	60%	7	70%
ICEAP 00053	8	80%	8	80%
ICP 9145	4	40%	7	70%
Sig. Probability	p = 0.189		p = 0.843	

Table 19. Number (and percentage) of plots with pigeonpea plants dead by *Fusarium* wilt and by all diseases under intercropping and sole cropping for long duration varieties at Mangunda

Variety	Number of plots with Fusarium deaths	% of plots with Fusarium deaths (n = 5)	Number of plots with deaths by all diseases	% of plots with deaths by all diseases (n = 5)
Intercropped	10	67%	12	80%
Sole cropped	8	53%	10	67%
Sig. Probability	$p = 0.456$		$p = 0.409$	

3.4.3 Modelling plant deaths through the season

Numbers of plants dead by *Fusarium* wilt and numbers dead by all plant diseases were modelled using a generalised linear model with a binomial error structure.

Results for long duration varieties appear in Tables 20 and 21. The first of these show clear evidence of variety differences with respect to resistance to plant diseases. This is largely due to the very poor performance of ICEAP 00053. Chances of plant deaths for this variety are over 20%, while for varieties ICEAP 00040 and ICP 9145, the predicted probabilities are about 2% for deaths by *Fusarium* and about 3-5% for deaths by any disease. These results are consistent with the performance of these varieties with respect to yield parameters.

Table 20. Pigeonpea plant deaths by *Fusarium* and by all diseases (long duration varieties) at Mangunda

Variety	Predicted percent of deaths by *Fusarium*	Predicted percent of deaths by all diseases
ICEAP 00040	2.3%	3.4%
ICEAP 00053	20.7%	23.8%
ICP 9145	2.1%	4.7%
Sig. Probability	$p < 0.001$	$p < 0.001$

Table 21. Pigeonpea plant deaths by *Fusarium* and by all diseases for long duration varieties according to cropping pattern at Mangunda

Variety	Predicted percent of deaths by Fusarium	Predicted percent of deaths by all diseases
Intercropped	7.7%	9.7%
Sole cropped	10.0%	12.4%
Sig. Probability	p = 0.339	p = 0.364

3.5 Conclusions from the Mangunda trial (1998/99)

At Mangunda ICEAP 00040 and ICP 9145 gave much greater yields of over 400 kg/ha (s.e. 58 kg/ha) compared to ICEAP 00053. The latter yielded only about 100 kg/ha in this trial. The chances of plant deaths by *Fusarium* wilt were also low for ICEAP 00040 and ICP 9145 (< 3%), whereas for ICEAP 00053, this probability was over 20%. ICEAP 00040 and ICP 9145 are found to be the most promising of the long duration varieties. These varieties perform well under on-farm conditions, both with respect to their grain yields and with respect to their resistance to *Fusarium* wilt and other plant diseases.

4. FARMER EVALUATION OF PIGEONPEA VARIETIES

4.1 Group evaluations: 1997/98 season

During the 1997/98 cropping season groups of participating farmers in Lidala and Chiwinja villages in Chiradzulu North EPA and in Mangunda section of Matapwata EPA were asked to score the pigeonpea varieties in the on-farm trial plots on a 1-5 (or 1-10) scale against criteria which they themselves selected as the most important for pigeonpea variety evaluation (Mwale and Ritchie; 1998a, 1998b; Sutherland, 1998). While there were variations in scores between groups there was a general consensus that the ICEAP varieties outranked the local variety when scores for yield, early maturity, seed size, vigour, germination and wilt resistance were ranked and combined with a separate overall farmers' preference ranking.

4.2 Individual farmer evaluations, 1998/99 season

In the 1998/99 season these small-scale qualitative village group evaluations were supplemented by a more quantitative assessment of farmer satisfaction based on individual interviews with 36 of the participating farmers in the main pigeonpea trial in Mombezi and Matapwata EPAs (Abeyasekera 2000b; Kapulula and Lawson-McDowall, 1999; Simkoza, 2000a, 2000b). Farmers had requested seed of more varieties to assess under their own management and were given seeds of promising bean and pigeonpea varieties to grow on their own observation plots, or as they subsequently became known, the *kanthu nkako* ("our own thing") plots. The project only asked that the *kanthu nkako* plots should be set up close to the research plots to facilitate comparisons between them.

The main aims of the farmer observation plots were: (a) to enable farmers to assess the suitability of bean and pigeonpea cultivars under their own management; (b) to enable the FSIPM Project to assess the suitability of cultivars for wider promotion among farm households with differing levels of resources; (c) to observe the process of farmer adoption and adaptation of technologies.

4.2.1 Evaluation of crop establishment

In the first round of monitoring, farmers were asked to score each of the pigeonpea varieties on crop establishment, i.e. on overall emergence and vigour. Summary results are reported below. Variety comparisons are made using analysis of variance (ANOVA) techniques with appropriate adjustment to take account of farmer to farmer variation. The procedure assumes a continuous scale normal distribution for the mean scores under each variety. This assumption is reasonable if the number of farmers, whose evaluations are being used to calculate variety means, is sufficiently large. Here, responses were obtained from 36 farmers and this sample size may be regarded as being adequate. An analysis of "residuals" subsequent to the application of ANOVA procedures, confirmed this view.

Table 22 gives mean values of farmers' scores for crop establishment of the long duration varieties on the observation plots and the research plots. The significant difference between varieties on the research plots is caused by farmers' ratings for ICP 9145 being low compared to farmers' ratings for the other varieties. In fact, 13 out of 36 farmers (36%) gave a lower score for ICP 9145 on the research plot compared to their score on the *kanthu nkako* plot. ICEAP 00040 received the highest mean score on both types of plots.

Table 22. Mean farmer evaluation scores for crop establishment of long duration pigeonpea varieties 1998/99

Variety	Mean score on *Kanthu nkako* plot	Mean score on Research plot	No. of Farmers
ICEAP 00053	3.76	3.68	34
ICEAP 00040	3.90	3.90	36
ICP 9145	3.73	3.24	36
Sig. Prob.	p = 0.670	p = 0.003	-

4.2.2 Pre-harvest evaluations on research and observation plots

Prior to harvests, farmers were asked to look at each of the research plots and the *kanthu nkako* plots, and give an evaluation score (on a 1 – 5 scale) for each variety on the basis of five separate criteria, i.e. plant stand, firewood, maturity, seed size and expected yield. These scores are compared below across varieties and across the two types of plots, i.e. research or *kanthu nkako*.

The mean scores for each of the long duration pigeonpea varieties, are shown in Tables 23 and 24 for research plots and observation plots respectively. These are scores resulting from modelling the data, allowing for variation between farms. With respect to plant stand and value as firewood, there is little evidence that farmers' assessments differ across varieties grown on *kanthu nkako* plots. However on both plots for seed size, farmers gave a significantly lower mean score for variety ICP 9145. For earliness of maturity, farmers gave low scores for the local variety grown on either the research or the observation plot. Highest mean scores were given for ICEAP 00040 and ICP 9145 with respect to this criterion, on both research and kanthu nkako plots. With respect to expected yields, mean scores were highest for the ICEAP varieties. In general, the two ICEAP varieties get consistently high mean scores (3 or more) across all the criteria. On expected yields, ICEAP 00040 gets the highest mean score on both the research plots and the observation plots.

Table 23. Mean farmer evaluation scores for varieties on research plots (n = 34)

Variety	Plant Stand	Value as Firewood	Earliness of maturity	Seed size	Expected Yield
Local	3.7	3.1	2.1	4.0	2.9
ICEAP 00053	3.5	3.1	3.4	4.4	3.1
ICEAP 00040	3.9	3.5	4.2	4.1	4.0
ICP 9145	3.2	2.6	4.5	2.8	3.2
Sig. Prob.	$p = 0.005$	$p = 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

Table 24. Mean farmer evaluation scores for varieties on kanthu nkako plots (n = 30 except for the local variety where n = 25)

Variety	Plant Stand	Value as Firewood	Earliness of maturity	Seed size	Expected Yield
Local	3.9	3.3	1.8	4.4	2.9
ICEAP 00053	3.9	3.2	3.0	4.4	3.3
ICEAP 00040	3.7	3.0	3.7	3.8	3.5
ICP 9145	3.9	3.0	4.0	2.5	3.0
Sig. Prob.	$p = 0.841$	$p = 0.725$	$p < 0.001$	$p < 0.001$	$p = 0.051$

4.2.3 Conclusions from farmer evaluation

Farmers' assessment scores for long duration pigeonpea varieties on the research plots showed the greatest preference for variety ICEAP 00040 with respect to crop establishment, plant stand, value as firewood and expected yields. For earliness of maturity, ICP 9145 received a higher mean score than for ICEAP 00040 ($p = 0.069$), while for seed size the mean score for ICEAP 00053 was higher than that for ICEAP 00040. This latter difference however was not significant ($p = 0.180$).

On the observation plots, both ICEAP varieties had significantly higher scores than the local variety or variety ICP 9145 with respect to expected yields. On seed size, ICEAP 00053 had the higher mean score ($p = 0.040$) compared to ICEAP 00040, but on earliness of maturity, ICEAP 00040 scored higher ($p < 0.001$). Overall, it may be said that ICEAP 00040 was the most preferred variety on both research and observation plots. There was also reasonable agreement in scores between the two plots (research and *kanthu nkako*) with respect to ICEAP 00040 as well as with respect to the other varieties.

Farmer and researcher assessments were also found to be significantly related with respect to seed weight, stand count and plant height. However, the 100-seed mass showed little correlation with the farmers' assessment score for seed size. The analysis also indicated that scores given by farmers for expected yield were largely dependent on the number of plants with pods at pre-harvest time, while their assessment of firewood value was based on both plant height and stand count.

5. ECONOMIC EVALUATION

An economic analysis of pigeonpea yields based on the 1997/98 and 1998/99 on-farm trials in Mombezi and Matapwata was performed by Mwale (1999). The analysis assumed that seed of the four different varieties could be obtained for the same price. On this basis ICEAP 00040 gave consistently higher economic net benefits than the other pigeon pea varieties tested in both

Matapwata and Mombezi. Higher net benefits were particularly realised in Chiradzulu because average yields were generally higher than Matapwata. The greatest benefits in Chiradzulu were for those farmers who grew ICEAP 00040 in the upland in both 1997/98 and 1998/99. In Matapwata, dambo production of ICEAP 00040 gave higher net benefits than upland production in 1998/99 cropping season.

The pigeonpea yields from Mangunda (1998/99) under sole cropping and intercropping were also subjected to economic analysis (Mwale, 2000). Of the long duration varieties, ICP 9145 gave the highest gross benefits, closely followed by ICEAP 00040, under sole cropping or intercropping. Both were superior to ICEAP 00053 and the medium duration varieties except for ICEAP 00073. The analysis showed that benefit/cost ratios for sole cropping were below unity for all varieties. The slight yield advantage for sole cropping is offset by the high cost of labour when the benefits of a maize crop yield are absent.

6. RECOMMENDATION

From the yield results, economic assessments and farmer evaluations reported above for the Blantyre Shire Highlands, it can unequivocally be recommended that the pigeonpea variety ICEAP 00040 be officially approved for release in Malawi. There is good reason to believe that this variety will deliver significant benefits to smallholders in the Southern Region in terms of increased income and food security, as well as supporting the growth of the pigeonpea and *tur dhal* export industry.

7. REFERENCES

Abeyasekera, S. (1999). FSIPM 1997/98 Statistical Analysis Reports. Mimeo.

Abeyasekera, S. (2000a). FSIPM 1998/99 Statistical Analysis Reports. Mimeo.

Abeyasekera, S. (2000b). Farmers' assessment of improved pigeonpea varieties. 10 pp. Mimeo.

Abeyasekera, S., Ritchie, J.M. and Chanika, C.S.M. (2000). Experimental trials within the FSIPM Project and related statistical issues. Proceedings of the Final Workshop of the Farming Systems Integrated Pest Management Project.

Agricultural Communications Branch, 1994. *Guide to Agricultural Production in Malawi 1994/95 – 1995/96.* Ministry of Agriculture and Livestock Development, Lilongwe, Malawi.

Blantyre Agricultural Development Division (BLADD), 1999. Third Round Agricultural Estimates, 1998/99 crop season.

Jones, R.B., Likoswe, A. and Freeman, A., 2000. Improving poor farmers' access to technologies and markets for pigeonpeas in Malawi. Proceedings of the Final Workshop of the Farming Systems Integrated Pest Management Project.

Kapulula, P. and Lawson-McDowall, J. (1999). FSIPM Project 1998-99 On-Farm Trials. Monitoring Reports. 1999. 80 pp. Mimeo.

National Statistical Office (1997). Monthly Statistical Bulletin. July 1997.

Makato, C.J.A., 1997. *A description of crop varieties grown in Malawi.* Dept of Agricultural Research and Technical Services, Ministry of Agriculture and Irrigation, Lilongwe, Malawi.

517

Ministry of Agriculture and Irrigation (MOAI), 1999. National Crop Estimates (Smallholder and Estates Combined) 1998/99. Ministry of Agriculture and Irrigation, Lilongwe, Malawi.

Minja, E.M. (1997). Insect pests of pigeonpeas in Kenya, Malawi, Tanzania and Uganda, and grain yield losses in Kenya. A Consultant's Report submitted to the African Development Bank. ICRISAT, Bulawayo, Zimbabwe. 65 pp.

Mwale, B. and Ritchie, J.M. (1998a). Report on farmer evaluation for the pigeonpea trials for Lidala and Chiwinja. August 1998. 8 pp. Mimeo.

Mwale, B. and Ritchie, J.M. (1998b). Report on Farmer Evaluation for the pigeonpea trials at Mangunda. Sept. 1998. FSIPM Project. Mimeo.

Mwale, B. (1999). Economic analysis of on-farm trials 1997/98 - 1998/99. Jan 2000. Mimeo.

Mwale, B., Orr, A., and Saiti, D. (1999). Pests and markets: Why farmers grow susceptible varieties of pigeonpea. 25 Oct 1999. 23 pp. Mimeo.

Mwale, B. (2000). Economic analysis of Mangunda pigeonpea trial. February 2000. Mimeo.

Patel, R.G. (1998). Prosperity from pigeonpeas: opportunities for processing, utilization and export of Malawian pigeonpeas in the s1st Century. Workshop on prospects for groundnut and pigeonpea production, utilization and marketing in Malawi. Club Makokola, Mangochi, August 30 – September 2, 1998.

Ritchie, J.M., 1996. Workshop Summary Report. Farming Systems Integrated Pest Management Project Stakeholder Planning Workshop, Shire Highlands Hotel, Limbe, 4-6 June 1996. Mimeo.

Ritchie, J.M., Daudi, A.T., Fero, W.K., Mkandawire, C.B.K., Maulana, T.H., Milanzi, T. and Shaba, E.R., 1997. Farming Systems Integrated Pest Management Project: Interim progress report on Pest Management Trials in intercropped Maize, Pigeonpeas and Beans. Mimeo.

Ritchie, J.M., Polaszek, A., Abeyasekera, S., Minja, E. and Mviha, P. (2000). Pod pests and yield losses in smallholder pigeonpea in Blantyre Shire Highlands. Proceedings of the Final Workshop of the Farming Systems Integrated Pest Management Project.

Ritchie, J.M., Abeyasekera, S., Chanika, C.S.M., Ross, S.J., Mkandawire, C.B.K., Maulana, T.H., Shaba, E.R., and Milanzi, T.T.K. (2000). Assessment of improved pigeonpea varieties under smallholder management. Proceedings of the Final Workshop of the Farming Systems Integrated Pest Management Project.

Simkoza, E. (2000a). Matapwata and Chiradzulu Farmers: Long duration pigeonpea monitoring pre-harvest. Simkoza, E. March 2000. 4 pp. Mimeo.

Simkoza, E. (2000b). Mangunda farmers: Long duration and medium duration Pigeonpea monitoring pre-harvest. E. Simkoza. March 2000. 4 pp. Mimeo.

Sutherland A. (1998) Report on training course in participatory approaches to on-farm pest management trials and related aspects of the FSIPM Project. August 1998. Mimeo.

ANNEX 1. Grain yield (Kg/ha) and 100 seed mass (g) in long-duration pigeonpea in multi-location trial, Eastern and Southern Africa 1998/99 cropping season. Source: ICRISAT-Nairobi.

Variety	Mozambique-FHI		Kabete Kenya		Katumani Kenya		Kiboko Kenya		Makueni Kenya		Naliendele-Tanzania		Mozambique Loc. 2		Mean	
	Grain yield	100 seed mass (g)	Grain yield	100 seed mass (g)	Grain yield	100 seed mass (g)	Grain yield	100 seed mass (g)	Grain yield	100 seed mass (g)	Grain yield	100 seed mass (g)	Grain yield	100 seed mass (g)	Grain yield	Seed mass
ICEAP 00020	2222.7	21.0	3285.5	22.4	671.4	19.2	2334.7	22.1	1741.4	21.7	1342.6	17.0	2083.3	19.7	1954.5	20.4
ICEAP 00040	2157.2	20.0	2262.2	21.5	842.5	15.7	2073.9	23.2	2511.9	21.0	1782.4	20.0	1041.7	20.7	1810.3	20.3
ICP 9145	2341.2	16.5	3882.0	17.9	894.6	13.3	1441.6	16.5	1683.3	17.3	1458.3	14.7	694.4	15.3	1770.8	15.9
ICEAP 00933	2235.0	17.0	3276.4	18.6	856.8	13.7	1461.6	19.0	1872.2	19.3	1435.2	17.0	1157.4	16.3	1756.4	17.3
ICEAP 00560	2286.1	18.0	2943.1	17.5	922.9	13.7	2037.0	16.1	1109.5	16.7	1203.7	16.7	1504.6	16.7	1715.3	16.5
ICEAP 00932	2008.3	20.8	1715.2	20.9	1135.8	17.7	2189.7	19.6	1916.7	21.3	1458.3	19.0	1388.9	21.0	1687.9	20.1
ICEAP 00809	2079.2	19.0	3595.8	18.4	636.7	12.0	2064.9	18.3	1321.4	16.0	810.2	18.0	1206.0	17.3	1673.5	17.0
ICEAP 00053	1451.9	14.8	2796.7	15.8	634.2	16.5	1592.2	18.6	1472.2	19.7	1365.7	16.0	2199.1	16.0	1644.6	16.8
ICP 13076	2246.1	20.0	2134.4	21.1	1069.1	17.4	1506.9	20.2	1801.4	21.7	1041.7	16.7	1388.1	18.7	1598.1	19.4
ICEAP 00561	2052.5	15.8	2338.1	17.9	810.0	14.0	2474.6	17.6	1110.5	14.7	1643.5	17.3	694.4	16.0	1589.1	16.2
ICEAP 00790	1872.7	16.3	1674.8	15.7	771.8	16.1	1752.8	17.6	783.6	15.3	1736.1	13.7	2199.1	14.0	1541.5	15.5
ICEAP 00950	2166.2	16.7	3073.3	16.7	738.5	12.8	1315.4	16.5	526.4	18.3	1134.3	14.0	1157.4	15.3	1444.5	15.8
ICEAP 00934	1960.2	15.7	2267.7	20.1	580.8	17.3	2219.3	21.9	1527.8	22.0	925.9	14.3	694.4	14.3	1453.7	18.0
ICEAP 00528	2062.3	16.8	1923.2	19.4	523.2	12.6	1414.6	18.3	1642.2	18.0	1458.3	15.7	925.9	16.0	1421.4	16.7
Grand mean	2081.5	17.8	2654.7	18.9	792.0	15.1	1848.5	19.0	1501.5	18.8	1342.6	16.4	1309.7	17.0	1647.2	17.6

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A RECOMMENDATION FOR THE RELEASE OF IMIDACLOPRID FOR USE AS A SEED DRESSING FOR THE MANAGEMENT OF WHITEGRUBS AND OTHER SOIL PESTS IN MAIZE

SUBMITTED TO THE TECHNOLOGY CLEARING COMMITTEE OF THE MINISTRY OF AGRICULTURE AND IRRIGATION

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EXECUTIVE SUMMARY

This paper briefly summarises the results of two seasons of on-farm trials (1997/98 and 1998/99) of imidacloprid seed dressing as a pest management strategy for whitegrubs attacking smallholder intercropped maize in Blantyre/Shire Highlands.

The economic importance of whitegrubs (Scarabeidae) is briefly reviewed with particular reference to maize in Malawi. In Blantyre Shire Highlands the whitegrub pest complex in farmers' maize fields consists of at least seven species belonging to five genera representing three subfamilies. The *Schizonycha* species complex is the most prevalent and found in both EPAs while *Heteronychus licas* is potentially the most serious maize pest in its adult stage in the Chitera dambo in Mombezi EPA.

The value of seed dressing as a management tool for soil pests is briefly set out and some experiences of the use of imidacloprid for seed dressing are discussed. In 1997/98 Gaucho® 70 WS (Imidacloprid) (5g/Kg of seed) was tested on 61 farms in Blantyre Shire Highlands as a maize seed dressing on both dambo and upland fields since sampling in 1996/97 had indicated that upland fields had higher numbers of scarabaeid larvae than dambo fields. Levels of plant deaths by whitegrubs were very low overall (23% of plots <2% of plants). Maize yields were consistently higher in upland than dambo fields.

Seed dressing significantly increased maize yields in upland fields by about 500kg/ha (p=0.001) and by about 10% in dambo fields although this yield gain (c. 100kg/ha) was not statistically significant. Seed dressing significantly reduced whitegrub numbers at harvest in dambo fields (p=0.001), but not in upland fields.

During the 1998/99 cropping season, an on-farm trial was undertaken with 9 farmers to assess the effect of seed dressing with Gaucho-T® 45 WS as a cheaper alternative to Gaucho® 70 WS on whitegrub numbers and maize yields. Seed dressing significantly (p<0.05) increased maize yield though further analysis revealed that the beneficial effect was only realised in Chiradzulu upland fields.

Nine farmers participating in the 1998/99 trial were given measured quantities of Gaucho-T 45 WS to test on their own fields. All farmers reported that the seed treatment was easy to carry out. Just before harvest they were asked to score treated and untreated areas for plant survival, vigour, expected yield and severity of whitegrub attack. The average scores for treated plots were higher for treated plots than for untreated except for whitegrub attack which was lower.

Despite the relatively high cost of Gaucho® 70 WS, it appears that farmers with upland fields in Chiradzulu and Matapwata could achieve a satisfactory marginal rate of return (320%) using this formulation to dress maize seed against soil pests, especially whitegrubs. When the less expensive and less concentrated formulation, Gaucho-T 45 WS (35% imidacloprid + 10% Thiram), was substituted, the MRR was actually lower (201%) but was still acceptable.

On the basis of the above trial results, farmer assessment and economic evaluation it is recommended that Imidacloprid WS formulations should now be cleared for use as a maize seed dressing in Malawi, both on their own and in combination with the fungicide Thiram. In addition to its effects against whitegrubs, imidacloprid can be expected to show additional benefits by controlling not only wireworms, termites and other soil pests, but also *Cicadulina*, the vector of maize streak virus.

Annex 1 contains a summary of information on the environmental impact of imidacloprid, with details of formulations and manufacturers recommendations for use.

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CONTENTS

1. INTRODUCTION

1.1 Economic importance of whitegrubs in Southern Malawi.

The Soil Pest Project conducted surveys of soil insect pests in farmers' fields in 1990-91 and 1991-92 seasons. Surveys by ICRISAT in the 1986-87 growing season found white grubs to be the major pest of groundnuts in areas receiving more than 1000 mm of rain annually, while termites were the most serious pests in areas with lower rainfall (Wightman & Wightman, 1994).

The Soil Pest Project recorded whitegrubs as the second most damaging soil insect pest of maize (after termites) in 1990-91, while *Schizonycha* sp. was the most prevalent pest of vegetative groundnuts. Between 29 and 38 species of Scarabeid beetles were said to be involved in crop damage in Malawi. For most of these species the adult and juvenile stages have not been positively associated and only adult beetles can be reliably identified, even by experts.

The Farming Systems Integrated Pest Management (FSIPM) Project, financed by the UK Overseas Development Administration and the Government of Malawi, and based within the Department of Agricultural Research and Technical Services at Bvumbwe Research Station, conducted on-farm trials and investigations during three seasons (1996-1999). The aim of the FSIPMP was to develop appropriate pest management recommendations for major pests of maize, beans, pigeonpeas and sweet potato which could be extended to resource-poor farmers in Blantyre Shire Highlands Rural Development Programme (RDP) area of Blantyre Agricultural Development Division.

The initial crop focus of the project was determined by a Stakeholder Workshop in June 1996 which also highlighted particular key pests (Ritchie, 1996). The rationale for selection of specific EPAs within the RDP and specific villages within those EPAs has been documented by Ritchie (1997). The Project held meetings with separate groups of men and women farmers in the selected villages to discuss their perceptions of priority pests of their crops and possible control methods. Whitegrubs, termites, cobrot and *Striga asiatica* were perceived by farmers as the most serious field pests of maize. With the exception of cobrot, all field pests were perceived as increasing in severity. Farmers also used a wide range of control methods, several of which (eg. the use of Sevin seed-dressing for whitegrub control) were innovative farmer practices.

The perceptions of farmers are consistent within and between Matapwata and Chiradzulu and also show similarity to the views of the group of professionals and experts assembled at the Stakeholder Workshop. However whitegrubs, which were identified as the most important maize pest in both Chiradzulu and Matapwata, were not ranked as major pests by the Workshop. This perception by the farmers receives some support from the findings of the Chancellor College Soil Pests Project (Munthali *et al.*, 1992) which rated whitegrubs as the second most important soil pest after termites in Southern Malawi.

1.2 Whitegrub species damaging maize in Blantyre Shire Highlands and Thyolo RDPs

There is relatively little published work detailing the identity of the species making up the whitegrub fauna in smallholder farmers' fields. A study was therefore undertaken (Mzilahowa, 2000) to identify the whitegrub species present in farmers' fields affecting maize intercropping systems in Matapwata and Chiradzulu (Mombezi) North Extension Planning Areas (EPAs).

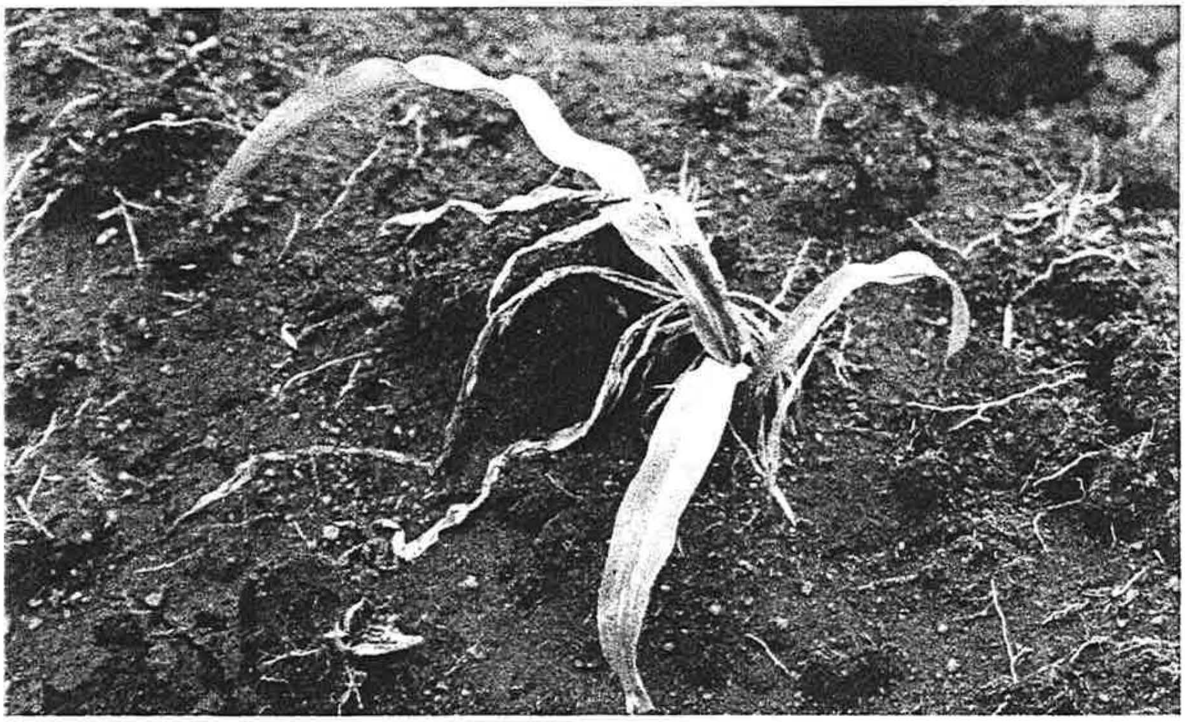

Plate 1(a). Characteristic dead-heart damage to young maize seedling caused by adult black maize beetle, *Heteronychus licas*.

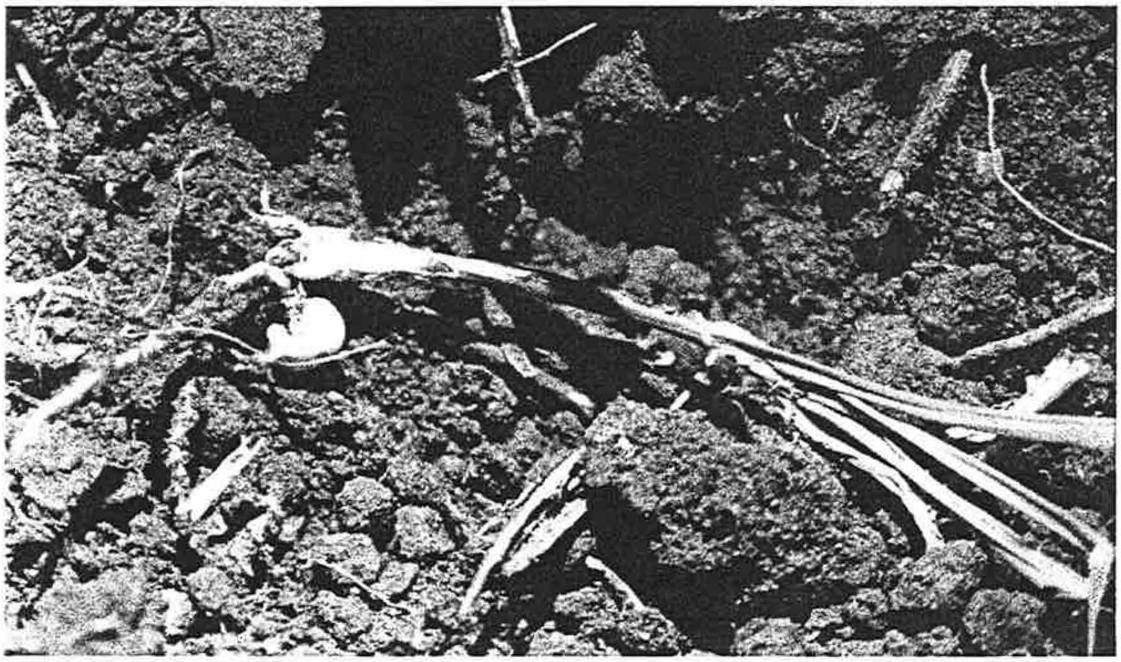

Plate 1(b). Excavated maize plant showing larval whitegrub (*Schizonycha* sp.) and effects of feeding causing extensive root damage, wilting and death of plant.

The sampling of whitegrubs was done from 61 farmers' fields who participated in the 1997/98 main trial. Sampling was done 3 times (in January, March and June) in the net plots. The adult beetles collected were preserved dry and sent to the International Institute of Entomology (IIE), UK for identification.

Table 1 shows the species of scarabaeid beetles found attacking maize in farmers' fields. Five species of scarabaeid beetles, *Heteronychus licas, Schizonycha fusca, Schizonycha salaama, Schizonycha angustula,* and *Trochalus exasperans* were identified to species level and a further two species, *Anomala sp.* and *Aserica sp.* were only identified to genus. They belonged to three subfamilies: Dynastinae, Melolonthinae and Rutelinae. The genus *Schizonycha* was the most prevalent and occurred across both EPAs (Table 2). The dynastine scarabaeid, *Heteronychus licas* (Klug) one of several related species commonly referred to as black maize beetle, is a potentially serious pest of maize in its adult stage, whereas the remaining species are all larval pests. In the 1995/96 cropping season there was an exceptional outbreak of black maize beetle that forced some farmers to abandon their maize fields in the Chitera dambo in Mombezi EPA. Representations by the local MP led to direct intervention by the Ministry of Agriculture with pesticide sprays, but too late to save the crops. The damage caused to maize by adult and larval whitegrubs is illustrated in Plate 1.

Table 1. Whitegrub species found in farmers' maize fields in Mombezi and Matapwata EPAs. Source: Mzilahowa (2000)

SPECIES	FAMILY	SUBFAMILY
Heteronychus licas (Klug)	Scarabaeidae	Dynastinae
Schizonycha fusca Brenske	Scarabaeidae	Melolonthinae
Schizonycha salaama Kolbe	Scrabaeidae	Melolonthinae
Schizonycha angustula Moser	Scarabaeidae	Melolonthinae
Trochalus exasperans Peringuey	Scarabaeidae	Melolonthinae
Aserica sp.	Scarabaeidae	Melolonthinae
Anomala sp.	Scarabaeidae	Rutelinae

Table 2 Occurrence of whitegrub species in farmers' maize fields in Mombezi and Matapwata EPAs. (Source: Mzilahowa, 2000).

SPECIES	MOMBEZI EPA		MATAPWATA EPA		
	Chiwinja Village	Lidala Village	Kambuwa Village	Magomero Village	Villages/ species
H. licas	+	-	-	-	1
S. fusca	+	+	+	+	4
S. salaama	+	+	+	+	4
S. angustula	-	-	+	-	1
T. exasperans	-	-	-	+	1
Aserica sp.	-	-	+	+	2
Anomala sp.	-	-	-	+	1
Species/village	3	2	4	5	

1.3 Seed dressing as a pest management strategy

Seed dressing with pesticides for the control of soil pests has been practised with good effect for more than 40 years (Hillocks *et al.*, 1996). The duration of insecticidal activity will depend on the **persistence** of the pesticide concerned. The extremely persistent organochlorine pesticides which were routinely used for seed dressing up to the 1980s (DDT, aldrin, dieldrin and BHC) are now withdrawn from use due to their tendency to enter the human food chain and become concentrated in the tissues of humans and other top predators. Since the 1980s a range of less environmentally damaging pesticides have been used, especially carbamates (including carbofuran, carbosulfan, furathiocarb) and organophosphates (such as chlorpyrifos) (Hillocks *et al.*, 1996). There is a trade-off between longer persistence which may give protection against late attack by pests such as termites (as in the case of Gaucho®) and the need for a very long pre-harvest interval to avoid human consumption of pesticide residues.

Advantages of seed dressing include the very accurate placement of the pesticide at the site of expected damage, especially in the case of soil pests attacking roots and stems. This has obvious economic advantages in avoiding waste and minimises environmental impact while maximising effectiveness. It has been estimated that in a hectare of treated maize, only a total area of approximately 58 m^2 is actually treated, by comparison with foliar spraying which would have needed to be applied over the whole crop (10,000m^2) (Bayer, undated).

If a **systemic** pesticide (such as Gaucho® or furathiocarb) is used, the protective effects are transferred to the whole plant without directly affecting natural enemies and beneficial insects such as bees. Comparison of furathiocarb and imidacloprid, however have indicated that the latter also possesses a systemic **antifeedant** action against black maize beetle (Drinkwater and Groenewald, 1994).

Before wetting, powder formulations are relatively less toxic by surface contact than liquid formulations, but carry a risk of inhalation. Once wetted and applied to seed, the pesticide is more easily absorbed through the skin than as a dry powder. The technique needs to be used with caution and to include the use of gloves and avoidance of inhalation of powder (Matthews *et al.*, 1974).

Seed dressing is an approach which is used as part of a preventive strategy in cases where damage is predicted from previous experience. Because it is applied at planting the investment is not subject to any possibility of revision according to the severity of subsequent pest attack (Hillocks *et al.*, 1996). This is in contrast to topical application of pesticides or other measures based on scouting of damage or occurrence levels to detect a threshold for pesticide application.

Suitable pesticides for seed dressing must not cause reduced germination or plant vigour. PRA in Chiwinja village (Chiradzulu North EPA) in 1996, elicited the information that a small group of innovative farmers had adopted the practice of treating maize seed with Sevin (Carbaryl) WP formulation (85%) against attacks of black maize beetle (*Heteronychus licas*) in the Chitera dambo. Respondents indicated that the technique, which involved soaking seed, draining and mixing it with the insecticide, had been highly effective in killing beetles and reducing damage. However as discussed below (Section 2.1), a trial of this approach demonstrated that the pesticide had a significantly toxic effect on maize which led to reduced yields (Ritchie et al., 2000).

1.4 Imidacloprid as a seed dressing for whitegrubs and other pests

Drinkwater and Groenewald (1994) compared the efficacy of imidacloprid (a nitromethylene) and furathiocarb (a carbamate) as seed dressing insecticides for the control of adult black maize beetle (*Heteronychus arator)* in maize in laboratory and greenhouse trials. The numbers of damaged plants, level of plant damage and numbers of dead adults were recorded. Results indicated that both chemicals had a systemically translocated insecticidal action.

Imidacloprid also had a systemically translocated antifeedant action in the stems of plants. The apparent absence of an antifeedant action in the furathiocarb treatment rendered it inferior to the imidacloprid treatment.

Mittnacht (1994) studied the biological activity of tefluthrin and imidacloprid as insecticidal seed dressings for sugarbeet seed in field trials in Baden-Wurttemberg, Germany, during 1986-93. Results showed that both compounds were superior to the standard compounds used for sugarbeet seed dressing, methiocarb and carbofuran.

Bosch and Schaufele (1994) carried out field trials in 12 European countries which showed that imidacloprid as a seed treatment for sugarbeet seed was highly effective at controlling soil and foliar insect pests, especially aphids, at all doses tested (30, 45, 60 and 90 g a.i. per unit). Seed treatment did not affect yield but led to a slight slowing in emergence and reduced vigour of plants early in the growing season.

Heatherington and Meredith (1992) tested imidacloprid (Gaucho) in the UK in 1989-91 as a seed pellet treatment for the control of pests and virus yellows in sugarbeet. The insecticide was safe to the crop and in the absence of soil pests treated seed produced plant populations no different from untreated seed. Control of soil arthropod pests was equal to that from all standard materials used, and imidacloprid at 70 and 90 g a.i./100 000 seeds often achieved superior control of the leaf feeding pests. Significant increases in yields from the use of the insecticide were achieved at 2 out of 8 sites.

Deall *et al.* (1993) evaluated the effectiveness of seed treatment of maize with imidacloprid (Gaucho) 70 WS against a number of soil insect pests (mainly Coleoptera) in field trials in South Africa and Zimbabwe during 1988-91. The insects showed a differential response to dosage rates applied. The majority of the coleopteran pests (including pests of stored maize) were controlled to economically acceptable levels at 175g a.i./100 kg seed.

The cicadellid *Cicadulina mbila*, the vector of maize streak geminivirus, was effectively controlled at 350g a.i./100 kg seed (Deall et al., 1993). Kibata and Ong'aro (1999) in a comparative study over five seasons 1992-1997, also found that imidacloprid applied as a seed dressing provided consistently effective protection from maize streak virus (MSV). Ngwira et al. (1999) compared Gaucho-T at five different rates with Furadan and Sumicombi at Dowa and Salima in Malawi for control of MSV. At Dowa the disease incidence was too low to detect an effect, but at Salima Gaucho-T reduced MSV incidence by 60% or more, outperforming other treatments.

A large number of trials of imidacloprid have been undertaken in the last ten years in many countries. A few relevant examples have been cited in this report. Results have generally been highly encouraging. Gaucho 70 WS is routinely used for seed dressing maize in South Africa and Kenya. In Kenya Pioneer seed is treated by the suppliers at a rate of 2.5g/kg of seed. There are economies of scale in such an arrangement which also avoids wastage and hazard associated with seed treatment by smallholders.

The most economical way in which Gaucho can be used as a seed treatment would involve treatment of hybrid maize seed by seed companies (as occurs at present with Thiram treatment). Bayer have been discussing the possibility of this with seed companies. In Swaziland Bayer sells treated seed in bags of 2 kg, 5kg, and 10 kg alongside untreated seed. The premium on treated seed is about 20% (J. Leroux, personal communication).

In the case of composite seed which is promoted by government and NGOs rather than commercial companies, there appears to be scope for mass treatment of seed before distribution. Such treatment would avoid the need for fumigation in storage. Supplies might be obtained using existing arrangements with donors (e.g. Kennedy Round Funding) (J. Leroux, personal communication).

The smallest packet size for Gaucho 70 WS currently available is 125 g which would not be affordable by most smallholder farmers. It is likely that once the product is licensed for use on maize in Malawi, Bayer will respond with new initiatives to increase its attractiveness to farmers.

2. FSIPM PROJECT ON-FARM MAIZE SEED DRESSING TRIAL (1997/98)

2.1 Background and objectives

As indicated above (Section 1.1) the FSIPMP found that whitegrubs were seen by farmers and by researchers who had worked in the area as a serious pest of maize in the Blantyre Shire Highlands. Seed dressing is the strategy of choice for whitegrub control (Section 1.3). Since farmers were already using an available pesticide (carbaryl) for seed dressing their maize, a multi-factorial trial was mounted across 32 dambo fields in four villages in 2 EPAs in 1996/97, using two dose rates for carbaryl (7 and 14g/kg of seed) and a control.

At the higher dose rate, there was a significant negative effect on both maize yield (p=0.051) and on maize plant height (p=0.022). Farmers who used seed dressing with Sevin had claimed that the use of seed dressing leads to better plant emergence by killing whitegrubs at initial stages of seed growth (Orr et al. 1999b). In Chiradzulu, germination rates were not significantly different. However in Matapwata, the lower dose of Sevin (7g) reduced the germination stand count by about 5% (a non-significant reduction), while the higher dose of Sevin (14g) reduced the germination stand count (significantly) by about 12%. (Ritchie *et al.*, 2000). All results emerging from yield data analyses, except the raw summaries, demonstrate a systematic reduction in maize yields with increasing applications of Sevin used as a seed dressing for maize. After excluding plots with zero yields caused by flooding, mean yield differences between control plots and plots with 14 gms of Sevin per 1 kg of seed were 317 kg/ha for grain yields (95% C.I. = (62, 572)) and 300 kg/ha for usable grain yield (95% C.I. = (0, 600)).

The overall incidence of plant deaths by whitegrubs was much lower in Matapwata (<1%) than in Chiradzulu (about 6%). The data did not demonstrate any beneficial effects of seed dressing in Matapwata where the whitegrub incidence was low. However in Chiradzulu, the mean number of plant deaths due to whitegrubs was about 5 times higher in plots without seed dressing, or with a low dose (7g) of seed dressing, compared to plots with the higher dose (14g) of seed dressing. This suggests that farmers' perceptions of the effectiveness of carbaryl in protecting maize against whitegrubs could be justified when whitegrub populations are large. However the results here demonstrate that although Sevin can significantly reduce whitegrub populations, its phytotoxic effects can be quite serious, leading to a reduction in maize yields by as much as 300 – 600 kg/ha.

2.2 Treatment factors and distribution of farmers

Maize IPM trials in the 1997/98 season were a follow-up to the trials with Carbaryl seed dressing conducted in the 1996/97 season in four villages in Chiradzulu and Matapwata EPAs. After consulting the literature, the less toxic alternative seed dressing, Gaucho 70 WS (Imidacloprid), sold elsewhere in Africa specifically for whitegrub control, was selected for use. Gaucho was applied at a rate of 5g/kg of maize seed. The experiment was conducted both in dambo fields (as for 1996/97) and in upland fields because it had been established in 1996/97 that larval whitegrub attack occurs throughout the area, and also because there is known to be an anti-feedant effect of Gaucho on termites which it was hoped would be detectable on upland farmers' trial plots.

The design of on-farm trials for the 1997/98 season was specifically intended to ensure that most of the proposed combinations of management practices would be visible to each farmer on one or more of the four experimental plots on his or her farm and could therefore be evaluated by farmers. Three treatment factors for maize were included in the trial. One factor, i.e. seed dressing with Gaucho 70 WS, was used for the management of whitegrubs; and one factor, i.e. Mbwera or no Mbwera (in Matapwata), and weeding with banking or weeding without banking at second weeding (in Chiradzulu North) was used for the control of termites.

Sixty one farmers were included in the 1997/98 main intercrop trial. Each farmer had four plots on his/her farm with each plot having one of the proposed treatment combinations. The distribution of farmers across zones, villages and EPAs is shown in Table 3.

Table 3. Distribution of farmers across villages and land types.

Land type (zone)	Chiradzulu		Matapwata		Total
	Chiwinja	Lidala	Kambuwa	Magomero	
Dambo	11	6	8	5	30
Upland	5	12	7	7	31
Total	16	18	15	12	61

2.3 Design layout

The general form of the experimental design used for the 1997/98 main intercrop trial is that of a randomised block experiment with a factorial treatment structure with 4 units per farm forming a block. Factorial combinations between treatment factors were allocated to the incomplete blocks so that all important 2-factor interactions could be estimated. The design layout for farms in each village and by zone (dambo/upland) appears in Annexes 3 and 4 of Ritchie *et al.* (2000).

In each farm two plots had maize seed dressing and two did not. Where banking or mbwera were applied, two plots were banked or mbwera was done on two of the four plots, so that each of four plots on each farm received each of the four treatment combinations.

2.4 Maize harvest data

Four yield responses were considered for analysis. These were

- Usable grain weight (kg/ha) adjusted for stolen cobs and moisture content;
- Mean height of ten randomly selected plants from the net plot at harvest (metres);
- Average weight per cob (kg), i.e. ratio of the weight of all cobs at harvest to the number of cobs;
- Average number of cobs per plant = number of cobs/net plot stand count.

The means for these responses under each of the treatment factors across zones, are shown in Table 4. It is apparent that the maize yield performance is generally better in upland fields than in dambo fields. Results demonstrate a beneficial effect due to seed dressing in upland fields with respect to usable grain weight and an improvement in grain yields with banking in dambo fields.

Table 4. Mean values for four maize yield parameters according to land type and treatment factors

Treatment factor			Usable grain weight (kg/ha)		Mean height of plants at harvest (metres)		Average weight per cob (kg)		Average number of cobs per plant	
		N	Dambo	Upland	Dambo	Upland	Dambo	Upland	Dambo	Upland
Seed Dressing	Yes	120	1299	2701	1.74	2.03	0.093	0.145	0.755	0.939
	No	118	1180	2174	1.72	1.96	0.095	0.138	0.752	0.925
Banking	Yes	175	1429	2404	1.79	2.01	0.105	0.142	0.827	0.928
	No	63	630	2532	1.53	1.97	0.060	0.141	0.522	0.942

It is important to note that the summary data presented above make no allowances for other sources of variation that reside in the data such as the farmer to farmer variability, variation due to zones and EPA, etc. Investigation of the effect of the intervention treatments must take these sources of variability into account in order to provide information about the true performance of the maize crop under the different treatments. Such an analysis is presented in sections 2.5 and 2.6 below.

To study the treatment effects more formally via appropriate statistical procedures, two components to the analysis must be recognised:

- Investigating maize yield responses at the farmer level relative to the farmer to farmer variation.
- Investigating the effects of seed dressing, banking and use of mbwera, all of which were applied at plot level within farmers' fields. Hence these factors were investigated relative to the "within farmer" variation.

The analysis and results for seed dressing are discussed below.

2.5 Effect of Gaucho on maize yield

The major factors and variates found to influence the farmer to farmer variation have been discussed in full by Ritchie et al., (2000) and are not further considered here. Treatment factors applied at the plot level were the application of seed dressing, banking and the use of mbwera. The interactions of these factors with zone and EPA differences were also investigated. The effects of banking and mbwera was reported by Ritchie *et al.* (2000) and are not further considered here.

In the analysis, clear differences were found in maize yield responses between plots with and without seed dressing ($p<0.001$). This difference, favouring plots with seed dressing, was mainly due to the substantially greater yields (by about 500 kg/ha) in the upland areas compared to the dambo areas. The increase in maize yields under seed dressing in the dambo areas was only about 100 kg/ha which was not a significant difference. Results for the major treatment factors, for each of the maize yield responses, are shown in Table 5.

Table 5. Mean yields to show beneficial effects of seed dressing

Yield response		With seed dressing	Without seed dressing	Difference in means	Standard error of difference	p-value for significance of difference
Mean grain yields* (kg/ha)	Dambo :	1312	1193	119	104.3	0.255
	Upland :	2721	2216	505	103.7	<0.001
Mean Height (metres)		1.891	1.840	0.0515	0.0209	0.015
Av. Weight of cobs (kg)		0.121	0.119	0.0017	0.0028	0.550
No. of cobs per plant		0.852	0.843	0.0089	0.0155	0.568

*Only mean grain yields have been disaggregated by zone since this was the only response variate which gave a significant zone by seed dressing interaction.

2.6 Effect of Gaucho on whitegrub numbers at harvest

The effects of seed dressing and banking on whitegrub numbers were investigated using a generalised linear model with Poisson distributed errors. For whitegrub numbers, there was some evidence of a difference between the EPAs ($p=0.029$) and strong evidence of a difference between dambo and upland areas ($p<0.001$). The application of seed dressing also had a beneficial effect ($p<0.001$) but there was no evidence of an effect due to banking ($p=0.576$). Further investigation of the seed dressing effect showed an interaction with the land type ($p=0.009$). The effect of seed dressing appeared to be evident only in the dambo areas and not in the uplands. The mean numbers of whitegrubs per plot are shown in Tables 6 and 7.

Table 6. Mean whitegrub numbers per plot at harvest by land type and seed dressing factors

Seed dressing	Dambo	Upland
No	2.71	3.77
Yes	1.54	3.68
Sig. Prob.	$p < 0.001$	$p = 0.879$

Table 7. Mean whitegrub numbers per hectare at harvest in different strata and across treatment factors

Area, land type and treatment factors		Sample size	Mean whitegrub numbers/ha	p-value for significance
EPA	Chiradzulu	136	4.95	0.029
	Matapwata	108	0.90	
Zone	Dambo	120	2.13	<0.001
	Upland	124	3.72	
Seed dressing	No	122	3.24	<0.001
	Yes	122	2.61	
Banking	No	64	2.68	0.576
	Yes	180	2.96	

2.7 Effect of Gaucho on whitegrub damage incidence

Mean numbers of plants per plot, dead or attacked by whitegrubs were studied at each sampling occasion for plots with/without seed dressing. There was little incidence during the season but where it occurred, whitegrub attack was about 8-10 tonnes lower for plots with seed dressing than for plots without seed dressing. Deaths due to larval whitegrubs occurred mainly the first two sampling occasions (10 December to 2 January, 1998). Deaths caused by adult beetles were noted only at the seventh sampling occasion (9-14 March, 1998). There was little indication that banking had an effect on mean numbers of plants per plot affected by whitegrubs.

The actual numbers of plots affected over the entire season by whitegrubs, and hence giving rise to varying numbers of affected plants, are shown in Table 8. The percentage of plots affected is about 30%.

Table 8. Number of plots affected by whitegrubs (n=244)

Number of plants affected per plot	Dead by whitegrub larvae	Dead by whitegrub adults	Attacked by whitegrubs
0	225	240	192
1-4	8	2	31
5-10	8	0	16
>11-15	3	0	5
Number of plots affected	19	4	52
Percent of plots affected	7.8%	1.6%	21.3%

Chi-square tests were applied to determine whether the proportion of plots affected by whitegrub attack differed significantly across the seed dressing and banking treatment effects. The results are shown in Tables 9 and 10 for plots with plants dead due to whitegrubs and plots with whitegrub attack. The results indicate a significant lowering of whitegrub incidence in plots with seed dressing compared to plots without seed dressing. There was insufficient evidence to demonstrate an effect due to banking.

Table 9. Number (and percentage) of plots with plants killed by whitegrubs

Effect of Whitegrubs	Seed dressing No	Seed dressing Yes	Banking No	Banking Yes
No deaths	102(83.6%)	119(97.5%)	55(85.9%)	166(92.2%)
Deaths of Plants	20(16.4%)	3(2.5%)	9(14.1%)	14(7.8%)
Sig. Prob.	p<0.001		P=0.139	

Table 10. Number (and percentage) of plots with live plants attacked by whitegrubs

Effect of Whitegrubs	Seed dressing		Banking	
	No	Yes	No	Yes
No deaths	89(73%)	103(84.4%)	55(85.9%)	137(76.1%)
Deaths of Plants	33(27%)	19(15.6%)	9(14.1%)	43(23.9%)
Sig. Prob.	p=0.029		P=0.099	

Incidence of plant deaths due to whitegrubs at plot (and plant) level over the eight sampling occasions is shown in Table 11. The plot level summaries show that less than 10% of plots are affected, while the plant level summaries show that the proportion of plants killed by whitegrubs (in approximately two week periods) is less than 0.5%. Incidence is greater in the early part of the season.

Numbers of plants killed by whitegrubs, totalled over all sampling occasions, is shown in Table 12. The percentages shown correspond to the numbers killed as a proportion of the initial germination stand count. The latter has been taken as the maximum, over the first 2 sampling occasions, of the number of standing (live) and dead plants. The overall incidence of death by whitegrubs is very low (less than 2%), but there does appear to be a reduction in incidence for plots that have maize seed dressing. Incidence in Matapwata is substantially higher than in Chiradzulu within dambo areas but there appears to be little difference in the uplands.

Table 11. Whitegrub incidence at plot/plant level over sampling occasions

Sampling Occasion	Incidence at plot level (n=24)	Incidence at plant level (n from 12834 to 25542)
	% of plots showing incidence	% of plants killed by larvae/adults
11/12/97-17/12/97	6.1	0.33
29/12/97-2/1/98	2.0	0.14
12/1/98-16/1/98	0.4	0.01
26/1/98-1/2/98	0	0
13/2/98-25/2/98	0	0
26/2/98-5/3/98	0	0
9/3/98-14/3/98	1.6	0.21
23/3/98-31/3/98	0	0

Table 12. Number (and percentage) of plants killed by whitegrubs, totalled over all sampling occasions

Seed dressing	Chiradzulu		Matapwata		Totals
	Dambo	Upland	Dambo	Upland	
Without seed Dressing	0.59%	1.85%	0.97%	1.57%	0.13%
With seed dressing	0%	0.13%	0%	0.21%	0.09%
Totals	0.28%	0.97%	0.46%	0.84%	0.65%
	19	72	27	52	170
	n=6827	n=7387	n=5817	n=6164	n=26195

The results presented so far in this section all relate to raw data summaries. Data on the numbers of plants killed by whitegrub larvae or adults, considered as a proportion of the initial plant stand, were subjected to a *generalised linear modelling* procedure to investigate whether this proportion was affected by seed dressing, having allowed for possible effects due to variation between EPAs, zones and farmers. Predictions following the modelling procedures are shown in Tables 13 and 14. There was no evidence of an EPA effect ($p=0.825$). Seed dressing significantly reduced plant proportions killed by whitegrubs ($p < 0.001$). Dambo areas had significantly lower incidence than in the uplands. There was also a significant zone by seed dressing interaction ($p=0.006$).

There was evidence of an effect due to banking ($p=0.010$) and a banking by zone interaction ($p<0.001$). Banking appears to slightly reduce the percentage of plant deaths due to whitegrubs. The overall incidence however is very low.

Table 13. Model predictions of percent of whitegrubs affected plants across seed dressing levels

Seed Dressing	Land type		Overall seed dressing effect
	Dambo	Upland	
No	0.77%	1.73%	1.26%
Yes	0%	0.17%	0.09%
Overall land type effects	0.36%	0.91%	p-value for difference between seed dressing levels is $p < 0.001$
p-value for difference between dambo and upland areas is $p < 0.001$			

Table 14. Model predictions of percent of whitegrub affected plants across banking levels

Banking	Land type		Overall banking effect
	Dambo	Upland	
No	0.40%	1.20%	1.26%
Yes	0.35%	0.80%	0.09%
Overall land type effects	0.36%	0.91%	p-value for difference between banking levels is $p = 0.010$
p-value for difference between dambo and upland areas is $p < 0.001$			

2.8 Effect of Gaucho on termite-lodging of maize plants at harvest

At harvest time, data were collected on the number of termite lodged plants per net plot. Table 15 shows the frequency distribution of numbers of termite lodged plants over the 244 plots in the trial split between dambo and upland areas. Very skew distributional patterns are seen and there are also a large number of plots showing no incidence of termite attack. Termite lodged plants occurred mostly in the upland areas. Only about 17% of plots in the dambo areas were affected by termites.

Table 15. Frequency distribution of termite-lodged maize plants by land type

Number of plants affected per plot	Dambo	Upland
0	100	55
1	7	7
2	6	5
3	3	9
4	1	1
5	2	4
6-10	1	21
11-15	8	8
>15	0	14
Number of plots	120	124

An analysis of the number of termite-lodged plants using a generalised linear model with Poisson errors showed strong evidence of differences between farms with respect to the mean numbers of termite lodged plants and strong evidence of an effect due to the seed dressing factor ($p<0.001$) and due to banking ($p<0.001$). There was also some evidence of a seed dressing by banking interaction ($p=0.016$). As expected farmer differences were also highly significant. The strong farmer to farmer effect was largely caused by four farmers having considerably larger numbers of termite lodged plants averaging over 20 lodged plants per plot. The effects of seed dressing and banking are shown in Table 16.

Table 16. Mean number of termite-lodged plants per net plot of 32.4 m^2

Seed Dressing	Banking No	Banking Yes	Overall seed dressing effect
No	3.02 (n=28)	5.35 (n=94)	4.18
Yes	2.18 (n=36)	2.30 (n=86)	2.24
Overall banking effects	2.60 (n=64)	3.82 (n=180)	p-value for difference of 1.94 between seed dressing levels is p < 0.001
p-value for difference of 1.22 between banking levels is < 0.001			

Data on the numbers of plants with termite lodging, considered as a proportion of the initial plant stand, was subjected to a *generalised linear modelling* procedure to investigate whether this proportion was affected by seed dressing and by banking, having allowed for possible effects due to variation between EPAs, zones and farmers. Predictions following the modelling procedures are shown in Table 17. There was no evidence of an effect due to banking (p=0.171). Seed dressing significantly reduced the proportion of plants lodged by termites (p<0.001). There was some evidence of a significant zone by seed dressing interaction (p=0.044) and of an EPA by zone interaction (p<0.001).

Table 17. Model predictions of percent of termite lodged plants across seed dressing levels

<table>
<tr><td rowspan="2">Seed Dressing</td><td colspan="2">Land type</td><td rowspan="2">Overall seed dressing effect</td></tr>
<tr><td>Dambo</td><td>Upland</td></tr>
<tr><td>No</td><td>1.56%</td><td>3.05%</td><td>2.33%</td></tr>
<tr><td>Yes</td><td>0.83%</td><td>2.55%</td><td>1.72%</td></tr>
<tr><td>Overall zone effects</td><td>1.18%</td><td>2.79%</td><td rowspan="2">p-value for difference between seed dressing levels is p < 0.001</td></tr>
<tr><td colspan="3">p-value for difference between dambo and upland areas is p < 0.001</td></tr>
</table>

2.9 Conclusions on whitegrub management using Gaucho 70 WS (1997/98 trial).

During the season, no record was made of whitegrub numbers since the insects are subterranean and it was not desirable to disturb plant growth in a trial hosted by resource-poor farmers. However the number of plants affected by whitegrubs in each plot was recorded on each sampling occasion. Incidence in terms of plots with dead plants killed by whitegrubs was very low (less than 10% of plots). However about 20% of plots showed plants with attack by whitegrubs. Less than 0.5% of plots were found to have more than 10 plants dead or attacked by whitegrubs during the season.

Despite the relatively low levels of whitegrub occurrence and damage recorded during this study, the main finding is still a clear beneficial effect due to the application of seed dressing with Gaucho in upland areas. The increase in usable grain weight (kg/ha) with seed dressing was about 500 kg/ha (s.e. = 104) in the upland areas but only about 120 kg/ha (s.e. = 104) in dambo areas. Seed dressing had only a marginal effect on the mean height of plants (p=0.015). There was no evidence of an effect of seed dressing on the average weight of a cob, nor on the number of cobs per plant.

The mean number of whitegrubs found at harvest time on a random sample of 5 plants was significantly lower with Gaucho seed dressing than without (p<0.001).

The percentage of plots affected by whitegrubs was significantly lower with Gaucho seed dressing than without. The incidence of dead plants was about 16% for plots with no seed dressing compared to about 3% for plots that did have seed dressing. Overall attack by whitegrubs was also significantly lower (about 16%) for seed dressed plots compared to plots without seed dressing (27%).

Termite attack was seen in about 40% of plots during the season. The incidence was higher later in the season than earlier. The severity of attack in terms of the number of plants lodged was very low (2.5% accumulated over the season). It is likely that the heavy rains in the

1997/98 season led to an overall reduction in attack by termites. However, the mean number of termite lodged plants at harvest time was reduced significantly by Gaucho seed dressing although the difference in mean numbers of plants affected was only 2-3 plants per plot.

3. FSIPM PROJECT ON-FARM SEED DRESSING TRIAL (1998/99)

3.1 Selection of treatments and farmers

The FSIPM Project had been using the legume, *Tephrosia vogelii* (fish bean) as a green manure to improve soil nutrient status and organic matter content of farmers' fields and as a trap crop for witchweed (*Striga asiatica*). *T. vogelii* contains rotenoids and Tephrosin which have insecticidal activity. It was desirable to determine what effect the incorporation of *Tephrosia* biomass would have on whitegrub populations.

Results from the 1997/98 on-farm trials by FSIPM Project showed that Gaucho 70 WS could significantly reduce the number of maize plants killed by whitegrubs and increase maize yields. However the cost of Gaucho 70 WS ($41.50/125g packet) was felt to be prohibitive for smallholder farmers. After discussion with the manufacturers (Bayer AG) a cheaper formulation combining Gaucho 35 WS and Thiram, called Gaucho-T 45 WS (35% Gaucho and 10% Thiram) was selected for the 1998/99 trial.

The aim of the trial was therefore to assess the effects of (a) incorporated *Tephrosia* leaves at 2 tons/ha wet biomass and (b), Gaucho-T 45 WS (at a rate of 5g/kg of maize seed), on whitegrub numbers, maize deaths due to whitegrubs and maize yield.

In the 1997/98 trial it was found that many farmers had experienced little or no whitegrub damage. To address this problem in 1998/99 season, a smaller trial involving just 9 farmers was conducted, these farmers being those who had experienced high whitegrub populations in previous years.

3.2 Trial design

The four plots used in the 1997/98 trial (two with Gaucho seed dressing, two without seed dressing) were split in half to give 8 plots, each 5.4 m × 5.4 m. It was necessary to factor into the experiment the previous history of the plots in terms of the 1997/98 seed dressing treatment in case there was a carry-over effect. The following treatment combinations were therefore planned for these 8 plots in the 1998/99 season.

1. Gaucho in 1997/98, no Gaucho in 1998/99, no *Tephrosia* incorporated
2. " " " , Gaucho in 1998/99, " " "
3. " " " , no Gaucho in 1998/99, *Tephrosia* incorporated
4. " " " , Gaucho in 1998/99, " "
5. No Gaucho in 1997/98, no Gaucho in 1998/99, no *Tephrosia* incorporated
6. " " " " , Gaucho in 1998/99, " " "
7. " " " " , no Gaucho in 1998/99, *Tephrosia* incorporated
8. " " " " , Gaucho in 1998/99, " "

The above treatment structure falls into a 2 × 2 × 2 factorial array. As in 1997/98, the maize was intercropped with beans and pigeonpeas. Maize and pigeonpeas were planted at a rate of 3 seeds per station; beans at 2 seeds per station. Damage assessments were made at each of eight sampling occasions.

3.3 Maize harvest data – Basic Summaries

Mean values for usable grain weight (kg/ha) (adjusted for stolen cobs and moisture content) by location and the 1998/99 seed dressing treatment are shown in Table 18.

Table 18 Mean yield responses by location and across the seed dressing treatment

Yield Response	Seed Dressing	Chiradzulu Dambo	Chiradzulu Upland	Matapwata Upland
Usable grain	No	1398	2947	1106
Weight	Yes	1468	3376	1105
Average weight	No	0.107	0.120	0.076
Per cob	Yes	0.103	0.202	0.083

3.4 Effect of Gaucho-T on maize usable grain weight

The 1998/99 whitegrub trial had data arising from three different types of fields and locations, i.e. Chiradzulu dambo, Chiradzulu upland and Matapwata dambo. The analysis involved fitting analysis of variance models to the yield responses, allowing for variation across types of fields and locations, residual farm to farm variation, the treatment factors and their interaction with type of field and location. Overall effect of seed dressing, averaged over land types and EPAs, was found to be significant (p=0.030). However, further analysis showed that a significant beneficial effect was evident only in Chiradzulu upland fields (Table 19).

Table 19 Mean usable grain weight (kg/ha) across seed dressing

Treatment Factor	Chiradzulu Dambo	Chiradzulu Upland	Matapwata Upland
No seed dressing	1396	2926	1104
Seed dressing with Gaucho	1466	3454	1103
Diff. In means	70	528	-1
Std. Error of diff.	232	168	190
Sig. Prob. For diff.	P=0.763	p=0.003	p=0.991

3.5 Conclusions on whitegrub management using Gaucho-T (1998/99 trial)

The main finding was that use of Gaucho-T increased maize yields though the beneficial effect was only realised in upland fields in Chiradzulu (Mombezi EPA). Gaucho-T was not shown to have a significant effect on whitegrub numbers which were generally low in both treated and untreated plots.

4. FARMER EXPERIMENTATION WITH, AND EVALUATION OF GAUCHO SEED DRESSING (1998/99)

In the 1998/99 season, the nine farmers participating in the research trial were given the opportunity to use seed treatment on their own maize seed and under their own management. Each farmer was supplied with a measured amount of Gaucho-T in a small knotted plastic bag along with a volume measure (a cut down squash bottle) for their maize seed, a pair of disposable rubber gloves and a large plastic bag for mixing. Farmers were instructed by the research team how to mix the correct amount of Gaucho and the correct volume of maize seed in the large plastic bag together with about 10 mls of water (Kibata and Ong'aro, 1999). Every farmer was given a demonstration of the technique on the research plots before being encouraged to repeat this themselves without supervision on their own field. All the farmers carried out the operation successfully and all reported that it had been easy to do and without problems. (Kapulula and Lawson-McDowall, 1999).

Despite the overall low incidence of whitegrubs in the 1998/99 trial, farmers still observed that maize in treated observation plots had better survival, grew with much vigour and healthy, and that they expected better yields than maize from untreated plots. Soon after germination farmers were asked to score treated and untreated observation plots for maize crop establishment (emergence and vigour) on a score of 1 to 5 where 5 was very good and 1 was very poor. Just before harvest they were asked to score plant survival, vigour, expected yield and severity of whitegrub attack in the same way.

The average scores for treated plots were higher for treated plots than for untreated except for whitegrub attack which was lower (Kapuplula and Lawson-McDowall, 1999).

5. ECONOMIC ANALYSIS OF IMADOCLOPRID SEED DRESSING

An economic analysis was carried out by Mwale (1999). Annex 2, table 1 compares the economic returns of seed dressing maize seed with Gaucho at FSIPM research sites in Matapwata and Chiradzulu uplands in 1997/98. Maize yields with seed dressing in Chiradzulu were 2976 kg/ha and without seed dressing, 2472 kg/ha. Adjusted downwards by 20% to allow for farmer management, these were equivalent to 2381 kg/ha and 1978 kg/ha respectively.

Gross benefits were higher for plots where maize was seed dressed with Gaucho (MK 15, 477/ha) than where it was not seed dressed (MK 12, 857/ha). When the cost of Gaucho was included in the variable costs, returns over variable costs (net benefits) were MK 9,504/ha with seed dressing compared to MK 7,507/ha without seed dressing. The benefit cost ratio (full cost basis) for seed dressing (2.59) was similar to the ratio without seed dressing (2.40). However, gross returns to labour were higher for seed dressing (MK 67/day) than without seed dressing (MK 52/day). The marginal rate of return, which is the marginal net benefit divided by the marginal cost (320%) indicates that farmers can expect to gain, on average, in return for their investment when they decide to seed dress their maize seed with Gaucho.

In Matapwata, maize yields in the 1997/98 season were slightly lower than in Chiradzulu. With seed dressing, average maize yield was 2465 kg/ha and without seed dressing, maize yield was 1960 kg/ha. Adjusted downwards by 20% to allow for farmer management, these were equivalent to 1972 kg/ha and 1568 kg/ha respectively. As in Chiradzulu, gross benefits were also higher for plots with seed dressing (MK 12,818/ha) than without seed dressing (MK 10, 192/ha). When the cost of Gaucho was included in the variable costs, net benefits were MK 6,845/ha and MK 4,842/ha, respectively. The benefit cost ratio (full cost basis) for seed dressing was higher with seed dressing (2.15) than without seed dressing (1.91). Overall gross returns to labour were also high for seed dressing. The marginal rate of return for Matapwata was 321%, also indicating that farmers can expect to gain in return for their investment when they decide to seed dress their maize seed with Gaucho.

Annex 2, table 2 presents the same analysis for Chiradzulu upland only in 1998/99 season. Matapwata upland fields showed insignificant benefits from Gaucho for the 1998/99 season. Again, the results in Chiradzulu favoured seed dressing against no seed dressing.

Gross benefits with seed dressing were MK 23, 486/ha compared to MK 19899/ha without seed dressing. Net benefits with seed dressing were MK 15,412/ha and without seed dressing were MK 13,015/ha. The benefit cost ratios at full cost were similar but returns to labour were higher for seed dressing (MK 108/day compared to MK 92/day. With a marginal rate of return of 201%, farmers should expect to gain if they seed dress their maize seed with Gaucho.

6. RECOMMENDATION

Despite the notoriously high variability of smallholder maize yields, FSIPMP trials over two seasons have shown conclusively that imidacloprid can reduce whitegrub numbers and increase maize yields in Malawi. In addition to its activity against whitegrubs, it is likely that a proportion of the yield increase experienced with gaucho seed dressing is derived from its suppressive effect on other soil pests, especially wireworms and other insect larvae and termites. Munthali et al. (1992) showed that termites and wireworms are major pests of maize in Southern Malawi and it is likely that they contributed to yield losses in the FSIPMP trials. FSIPMP trial data have demonstrated that termite damage is significantly reduced by seed dressing maize with imidacloprid.

There can be no doubt that WS formulations of imidacloprid for seed dressing can enable farmers whose maize is threatened by soil pests to significantly improve their yields. Until government approval for release is given these potential gains to individual and national food security and wealth generation will remain unrealised.

Economic analysis has shown that farmers can expect to benefit by seed dressing their maize seed with both Gaucho 70 WS and Gaucho-T for the management of whitegrubs in both Chiradzulu North and Matapwata EPAs. In other areas where incidence of any of these pests is higher than in the trials reported here, much higher yield returns can be expected from the treatment.

The recommendation of this report is that Imidacloprid WS formulations, both alone and in combination with Thiram, should now be cleared by the Technology Clearing Committee of the Ministry of Agriculture and Irrigation for seed dressing maize in Malawi.

7. REFERENCES

Abeyasekera, S., 1998. FSIPM 1996-97 On-station and on-farm experimental trials. Statistical analysis reports. (9 reports and appendices). Mimeo.

Bayer, 1992. Gaucho® (NTN 33893). Insecticidal seed dressing with systemic activity particularly against sucking, but also against other important peasts. Technical Information. Bayer, Leverkusen, Germany. 27 pp.

Bayer, 1998. *Crop Protection Guide Malawi.* Bayer (Pty) Ltd, Isando, South Africa. 103 pp.

Bayer, 1999. Technological success story: Making a good thing better, a paradigm for crop protection. *Courier Agrochem*, **1**, 1999: 8-11.

Bayer, (undated). Gaucho. Reliable protection right from the start. Product leaflet. 12 pp.

Bosch, U and Schaufele, W.R. 1994. Pest control in sugar beet through seed treatment with imidacloprid. Gesunde-Pflanzen. 46(2): 44-55.

Deall, M.W; T.L. Prinsloo; E. Stanz and C. Chittenden. 1993. Results on the control of maize insects with Gaucho 70 WS (imidacloprid) in the Republic of South Africa and Zimbabwe. Pflanzenschutz-Nachrichten-Bayer-English-ed. 46(1): 33-48.

Drinkwater, T.W. and Groenewald, L.H., 1994. Comparison of imidacloprid and furathiocarb seed dressing insecticides for the control of the black maize beetle, *Heteronychus arator* Fabricius (Coleoptera: Scarabeidae) in maize. *Crop Protection.* **13**, 6: 421-424.

FSIPM Project, 1996. Diagnostic Surveys in Matapwata and Chiradzulu EPAs. Mimeo.

Heatherington, P.J and R.H. Meredith. 1992. United Kingdom field trials with Gaucho for pest and virus control in sugar beet, 1989-1991. Pflanzenschutz-Nachrichten-Bayer-English-ed. 45(3): 491-526.

Kapulula, P and J. Lawson-McDowall, 1999. 1998-99 On-farm trials. Monitoring Reports. 73pp. Mimeo.

Khonga, E.B. 1997. Integrated pest management of soil pests in Malawi. EMC X0147 (Phase 2). Final Technical Report, University of Malawi, Chancellor College: Soil Pests Project. Mimeo. 50 pp.

Kibata, G.N. and Ong'aro, J.M. 1999. Evaluation of seed dressing and soil applied insecticides for control of leafhoppers, vectors of maize streak disease. KARI/DFID NARP II Project End of Project Conference- Volume 1 Mini-papers. 249-251.

Logan, J.W.M., Nyirenda, G.K.C., and Munthali, D.C. , 1995. The importance of termites as pests of maize in smallholder farms in Southern Malawi. Soil Pest Project, Chancellor College. Mimeo.

Ngwira, P.., Malangano, N., Chikonda, N., Nowa, G. and Nyasulu, O. 1999. Control of maize streak virus. Paper presented at the 1998/99 Plant Protection Meetings, 4-7 August, 1999. 5 pp. Mimeo.

Matthews, G.A, Whellan, J.A., Siddiqi, M.A. and Mkamanga, G.V. 1974. Malawi Crop Protection Handbook. Ministry of Agriculture and Natural Resources, Lilongwe, Malawi. 86 pp.

Mittnacht, A. 1994. New insecticides for coating seed of sugar beet. Gesunde-Pflanzen. 46(2): 39-44.

Munthali, D.C., Kaunda, C.E. and Nyirenda, C.B., 1992. The major insect pests, plant diseases and weeds affecting subsistence farmers' crops in the southern region of Malawi. Report No. 2. Unpublished, University of Malawi, Chancellor College, Zomba. Malawi. 169 pp.

Mwale,B. 1999. Economic analysis of OFTs 1997/98-1998/99. Mimeo

Mzilahowa., T.D. , 2000. Whitegrubs (Coleoptera: Scarabeidae) associated with maize-based smallholder cropping systems in the Blantyre Shire Highlands RDP. MSc Thesis, Bunda College of Agriculture. Mimeo.

Ritchie, J.M., 1996. Workshop Summary Report, Stakeholder Workshop 4-6 June. August 1996. Mimeo.

Ritchie, J.M., 1997. Proposals for on-farm pest management field trials. 1997-98 Season. Mimeo

Ritchie, J.M., A. Daudi, W. Fero, B Mkandawire, T. Maulana, T. Milanzi, and E. Shaba, 1997. Interim progress report on pest management trials in intercropped maize, pigeonpea and beans, 1996/97. Paper presented at annual Project Meeting for Crop Protection, Mangochi, 24-29 August 1997. Mimeo. 21 pp.

Ritchie, J.M., Abeyasekera, S., Mzilahowa, T.D., Mwale, B., and Nyirenda, G.K.C., 2000. Costs and benefits of seed dressing as a pest management strategy for whitegrubs in Blantyre/Shire Highlands. Integrated Crop Management Research in Malawi: Developing Technologies with Farmers. Proceedings of Workshop, Club Makokola, Malawi, 29 November – 3 December 1999.

Wightman, J.A. and Wightman, A.S., 1994. An insect, agronomic and sociological survey of groundnut fields in southern Africa. Agric. Ecosys. & Env. 51: 311-331.

WHO, 1990. IPCS International Programme on Chemical Safety. The WHO recommended classification of pesticide by hazard and guidelines to classification 1990-91 (WHO/PCS/90.1). World Health Organization, Geneva, Switzerland. 39 pp.

8. ANNEXES

ANNEX 1. PRODUCT INFORMATION FOR IMIDACLOPRID.
(Sources: Bayer, 1992, 1998, 1999)

1. Active ingredient and spectrum of pesticidal activity

Imidacloprid is the common name for the product whose technical name is chloro-nicotinyl nitroguanidine. The full chemical designation is:

1-[(6-chloro-3-pyridinyl)methyl]-=4,5-dihydro-N-nitro-1H-imidazol-2-=amine.

The empirical formula is $C_9H_{10}ClN_5O_2$. Imidacloprid is a colourless crystalline solid with a slight characteristic odour. It is highly soluble in dichloromethane but only slightly soluble in water and other organic solvents.

Imidacloprid belongs to a new family of active ingredients, the nitroguanidines, also known as nitromethylene insecticides. These compounds are characterized by relatively low mammalian toxicity (Table 1) while showing high levels of toxicity to a range of insects and considerable systemic activity via plant tissues (Bayer, 1992).

The mode of action involves excitation of insect nerve cells by mimicking the action of the insect neurotransmitter acetylcholine. This substance is normally rapidly broken down by acetylcholinesterase, but imidacloprid is only inactivated very slowly, if at all, leading to the rapid death of treated insects through persistent overstimulation of nerve receptor sites. The product has an acute contact and stomach poison effect against a wide range of insect species, including sucking bugs (Hemiptera) numerous beetles (Coleoptera)and some flies (Diptera). Because of its novel mode of action, the manufacturers indicate that it is effective against pest strains resistant to other types of pesticidal compounds. However no effect is claimed against either spider mites (Acari) or against nematodes.

2. Formulations

Imidacloprid is marketed in Africa as Gaucho® 70 WS, containing 700g/kg of active ingredient (a.i). The product is marketed as a powder mixed with a blue dye in plastic bags of 120g as a systemic insecticidal seed dressing for the control of a wide range of pests on maize, wheat, sorghum and cotton, including black maize beetle (*Heteronychus* sp.). For maize, dosages of 1g/kg of seed (for *Astylus* larvae), 2.5g/kg of seed (for black maize beetle and other beetle pests) and 5g/kg of seed (for *Cicadulina* leaf hoppers vectoring maize streak virus) are recommended (Bayer, 1998).

Gaucho® is the registered trademark of Bayer AG, Germany. It is sold in southern Africa by Bayer (Pty) Ltd, P.O. Box 143, Isando 1600, South Africa. Agents in Malawi are Farmers Organization Ltd, P.O. Box 1916, Blantyre. Gaucho® 45 WS contains 350g/kg of a.i. A mixture of Gaucho® 35 WS and the fungicide Thiram (10%) has been formulated as a less expensive seed dressing combining fungicidal and insecticidal efficacy. It is marketed as Gaucho-T®.

Confidor® 350 SC is a suspension concentrate liquid, containing 350g/l a.i., for use as a foliar spray or drench mixed with water for the control of foliage pests on various crops and trees. Confidor® 200 Sl is a soluble liquid formulation with 200g/l a.i. (see Bayer, 1998 for details).

3. Behaviour in the soil and effects on soil organisms

Imidacloprid is readily taken up from seed dressing or soil application by plant roots and translocated within the plant. In maize and a range of other crops the compound is metabolized via similar pathways which involve loss of the nitro group, hydroxylation at the imidazoline ring, hydrolysis to 6-chloronicotinic acid and formation of conjugates (Bayer, 1992). Because all breakdown products contain 6-chloropyridinylmethylene, residue analysis is based on detection of this chemical for which a method has been developed.

Experiments with C14-labelled imidacloprid showed that the compound is relatively immobile in soil and unlikely to be readily leached. Degradation in soil is strongly accelerated by vegetation. Metabolites occur in small quantities compared to the parent compound and it is the latter which is specified as being the residue to be analysed in residue studies (Bayer, 1992). Experiments with doses of 200g and 2000g applied to loamy sand and to silt revealed no discernible effect on nitrogen mineralization, ammonia nitrification or soil respiration. The manufacturers do not expect any negative effects on soil microflora under normal conditions of use as a seed dressing.

The LC_{50} in soil for earthworms has been measured at 10.7 mg/kg of dry soil. At four times the normal sowing rate, treated sugar beet pellets in a 14-day test showed no effect on earthworm mortality. A trial with two applications of 500g of active ingredient/ha showed only short-term lowering of earthworm populations which recovered by the autumn of the same year (Bayer, 1992).

4. Behaviour in water and effects on aquatic organisms

In water in natural sunlight photolysis of imidacloprid proceeds rapidly (Half-life 4h) . Microbial activity under eutrophic conditions leads to rapid translocation of imidacloprid from water into sediments (half-life <14 days in absence of light). Under oligotrophic conditions this rate is slowed. The effective concentration (EC_{50}) for the increase of biomass and for increase in growth rate of the green alga *Scenedesmus subspicatus* (96 h at 23°C) was determined to be >10 mg/l. In normal agricultural use a detrimental effect on water organisms is therefore unlikely (Bayer, 1992).

Acute toxicities for fish (LC_{50} – 96 h) range from 211-280 mg/l. No observed effects were found in a 21-day test with rainbow trout at 28.5 mg/l. The EC_{50} for water fleas (*Daphnia magna)* was 85 mg/l over 48 h at 20°C.

5. Effects on mammals and birds

In mammals and birds orally-administered imidacloprid is rapidly absorbed, distributed widely in the body and rapidly eliminated via urine and faeces. In rats about 15% is eliminated as unchanged parent compound. Highest concentrations occur in the liver and kidneys. Once again breakdown products all contain the 6-chloronicotinic acid moiety of imidacloprid and a technique for analysis has been developed (Bayer, 1992; G. LeRoux, personal communication). Acute oral toxicity for rats is about 450mg/kg of body weight (Table 1).

Acute toxicities for birds vary from 25-152 mg/kg of body weight. Subacute toxicity has been measured as the LC50 in a five day feeding test in mg/kg of diet. Figures range between 1420 and >5000 mg/kg. The manufacturers infer that residues in plant material or insects would not be expected to cause damage to birds which consume them. In the case of seed dressing such effects are likely to be even less marked than with foliar application. In addition seed dressed with imidacloprid is repellant to a wide range of birds (Bayer, 1992). However, manufacturer's warnings (Bayer, 1998) include the caution that treated seed may be poisonous to seed-eating birds and should be planted correctly and totally covered with soil. It must not be left where it might be eaten by birds.

Table 1. Comparative oral mammalian toxicity data for some common pesticides. (Source: WHO, 1990; Bayer, 1992).

Common name	Chemical type	LD50 (mg/kg) oral for rat	Hazard Classification (WHO)
Aldicarb	Carbamate	0.93	Extremely hazardous
Carbofuran	Carbamate	8	Highly hazardous
Endosulfan	Organochlorine	80	Moderately hazardous
Chlorpyrifos	Organophosphate	135	Moderately hazardous
Deltamethrin	Pyrethroid	c135	Moderately hazardous
Furathiocarb	Carbamate	137	Highly hazardous
Carbosulfan	Carbamate	250	Moderately hazardous
Cypermethrin	Pyrethroid	c250	Moderately hazardous
Carbaryl	Carbamate	c300	Moderately hazardous
Imidacloprid	Nitroguanidine	450	Moderately hazardous
Fenitrothion	Organophosphate	503	Moderately hazardous
Malathion	Organophosphate	2100	Slightly hazardous

6. Pre-harvest intervals and residue limits

In South Africa the pre-harvest interval for maize is 65 days. Maximum residue limits (MRL)/Kg of produce vary between 0 mg/kg in Belgium for all commodities and 0.2 mg (rice) to 1.0 mg (fruits) /kg in Japan (Bayer, 1992). In Spain the MRL varies from 0.05mg/kg in maize (the minimum detectable level) and 1.0 mg/kg.

7. Manufacturers recommendations for use

Gaucho® is recommended for use as a seed dressing on cereals (including maize, sorghum and rice), cotton, fodder legumes, groundnuts, potatoes, rape, beets. Its is recommended for a broad range of insect pests including soil-living life stages of beetles and flies, termites, millipedes and sucking aerial pests such as aphids, thrips and leafhoppers (Bayer, 1992; 1998). The recommended dosage of active ingredient for these pests is 3.5g of active ingredient per 1kg of seed (Bayer, undated). Rates as low as 1.75g a.i./kg of seed are also quoted (Bayer, 1998). Imidacloprid has been marketed since 1991 and is now used in over 60 crops in more than 80 countries (Bayer, 1999).

ANNEX 2. ECONOMIC EVALUATION TABLES FOR IMIDACLOPRID FOR MAIZE SEED TREATMENT. (Source: Mwale, 1999).

Table 1. Economic evaluation of Gaucho 70WS for treatment against whitegrub, 1997/98 (sample size 61)

Variable	**Chiradzulu upland**		**Matapwata Upland**	
	Without seed dressing	With seed dressing	Without seed dressing	With seed dressing
Benefits				
Yield (kg/ha)	2472	2976	1960	2465
Adjusted yield (kg/ha)	1978	2381	1568	1972
Unit price	6.50	6.50	6.50	6.50
Gross benefits	12,857	15,477	10,192	12,818
Variable costs				
1 Materials (MK/ha)				
Seed	1000	1000	1000	1000
Fertiliser	890	890	890	890
Credit	202	202	202	202
Other material inputs (Gaucho)	0	623	0	623
Labour requirements (Hours/ha)	850	850	850	850
Labour for intervention (hours/ha)	0	0	0	0
Total labour requirements (hours/ha)	850	850	850	850
Unit price (MK/day)	23	23	23	23
Imputed labour cost (MK/ha)	3258	3258	3258	3258
Total costs	5350	5973	5350	5973
Net benefits				
Return over variable costs (MK/ha)	7507	9504	4842	6845
Benefit-cost ratio (full-cost basis)	2.40	2.59	1.91	2.15
Benefit cost-ratio (cash cost basis)	6.15	5.70	4.87	3.57
Gross returns to labour (MK/day)	52.99	67.09	34.18	48.32

Marginal rate of return for applying Gaucho:

(a) Chiradzulu upland

= Marginal benefit/marginal cost
= (9504-7507)/(5973-5350)
=1997/623
=3.2054=320.54

(b) Matapwata upland

= marginal benefit/marginal cost
= (6845-4842)/5973-5350
=2003/623
=3.2150=321.5%

ANNEX 2 contd

Table 2: Economic evaluation of Gaucho-T for treatment against whitegrub, 1998/99 (sample size 9, Chiradzulu upland fields only).

Variable	Chiradzulu upland	
	Without seed dressing	With seed dressing
Benefits		
Yield (kg/ha)	2926	3454
Adjusted yield (kg/ha)	2341	2763
Unit price	8.50	8.50
Gross benefits	19,899	23,486
Variable costs		
1 Materials (MK/ha)		
Seed	1000	1000
Fertiliser	2140	2140
Credit	486	486
Other material inputs (GauchoT)		1190
Labour requirements (Hours/ha)	850	850
Labour for intervention (hours/ha)	0	0
Total labour requirements (hours/ha)	850	850
Unit price (MK/day)	23	23
Imputed labour cost (MK/ha)	3258	3258
Total costs	6884	8074
Net benefits		
Return over variable costs (MK/ha)	13015	15412
Benefit-cost ratio (full-cost basis)	2.892	2.91
Benefit cost-ratio (cash cost basis)	5.49	4.88
Gross returns to labour (MK/day)	91.87	108.79

Marginal rate of return for applying Gaucho:

=Marginal benefit/marginal cost
=(15,412- 13,015)/(8074-6884)
=2397/1190
=2.0142=201.42%