

Appendix 1

Application parameters and meteorological conditions during application of fipronil barrier spray treatment as described in chapter 4

Date of application = 03/04/2000

Application Parameters

Sprayer calibration: Flow rate = 0.73 l/min

Spray Swath = 0.6

Application rate = 100 l/ha

Sprayer pressure = 2.5 bars

Spray speed = 8 km/hour

Nozzle type = Yellow (Flood type)

Meteorological conditions at the beginning and end of spraying

Temperature start = 15 °C

Temperature end = 21.2 °C

Rainfall at time of application = 0 mm

Cloud cover = clear skies

Wind speed = 3 m/sec

Temperature

20 °C

21 °C

Rainfall

13 mm

0 mm

Soil temperature

25 °C

25.4 °C

Appendix 2

Application parameters and meteorological conditions during application of fipronil barrier spray treatment and carbaryl bran bait as described in chapter 5

Application Parameters

Sprayer calibration: Flow rate = 0.73 l/min

Spray Swath = 0.6

Application rate = 100 l/ha

Sprayer pressure = 2.5 bars

Spray speed = 8 km/hour

Nozzle type = Yellow (Flood type)

Meteorological conditions

Temperature start = 17 °C

Temperature end = 22 °C

Rainfall at time of application = 0 mm

Cloud cover = clear skies

Wind speed = 2.5 m/sec

Meteorological conditions 48 hours before and after treatment of plots

	48 hours before	48 hours after
Temperature:	20 °C	21 °C
Rainfall	1.3 mm	0 mm
Soil temperature	25 °C	25.4 °C

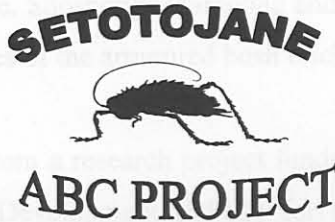
The authors can be contacted:

Dr D. S. Green, HRI University of Greenwich, Chatham Maritime ME4 4TB, UK

Dr C/o Mr P. Msimpti, Sebale Research Station, Private Bag 0013, Gaborone.

Appendix 3

A report on the survey conducted by scientists collaborating in the ABC project and assisted by local extension officers. The report provided information farmers' perception of the ABC as a pest and indigenous control methods that farmers use against the pest.



UK DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID) CROP PROTECTION PROGRAMME
PROJECT R7428:

“BIOLOGY AND CONTROL OF ARMoured BUSH CRICKETS IN SOUTHER AFRICA”

Survey of Farmer' Indigenous Knowledge and Control Practices Against Armoured Bush Cricket (Setotojane) in Central and Francistown Agricultural Regions of Botswana

April 2000

H. Matsuert, POP Mosupi, PJZ Mviha, SV Green and E Minja¹

Distribution:

UK and International	Botswana
Natural Resources Institute	Director, Dept of Agricultural Research (2 copies)
DFID Crop Protection Programme	Director, Dept of Crop Production and Forestry
ICRISAT	Chief Agricultural research Officer – Crops
British High Commission, Gaborone	Head of Extension Division
DFID Regional Dev. Div, Pretoria	Rural Sociologist – Ministry of Agriculture
Francistown	Regional agricultural Officers – Central and
	Plant Protection Division – Sebele
	Farming Systems Teams: Mahalapye and Francistown
	Technical Assistants (TAs) in Survey Village

The authors can be contacted
C/o Dr S. green, NRI University of Greenwich, Chatham Maritime ME4 4TB, UK
Or C/o Mr P. Mosupi, Sebele Research Station, Private Bag 0033, Gaborone.

ACKNOWLEDGEMENTS

The ABC project would like to thank the Ministry of Agriculture staff that worked with us at Gaborone, Mahalapye and Francistown (see Appendix 1a). We greatly appreciate the time and energy, which they contributed to this survey. Many thanks also to the villagers of Makwate, Shoshong, Marapong and Shashe Mooke who spent time discussing their experiences of the armoured bush cricket, Setotojane.

This publication is an output from a research project funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries (Project R7428, Crop Protection Programme). The views expressed are not necessarily those of DFID.

ACRONYMS

ABC	Armoured Bush Cricket
ALDEP	Arable Lands Development Project
ARAP	Accelerated Rain fed Programme
ATIP	Agricultural Technology Improvement Project
DFID	UK Department for international Development
GIS	Geographical Information Systems
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
NRI	Natural Resources Institute, University of Greenwich, UK
PRA	Participatory Rural Appraisal

INTRODUCTION

CONTENTS

Armoured bush cricket of the genus *Amastophya* (Savignac, 1896)

Introduction.....122

Methodology.....123

Group meetings.....124

Household interviews.....124

Limitations in methodology.....125

Key findings.....126

1. Farming systems in Central and Francistown regions.....126

2. Farmers’ experience of armoured bush cricket.....127

3. Farming practices and environmental factors which effect armoured bush cricket populations.....128

4. Farmers’ knowledge and awareness of armoured bush cricket129

5. Control measures.....130

6. Information flows and support systems.....134

Conclusions and action points.....135

References.....138

Appendix 1 - Survey team.....139

Appendix 2 - Guidelines for interviews and group discussion.....141

Appendix 3 - Ranking of main crop pests.....144

Appendix 4 - Article on Ngwali.....146

Appendix 5 - Questionnaire for agricultural field staff.....147

INTRODUCTION

Armoured bush crickets of the genus *Acanthopplus* (Setswana: Setotojane), henceforth referred to as ABC, are destructive but sporadic pests of smallholder cereal crops in semi-arid areas of Southern Africa. This research project has been developed in collaboration with the Departments of Agricultural Research & Crop Production and Forestry of the Botswana Ministry of Agriculture. The project's main aims are twofold: firstly to develop effective, environmentally acceptable ABC control measures which are practical for resource poor farmers, and secondly to better understand the population dynamics and behaviour of ABC in order to develop an outbreak forecasting system.

Collaboration with farmers in problem identification and development of appropriate control measures is an important part of this project. This farmer survey has been carried out at an early stage of the research programme and has a number of aims:

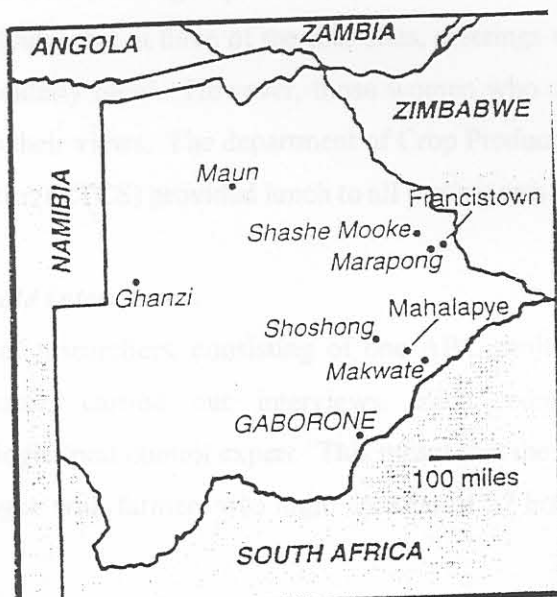
1. To assess farmers' knowledge and awareness of ABC biology and life cycle.
2. To learn from farmers' knowledge of environmental factors that affect ABC populations, and any forecasting methods they currently use.
3. To collect information on farm management and control measures currently taken against ABC by different types of farmer (in terms of resource base and farming practices), so that appropriate and acceptable control measures can be developed.
4. To identify information flows and support systems for ABC forecast and control, so that these may be used to disseminate and implement project findings.
5. To collect baseline data to allow the impact of the project to be assessed.
6. To identify farmer research partners for on farm research work in the 2000/2001 season.
7. To publicize the project amongst farmers and Ministry staff.

The survey was carried out in two agricultural regions of Botswana. Since ABC is a pest throughout Southern Africa and this project is relevant to other countries in the SADC region, it would be desirable to conduct a second farmer survey in a country other than Botswana at a later date.

Methodology

The project's social anthropologist, in consultation with other team members and with the Ministry of Agriculture's Department of Rural Development and Farming Systems teams, developed the survey methodology. In order to meet the aims of the survey and to derive most benefit from the interaction between project entomologists and farmers, qualitative research methods were used. These consisted of group discussions using of PRA methods, and individual interviews (see Appendix 1b for guidelines for individual interviews and group discussions).

The survey was carried out in Central and Francistown regions in eastern Botswana (see Figure 1). These regions were selected because they are areas with a high density of smallholder farmers. The Mahalapye area of Central Region is primarily a sorghum producing area, whilst millet becomes more important in Francistown area. The project team spent one week in each area, joining local Agricultural Extension and Farming System personnel for survey activities (see appendix 1) for list of collaborators). In both areas, two villages were selected for the survey: *Makwate* and *Shoshong* in Central Region, *Shashe Mooke* and *Marapong* in Francistown Region.



Appendix fig.1. Botswana, featuring the four villages where survey work was undertaken

The weekly programme consisted of:

Day 1: Travel to survey area

Day 2: Briefing of local collaborators, discussion and adaptations to methodology.

Site visits to meet local technical staff, village headmen and to begin key informant interviews.

Day 3: Village 1: morning spent in groups' discussions. Afternoon spent carrying out individual interviews. Team debriefing at end of the day.

Day 4: Village 2: morning spent in group discussions. Afternoon spent carrying out individual interviews.

Day 5: Team debriefing. Summary of findings, conclusions, action points and follow up needed. Return to Gaborone.

Group Meetings

Group meetings were publicized by the local Agricultural Demonstrators and were attended by any interested farmers. Attendance ranged from 14 farmers (at Marapong where there had been no recent ABC infestation) to 54 farmers in Makwate. Farmers were divided into two groups for PRA exercises and discussions, and met after these for a plenary (see Appendix 2). A group size of 20 farmers (small groups of 10) was found to be ideal for productive discussions. We found that at three of the four sites, meetings were dominated by middle aged and elderly men². However, those women who did attend participated well and gave their views. The department of Crop Production and Forestry Rural Training Centres (RTCS) provided lunch to all participants at the end of the meeting.

Household Interviews

Pairs of researchers, consisting of one ABC project team member and one local collaborator, carried out interviews. Each team consisted of at least one entomologist/pest control expert. This meant that the quality and subject matter detail of dialogue with farmers was high. A total of 57 household interviews were carried out.

In order to ensure that the team talked to different types of farmer (with different resource levels and farming methods), a simple wealth ranking was used to ensure that different farm types were selected for interview. This wealth ranking was based

on previous farm characterization carried out by Farming Systems teams in some of the study areas, and on the advice of our local collaborators.

In Mahalapye area, differentiation of farm types was based on access and use of draught power. Farmers were grouped into tractor owners, donkey owners and draught power hirers or borrowers. Those with least resources fall in the category of hirers. Those with own donkeys or tractors tend to cultivate larger areas of land. Tractor owners tend to be the largest scale producers and commonly hire labour to work on their farm³.

In Francistown region, the farming systems team had found that size of cattle herd was a key indicator of a household's resource base and farm type. For sampling purposes, differentiation was based on a household's eligibility for the ALDEP (Arable Lands Development Project) Scheme. In order to be eligible for ALDEP farmers must have a cattle herd size of less than 40⁴.

In both locations the local agricultural demonstrator provided a list of farmers who had acquired seeds from the office or applied for ALDEP packages. From these lists households were disaggregated according to our key indicators, and lists of households representing different farm types were created. In addition to these, a list was made of key informants – local agricultural technicians, village leaders, traditional healers, old and particularly knowledgeable farmers etc. Each interviewing team was given a list of 12 farmers from which to carry out interviews. In general each team managed to interview between 3 and 5 farmers in an afternoon. As interviews were carried out at field or homestead we encountered more female farmers than at the group meetings, and 47% of the farmers interviewed were women.

The average size of land cultivated by those interviewed was 1 ha, with the average in Central region (6.3 ha) being higher than that in Francistown. Those with their own draught power tend to cultivate larger areas compared to those who hire oxen.

²At Shoshong, Shashe Mooke and Marapong there were twice as many men as women. However 40 women and only 14 men attended the meeting at Makwate.

³Farmers interviewed: key informants 4, draught power owners 7, tractor hirers 17.

⁴Farmers interviewed: key informants 14, ALDEP farmers 12, non-ALDEP farmers 3.

Limitations of Methodology

The main limitation in the methodology used lay in site selection. Until we carried out this survey the sporadic and localized nature of ABC infestation was not fully

appreciated. Our site selection process was based primarily on cropping practices and on the existence of secondary data (past farming systems surveys carried out in these villages), the assumption being that as this was a year of high ABC populations most areas would have experienced some ABC infestation. In the event we found only one of the four village sites (Shoshong) had suffered recent severe ABC infestation. At the two Francistown area villages the farmers had never experienced serious problems with ABC. Because of the localized nature of ABC outbreaks, any future surveys would be best advised to identify areas of recent infestation prior to site selection.

The level of farmers' knowledge, control measures employed and interest in developing further control measures was, understandably, much higher at sites where ABC really is a pressing problem (i.e. Central Region). Our work at Francistown did however yield some useful information on relevant farming and pest management practices and general attitudes towards pest control measures.

Key Findings

1. *Farming Systems in Central and Francistown Regions*

Farming systems in the two regions are mixed: livestock and arable, with some horticultural production in the Francistown area. Arable production is small scale and primarily for subsistence purposes. A wide variety of crops are grown, the most important being: sorghum, cowpea, maize, bambara nut (jugo bean), sweet reeds, watermelon and pumpkins. In Central region very few farmers grow millet, while in Francistown region millet was grown by most farmers that were interviewed.

The average area of land cultivated for those interviewed was 5 ha, with the average in Central region (6.3 ha) being higher than that in Francistown. Those with their own draught power tend to cultivate larger areas compared to those who hire tractors. We were told that this was because of high charges for tractor hire (a service which was provided free by the government during the 1980s).

A striking feature of farming systems in the survey areas was the scarcity of young or even middle aged men in arable farming. The majority of male farmers interviewed (72 %) were over 50 years old. We interviewed no young men, nor did any attend discussion groups. Most farms are run by female-headed households (with husbands employed or occupied elsewhere) or by older people. Only a small number

of households interviewed (less than 10 %) indicated that they hired labour to assist them in farming.

In most cases weeding and bird scaring is carried out by family members, mainly women, older people and children, and labour is a serious constraint. Key labour demands are between February and June (ATIP reports), at the same time that ABC infestation occurs. Key cash constraints come in January/February due to demands for payment of school fees and for ploughing services.

The farming sector in Botswana receives a relatively high level of support and subsidy from the government. Many farmers have received large subsidies to purchase farm equipment and to fence their fields. In the past the government provided free ploughing services to small-scale farmers. The government also takes responsibility for control of major pests, characterized as 'national pests', including *Quelea*, Migratory Locusts and African Armyworm. Consequently, there is a high level of reliance on the government to implement pest control measures. None of the farmers interviewed had ever purchased pesticides or used sprayers themselves.

In terms of vegetation, the Francistown area villages lie in open tree savannah in which mopane and acacia are dominant. Mopane does not occur as far south as Mahalapye, and this area *acacia/combretum* shrub and tree savannah is predominant. Natural vegetation is undoubtedly of significance for ABC populations since the immature stages feed on wild grasses, and adults frequently aggregate in thorn bushes at night.

2. *Farmers' Experience of ABC*

The most damaging crop pest experienced by farmers this year, both in Central and Francistown regions, has been *Quelea*. In Central region, ABC is also considered a serious problem. Group discussions in the Central region villages of Makwate and Shoshong ranked ABC as the second most important crop pest, after *Quelea* (see Appendix 1c). All the farmers interviewed here had experienced ABC pest problems in their fields. There was general agreement in both villages that the ABC problem has intensified following the severe, widespread outbreak of 1993. In 1999 a particularly serious infestation was experienced. 71 % of farmers interviewed had attempted some type of control measure (mainly hand picking, but also weeding and clearing of land around field margins).

Farmers observed that in years of high infestation, ABC could cause very substantial crop losses, equal even to *Quelea* damage. They pointed out that ABC is particularly difficult to control because it cannot be scared away, and even with concerted handpicking the field is constantly reinvaded by crickets from the surrounding bush.

In contrast, ABC was not considered to be a problem at the two Francistown villages. In ranking of crop pests ABC was ranked = 5 at Shashe Mooke and = 7 at Marapong. ABC is present in this region, particularly in areas of denser acacia vegetation (such as along riverbeds), but the numbers we found were low and they remained largely in the bush. In individual interviews here (29 in total), only one farmer had experienced ABC as a crop pest. A further 9 farmers occasionally found ABC in their fields but did not consider it a serious pest. 18 farmers had never seen the ABC on crop fields.

3. Farming practices & environmental factors affecting ABC populations

The survey found no real evidence that farmers have any local methods for forecasting ABC infestation. However farmers did suggest several environmental and farming factors, which they feel, influence ABC population levels.

3.1 Environmental factors

- ❖ Importance of vegetation: ABC seems to be more abundant in areas with plentiful acacia bushes. During visits into fields in the Francistown area, where mopane woodland predominates, the researchers observed that ABC occurred mostly on farms adjoining acacia woodland or scrub, but not on farms surrounded by mopane woodland. The difference in vegetation may partly explain why ABC is present in much greater numbers in Central region than in Francistown. Some farmers felt that ABC populations were higher where there were plentiful wild grasses.
- ❖ Rainfall: Most farmers agreed that ABC populations were affected by rainfall. However, the exact dynamics were unclear. Some considered ABC populations to be higher in years of good rainfall. However if rainfall was too high then some farmers claimed that the ABC populations fell.

- ❖ Crop Density/Intercropping: It was observed that ABC are attracted to fields with a high crop density or where intercropping is practiced. Again this was thought to be because there is more shelter for them to hide amongst.
- ❖ Bush Fencing: Farmers felt that ABC infestation is higher in fields, which are fenced with cut branches (as opposed to wire fencing). At night time the ABC often aggregate on the bush fencing, which made from thorny acacia branches.
- ❖ Land Use: Farmers in Central region felt that the ABC problem was exacerbated by the land use pattern, where fields are isolated and surrounded by bush. It was felt that the bush provides ideal shelter and breeding areas, from which ABC can move into crop fields to forage.
- ❖ Farmers thought the ABC problem might have increased when the government tractor-ploughing scheme (ARAP) came to an end. When people had free ploughing services, they cultivated larger fields and there was less uncleared bush in the surrounding.

⁵Good knowledge was defined by any knowledge of the basic life cycle (egg laying, dormancy) and behaviour patterns (congregation at night, cannibalism). Those judged to have poor knowledge were not aware where the ABC came from, or how it reproduces.

4. *Farmers' Knowledge and Awareness of ABC*

The survey found levels of knowledge and awareness of ABC to be rather variable, but better in areas where ABC is a serious problem. In Central region almost half the farmers interviewed (13 of 28) were judged to have a reasonably good knowledge of the ABC life cycle and behaviour, and a few individuals were exceptionally well informed. In the Francistown region, by contrast, only 2 of the 29 farmers interviewed were judged to have good knowledge⁵.

One common misconception about ABC was the belief that the crickets bury themselves under the ground and re-emerge after the winter. A few farmers believed that the adult ABC develops a stage further into a large flying insect. Several told us that ABC is poisonous to chickens, although others specifically collected ABC to feed to their poultry. Most farmers would not touch ABC. Because of the ABC's

Cannibalistic behaviour, farmers have observed that when one is killed, many more crickets soon appear on the site. This is interpreted by some as showing that God (or the gods) is (are) angry with people for killing the ABC and more are sent in retribution. As discussed below under control measures (section 5) some farmers were reluctant to adopt control measures, which involved killing the adult ABC.

Farmers in Central region had received some information about ABC from their local Agricultural Demonstrators and also via radio broadcasts. Farmers in Francistown however, had received no information.

A very informative poster depicting the ABC life cycle has been produced by the Plant Protection Division of the Department of Crop Production and Forestry, but this was not seen on display in the local agricultural offices, which we visited.

5.0 Control Measures

5.1 Existing Control Measures

In Central region, 71% of farmers interviewed had attempted some kind of intervention to control ABC infestation. Those control measures mentioned were:

Hand Picking: (attempted by 50% of farmers interviewed).

This direct method of intervention involves farmers handpicking the ABC from the crop plants or knocking them down with a stick. The ABC's would then either be left on the ground, squashed or collected and deposited in pits. Whilst this method clearly has a direct impact on the pest, many farmers would not handpick because they were unwilling to touch ABC. The crickets are large, spiny insects with unpleasant defensive behaviours. They bite, screech and exude a noxious yellow liquid, and this partly explains farmers' reluctance to adopt this practice. As a control method, handpicking also has the disadvantage of imposing a high labour demand, since ABC continually reinvade from outside the field. A further obstacle to the adoption of this method is the perception that when ABC are killed, then still more are attracted into the field. This is a misconception, which arises because cannibalism of ABC carcasses is common, but is principally perpetrated by crickets already in the field. Many of the farmers interviewed had tried handpicking, but abandoned it.

Weeding

During farm visits we observed that weed populations in crop fields were generally high. This is probably due to labour shortages (weeding is carried out by hand), but frequent rains in the current growing season have discouraged people from working in their fields and have also probably promoted weed growth. In group discussions the consensus of opinion in both Central region villages was that weeded fields had a lower likelihood of being infested by ABC. Four farmers interviewed in Central region stated that they used weeding specifically as a control measure against ABC.

Traditional Rituals

We were told that in the past serious pest infestations would be reported to the local god, Ngwali (also Mwale), who resides on a mountain near Francistown (see Appendix 4). A messenger would be sent to report the problem to Ngwali, and would then return with instructions. These would include a number of taboos, for example people must stay away from the fields on a particular day. Villagers would also be instructed to carry out certain rituals. One common procedure, carried out by old women and children, is for ABC to be collected, fried with cream and special herbs, and then buried in the field, sometimes inside a hollowed out melon. The person who buried the crickets must then turn and walk away without looking back. Many farmers told us that traditional methods had been effective in the past, but that today there is not enough village cooperation and people have become dependent instead on government. In some cases, such as with *Quelea* control, traditional rituals were carried out in combination with community level action, such as village forays to destroy local nesting sites. It seems plausible that the inclusion of traditional rituals alongside new methods for ABC control might help to motivate community involvement, e.g. digging of trenches, baiting and destroying egg-laying sites.

Frying and Scattering ABC in Areas of infestation

During group discussions, several farmers reported successful ABC control by collecting crickets, frying them with salt and then scattering them in the field. However, one traditional healer reported that he had tested out this method (quite rigorously by the sound of it), but abandoned it as a failure.

Trenches at Field Margins

This method, which involves digging a trench around the cropped area has been used in northern Namibia, and currently is recommended by the Plant Protection Division. One woman interviewed in Central Region (an ALDEP demonstration farmer) had attempted this. She found it to be effective but felt the labour demand was too high. When the method was discussed with farmers many were intuitively sceptical about its effectiveness, feeling that ABC's would definitely be able to climb out. In practise however, we know the method does work reasonably well so long as the trenches are maintained free from fallen plant material which can afford an exit ladder.

Clearing an Area Around the Field

Three farmers interviewed in Central Region had attempted to control ABC infestation by clearing a strip of land around their crop fields. They found this method quite effective, although they felt it was expensive and demanding of labour. Some farmers, who had not tried this method, were sceptical, believing that ABC would cross the strip, as they often observed them crossing roads and paths.

Wire Fencing

Many farmers believe that ABC infestation is higher when fields have bush fencing. There is currently a government subsidy on wire fencing and many farmers are changing over to this. Since ABC aggregate in large numbers on thorn bushes at night time this seems plausible.

Spraying

Several farmers who had their fields sprayed by government staff in the past to control elegant grasshopper populations suggested that the government should spray ABC. However, one farmer who had arranged for his field to be sprayed during an ABC infestation claimed that many more ABC were attracted to the field afterwards.

Burning Mopane Leaves

This method was described by one traditional healer from Francistown region as a general pest control measure. She told researchers that the method is effective for ABC control. However none of the other farmers interviewed had attempted this.

In summary, there are currently no effective commonly practiced control measures for ABC. Farmers' attitude is generally one of passive acceptance of the problem. They find ABC repulsive, and the fact that further ABC are attracted to the site where one has been killed has fuelled the belief amongst some farmers that the creatures are sent as a punishment. There was a widespread feeling that nothing can be done against ABC, and that they should be left alone.

5.2 *Ideas for New Control Measures*

During group discussions, farmers suggested a number of alternative measures which might be used to control the ABC.

Control through Tillage

Some farmers felt that winter ploughing or deep ploughing could help control ABC by destroying egg pods which are laid in the soil.

Contour Strip Treatment

It was observed that ABC's sometimes shelter in contour strips and suggested that these could be targeted for spraying or baiting.

Spraying with Soapy Water

One farmer had used this method to drive away ABC around the homestead and thought it could be applied on a wider level. In group discussions, the ABC team described control methods which are being used in other areas, and which the project may seek to develop, in order to gauge their acceptability to farmers.

Plastic Bag Method

In Namibia some farmers hand pick ABC on a daily basis, putting them into a plastic bag which is then hung out in the sun so that the ABC overheat and die. In our group discussions farmers were not enthusiastic about this method. Many felt that the labour demands of daily picking were not achievable. Others were reluctant because this method involves touching the ABCs. A few individuals felt that directly killing the crickets was morally wrong.

Baiting

Insecticide baits for use against ABC were pioneered by ICRISAT in northern Namibia and this control measure is to be further developed by the present project. The method involves applying bait made from cereal bran, incorporating crushed dried ABC or fishmeal, and a pesticide. In individuals interviews some farmers expressed an interest in baiting. Some farmers had in fact tried baiting in the past to control rodents. However, in group meetings the reaction to this idea was very negative. Farmers feared that the poison would be dangerous to children, livestock and even to adults (due to abuse and mischief). At two of the four meetings the village headmen stood up and said they would not allow villagers to keep pesticide in their houses. Some farmers expressed concern about possible environmental side effects of baiting (e.g. harm to ABC's natural predators). Farmers in the survey areas are not accustomed to handling pesticide. If baiting were to be carried out, they would prefer it to be applied by government personnel.

Attracting Females to Egg Laying Areas

ABC seek shade to lay their eggs. It has been demonstrated that in open situations adult females are attracted from some distance toward tall objects (such as stacks of millet stems) next to which they will lay, in the shadow. By attracting females to artificial laying sites within or around fields, and subsequently destroying the egg pods by ploughing or digging, the following year's population can be reduced. Farmers were generally quite enthusiastic about this method. Destroying eggs was accepted as a plausible control measure, and was more acceptable to some farmers than killing adult ABC.

6. Information Flows and Support Systems

Extension Staff

Most farmers told us that they would go to their local extension staff if they encountered serious pest problems. The government plays an important role in pest control here and farmers depend on local field officers for information and interventions.

Agricultural demonstrators told us that they advise farmers individually and also organize courses on pest control. Farmers who come to seek advice or apply for

government subsidies visit the Agricultural Demonstrator's office. The office walls are *used to* display posters, and they could be used to raise awareness of ABC and control measures against it.

Radio

Several farmers told us that they receive information through radio broadcasts. Most households have a radio, and this would appear to be a very promising medium for raising awareness of ABC and its control.

Farmer-to-Farmer Information Flows and Support

Many farmers received and passed on information about pest infestations from other farmers, both family and neighbours. During group discussions many farmers, particularly the older people, told us that in the past community support systems were much stronger than today. Some expressed regret that by taking responsibility for pest control measures, the government had reduced communities' own self reliance and made them dependent on outside assistance which was not always reliable. They also noted that young people were reluctant to carry out cooperative activities such as joining Quelea control parties.

Conclusions and Action Points

1. The present survey work has re-emphasized the sporadic and geographically patchy nature of ABC infestation. The project plans to collect extensive data on the geographic distribution of infestation areas by means of a questionnaire to be sent out countrywide to Ministry of Agriculture field staff (see Appendix 5), which should allow us to identify ABC 'hot spots' throughout Botswana. Environmental factors which influence ABC distribution and population dynamics will then be assessed by seeking correlations between the timing and location of infestations and various environmental factors, using Geographic Information Systems (GIS). From our field observations and talking with farmers it is clear that some parts of Central region are severely affected by ABC, but that the Francistown region is not. Future collaborative research working with farmers would definitely be possible in Shoshong.

2. The survey identified a number of environmental factors and farming practices which farmers felt may influence ABC populations (see Key Findings, section 2). These will be further investigated. Farming practices such as weeding,

selection of fencing material, tillage practices and crop density could be investigated in forthcoming on-farm research work.

3. The survey identified some important misconceptions about the ABC life cycle and behaviour. More awareness raising would be useful. Radio would appear to be a promising medium for disseminating information to farmers. The role of field based Agricultural Demonstrators and farmer-to-farmer training could also be important.

4. The survey found that farmers are unable to forecast ABC infestations. If a forecasting system was developed, then in tandem with effective control measures this could be extremely useful.

5. There are currently no effective commonly practiced control measures for ABC in the areas that were surveyed. However, by exploring the methods which farmers have used to try and control ABC and other pests, some promising avenues for development have been identified.

6. This survey has highlighted certain important characteristics of farming systems which should be considered when developing appropriate control measures:

- ❖ Labour is a constraint to most households.

Many farms are managed by women headed households and elderly people. It is important to develop control measures which do not place unrealistic demands on their labour. If measures such as trenches are to be promoted, it is important to also look at mechanization which could reduce the labour inputs required to prepare these.

- ❖ High level of government intervention

Farming households are accustomed to receiving a relatively high level of government support. Farmers are generally reluctant to purchase or apply chemicals themselves but may expect this to be implemented by government personnel. A suitable control measure would therefore be one, which can realistically be implemented by government personnel, or alternatively one with a low level of external inputs.

- ❖ Lack of knowledge of pesticide use.

Farmers do not use pesticides and sprayers on their farms. They are apprehensive about control measures which use pesticide. Availability of pesticides may also be a problem in some areas.

- ❖ Taboos on killing ABC

Many farmers will not touch ABC, which are perceived as repulsive and dangerous. Many farmers are reluctant to kill ABC because they believe that more crickets will invade the field (sent by the gods) if any are killed. So they should not be interfered with. Raising awareness of the cannibalistic nature of the ABC and the fact that it is only nearby crickets which are likely to congregate where one has been killed, may help dispel this belief. It will also be important to promote more acceptable preventative practices/control measures which target the egg stage.

7. Farmers' negative reaction to baiting against ABC shows that great care needs to closely examine the environmental repercussions and to pay close attention to safety aspects.

8. The success of group discussions during the survey showed that there is good potential for the project to carry out collaborative research work with farmers. The project plans to conduct some on-farm research activities with farmer research groups who can play an active part in trial design, implementation, monitoring and evaluation. The farmer researcher groups could also be invited to evaluate researcher-implemented trials and around Sebele research station.

Action Points

This survey was carried out at an early stage of the ABC project. The findings will guide ongoing project activities. Direct action points arising from the survey are:

- ❖ A survey of Ministry of Agriculture field staff is needed in order to establish the incidence and severity of ABC infestations in different parts of Botswana, and to collect more information on indigenous control measures used in other parts of Botswana.
- ❖ Research into appropriate ABC control measures should consider:-
 - The effects of various farming practices e.g. crop density, weeding, fencing and tillage practices;
 - Use of trenches (possibly with mechanization to reduce labour)
 - Control by egg destruction at attractive artificial egg laying sites
 - Ways of promoting collective action (possibly sanctioned by traditional rituals).

* The project should use radio broadcasts as well as Agricultural

Demonstrator to disseminate information for farmers about ABC (e.g. the findings of this survey). The possibility of working together with traditional experts in pest management, such as spiritual healers and prophets of Ngwali, should also be considered (see Appendix 5).

- * Collaborative on-farm research should be developed at Shoshong, and possibly in another area that experiences frequent ABC infestation, depending on distribution of ABC infestations next year.

REFERENCES

- ATIP, 1985. Farming System Activities at Mahalapye. Summary 1982 – 1985
- ATIP, 1990. Farming Systems Research Handbook for Botswana. ATIP Report 3.
- Baker, D. 1988a. Draught Arrangements in Shoshong and Makwate. ATIP Working Paper 16.
- Baker, D. 1988b. Household Circumstances and Farming Practices in Shoshong and Makwate. ATIP Working Paper 17. Baker D1988c Village groups in Shoshong and Makwate. ATIP Working Paper 13.
- Miller W and Seleka T 1985 Agricultural Survey of Tutume District. ATIP Working Paper 3

Appendix 3a – Survey Team

Week 1 – Central Region: Makwate and Shoshong

ABC Researchers

Harriet Matsaert, NRI Social Anthropologist

Dr Stuart Green, NRI Entomologist

Dr Eli Minja, ICRISAT Entomologist

Pharoah Mosupi, Dept of Agricultural Research and PhD Student, Univ of Pretoria

Patrick Mviha, Phd Student, University of Pretoria

Local Collaborators

Patrick Boitshwarelo – Plant Protection Officer – Central Region

Kuate Sebua – Plant Protection Officer – Central Region

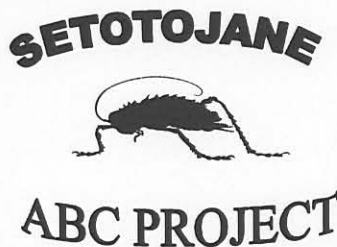
Badisa Jones Oboletse – Crop Production Officer – Selibe Phikwe

Nkosinathi Kengaletswe, Mahalapye Farming Systems Team

Sehularo Kgameane, Agricultural Demonstrator, Makwate

Galefele Tautona, Agricultural demonstrator, Shoshong

Malebogo Phatshwane, Farming Systems, Shoshong.



Week 2 – Francistown Region: Marapong and Shashe Mooke

ABC Researchers

Harriet Matsaert, NRI Social Anthoropologist

Dr Stuart Green, NRI Entomologist

Pharoah Mosupi, Dept of Agricultural Research and PhD Student, Univ of Pretoria

Patrick Mviha, PhD student, University of Pretoria.

Local Collaborators

- Magdline Nshakiwa, Crop Production Officer, Tonota
- Sonny Manyuela, Horticultural Officer, Francistown
- Simon Mololore, Crop Production Officer, Masunga
- Bangwe Baliki, Plant Protection Officer, Francistown
- Mr Matshediso Mothibi, TA Marapong
- Tshepo Mogwara, TA – Shashe Mooke

Topics to be covered:-

- Knowledge of sorghum biology, life cycle, feeding preferences and other relevant aspects (e.g. knowledge gaps and new information)
- Farmer perception of the degree and frequency of yield losses caused by sorghum (compared to other crops)
- Are there any local scientists?
- Has the farmer observed any environmental factors and farming practices which affect sorghum production/behaviour?
- How do farmers become aware that there will be a sorghum problem (infestation/damage). Do farmers monitor the sorghum population?
- What do farmers do when there is a problem, and at what stage do they take action? What practices do they take? (Any previous work control measures?)
- If control measures are used, how much do they cost (labour and cash)?
- What further measures could be taken?
- Information sources used by farmers.
- Has the farmer received any advice/information about sorghum control? If so, from whom/where?
- Location of control measures used to date, including date of use and by whom/for what. Are crop animals by products available for sorghum purposes?

Please also take GENERAL OBSERVATIONS – what you see in the field.

Water/Garden: (approximate) 100 litres in the household (head of household, daughter, relatives, etc.) of the person who is interviewed. What type of draught power do they use (own tractor, tractor or tractor hire tractor, donkey or self)? What labour is used (family member, wage)? What herbicide is cultivated? Any other comments on how the interview went.

Appendix 3b – Guidelines for Interviews and Group Discussions

Checklist – used for household interviews and discussion with local experts.

Discussion should be informal and carried out on the field site.

The checklist is used to ensure that all key topics have been covered before concluding the interview. It can also be used to structure writing up (under topic headings). It should not be used as a questionnaire!

Where possible, talk to the member of the household responsible for pest control.

Topics to be covered:-

- Knowledge of setotojane biology, life cycle, feeding preferences and natural enemies (identify knowledge gaps and new information).
- Farmers' perception of the degree and frequency of yield losses caused by setotojane (compared to other pests).
- Are there any uses of setotojane?
- Has the farmer observed any environmental factors and farming practices which affect setotojane population/behaviour?
- How do farmers become aware that there will be a setotojane problem (information flows). Do farmers monitor the setotojane population?
- What do farmers do when there is a problem, and at what stage do they take action? What measures do they take? (Any problems with control measures?)
- If control measures are used, how much do they cost (labour and cash)?
- What further measures could be taken?
- Taboos/superstitions about setotojane
- Has the farmer received any advice/information about setotojane control? If so, from what resource?
- Reaction to control measures used in other areas/being developed by entomologists. (Are crop/animal by products available for baiting purposes)?

Please also note GENERAL OBSERVATIONS – what you see in the field.

Note: Gender, age (approximate) and status in the household (head of Household, daughter, relatives etc.) of the person who is interviewed. What type of draught power do they use (own tractor, donkey or oxen/or hire tractor, donkey or oxen) What labour is used (family and/or hired. What hectareage is cultivated? Any other comments on how the interview went.

Group Discussion (2 – 3 hours).

A g e n d a

1. Open meeting, introductions (10 mins)
2. Introduction to the project and survey aims. (10 mins)
3. Divide into two groups for PRA exercises (1.5 0 2 hours)
4. Plenary, (30 mins) Farmers report back on group exercises. Entomologists talk about control measures used by farmers in other areas. Introduction to control and forecasting studies being carried out by the project.
5. Explain planned farmer interviews in the afternoon (we will visit about 12 farmers at their homes/fields. If there is an infestation next year we would be interested in working with farmers to test new control measures. Any farmers who are interested to participate, please give your name to the local technical assistant.
6. Questions
7. Close meeting
8. Lunch.

PRA Exercise:

Group 1 – Historical Timeline and Discussion of Farm Management and Environmental Factors which affect setotojane infestation.

1. **Timeline:** Key landmark events (from as far back as people remember), 100 years of setotojane infestation, changes in farm management over time (crop, tillage methods etc).
Use of timeline to develop discussion on setotojane biology, life cycle and factors which affect infestation.

Checklist:

- Can certain environmental factors be linked to setotojane infestation?
- Have changes in environmental factors over time been significant
- Can certain farm management factors be linked to setotojane infestation?
- Knowledge of setotojane biology, life cycle, feeding preferences, natural enemies etc.

Have control measures changed over time – what were the traditional control measures?

Note taker: please record main points in discussion and copy what is recorded on flip charts. Make a note of number of participants, age and gender, and any general comments on the methodology.

Group 2 – Ranking of Key Crops, Pests and Problem Solution Tree

1. List most important crops grown in the area. Show of hands to indicate who cultivates these crops.
2. List the main pests affecting farmers’ crops. Use stones for ranking? (each farmer gets 10 stones and distributes them as he/she wishes). How does the *setotojane* compare with other pests? Which crops are particularly affected?
3. Use problem tree to look at causes of ABC damage to crops (in terms of farm management practices, environmental factors, resources, labour etc.).
4. Use solution tree to explore: current control measures and potential control options (farmers, government and others). This exercise can also be used to gauge farmers’ reaction to the control options which the project is currently developing. Use exercise to identify any taboos to ABC use. Use exercise to identify who in the household/community is responsible for ABC control (ideas, information and the actual work).

Note taker: please record main points in discussion and copy what is recorded on flip charts. Make a note of number of participants, age and gender, and any general comments on the methodology.

Appendix 3c – Ranking of Main Crop Pests

Each farmer was given 10 stones to vote the most significant crop pests on their own farms.

Makwate (23 farmers)

Pest	Rank	% of stones
Quelea	1	58
ABC	2	18
Stink bug	3	8
Pod Borer	4	7
Elegant Grasshopper	5	6
Rodents	6	2
Jackals	7	1

It was noted that ABCs cannot be fenced out like livestock, or chased away like birds. They constantly re-infest which makes control very difficult. They mainly attack sorghum, but also like maize and cowpeas.

Shoshong (11 farmers)

Pest	Rank	% of stones
Quelea	1	42
ABC	2	38
Aphids	3	6
Rodents (porcupine)	=4	4.5
Termites	=4	4.5
Bugs	6	4
Wildlife	7	1
Elegant grasshopper	8	0

Marapong (6 farmers)

Pest	Rank	% of stones
Quelea	1	37
Crow	=2	13
Termites	=2	13
Stink bug	4	12
Rodents	5	8
Jackal	6	7
Stalk borer	=7	5
ABC	=7	5

Shashe Mooke (10 farmers)

Pest	Rank	% of stones
Quelea	1	38
Boll worm	2	17
Weeds (especially <i>Cynodon dactylon</i>)	3	15
Termites	4	11
Aphids	=5	5
ABC	=5	5
Rodents	=5	5
Lodging	8	3
Wildlife (hares, jackals and monkeys)	9	1
Grasshoppers		
Other Birds		

Appendix 3d – Article on Mwale

Published in The Voice April 14th 2000. The article reproduced opposite relates to the controversy over the power of local gods. During our group meeting at Shashe Mooke this was a contentious issue, and we witnessed heated discussion. “Traditionalists” who believed in the power of Mwale (Ngwali) blamed the sceptical non-believing faction amongst the farmers for the apparent loss of the god’s powers. Conversely, the skeptics dismissed the traditionalist’ belief as old fashioned and misguided. Clearly this is a sensitive issue. In order to promote up-take of technologies developed by this project there is a need to show respect for traditional beliefs and not alienate farmers adhering to these views.

THE GODS MUST BE ANGRY

By Hloniphani Chengeta

RESIDENT OF THE NORTH EAST ARE WORRIED THAT MWALE – THE RAIN GOD HAS FALLEN SILENT

Mwale is believed to reside in a hill near Ramokgwebane and has been healing people’s ailments and making rain since locals can remember, but Mwale has lost its voice. An elder at Jackalas 1 Village, Majeremana Zelembu attributed the recent floods to Mwale’s silence. He complained: “I was born 72 years ago and this hill was talking by then. It was after the death of its powerful fetish priest Vulumbu Ntogwa in 1994 that the hill stopped talking.” Zelembu said the hill is no longer talking because the young people no longer respect the gods. “The gods are angry. We no longer sacrifice to them as we did in the past”, he said Zelembu added that in the past before ploughing season, people used to gather at Mapoka under one special tree for the ceremonial rain begging rites after which the amahosana were sent to the hill to deliver the sacrifices of food, traditional brew and sometimes even money. Another elder at Zwnshambe village put the blame on the current fetish priest Robert Vumbu for what he called negligence.

He complained: “The man stays in town now and has neglected the hill. He is looking after his business.” The elder cautioned that if the situation were not resolved this country would have troubles.

Appendix 1e – Draft of questionnaire to be circulated to Agricultural Field Staff



Setotojane, the Armoured Bush Cricket (ABC), is a serious pest of cereal crops in some parts of Botswana. The *ABC project* has 2 main objectives:

1. To study the biology of *Setotojane*, in particular so that we can understand why infestations occur only in some places and in certain years, but not others;
2. To develop methods which farmers can use to control *Setotojane*.

We hope to develop and promote effective, safe *Setotojane* control measures for farmers, and to develop a forecasting system which will allow us to predict where and when damaging *Setotojane* populations are likely to occur.

Please could you help us by answering the questions below:

Your name:

Position:

Area:

How many years have you worked here?

1. What are the most important crop pests I your area? (list the 3 most important)

1st 2nd 3rd

2. Did farmers in your area experience *Setotojane* problems this year? Y/N

3. Have these farmers experienced *Setotojane* problems in past years? Y/N

If your answers to questions 2 and 3 are both No then you can stop here, but do please return the forms to us. If you answered yes to either question then please continue.

4. In which years did serious *Setotojane* infestations occur?
5. Do farmers take action to try and reduce damage by *Setotojane*?
6. What control measures were taken by government services against *Setotojane*?
7. Do farmers have any method to predict that a *Setotojane* infestation will occur?
8. Are there any environmental factors in your area (e.g. rainfall, vegetation) which you

believe influence *Setotojane* population size?

9. Are there any farming practices in your area which you think can affect *Setotojane* population size?

Please return this form to:

***Mr P.O.P Mosupi – Sebele Research Station
Dept of Agricultural research, P/Bag 0033
Gaborone.***

Thank you for your help.