Visit to sweet potato producing regions of Uganda, Kenya and Tanzania to liase with organisations and individuals with a current, historical or potential interest in aspects of sweet potato integrated pest management in East Africa.

24 April 2000 – 5 May 2000

ZA 0403 (A0956)

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BACKGROUND

Sweet potato (*Ipomoea batatas*) (L.) Lam., is an important food security crop in many of the poorest regions of the world including East Africa. In East Africa, sweet potato is grown predominantly by women, for both home consumption and to supplement household income by sale to local markets and urban centres. Uganda has the largest sweet potato production in Africa and the second largest in the world (FAO, 1998). Despite Tanzania having the second largest area of sweet potato production in Africa, it is only the eighth largest producer due to the chronically low yields. Kenya is the fourth largest producer in Africa.

Sweet potato weevils (*Cylas puncticollis* and *C. brunneus* (Coleoptera: Curculionidae)) constitute a major constraint to sweet potato production in East Africa. Female *Cylas* spp. lay eggs in cavities excavated in either vines or exposed/easily accessible roots of sweet potato. As the larvae develop they tunnel and feed within the vine or root. Even low levels of infestation can reduce root quality and marketable yield because the plants produce unpalatable terpenoids in response to weevil feeding and consumers pay only reduced prices for *Cylas* spp. damaged roots. High *Cylas* spp. infestation can render the roots completely inedible.

The problem begins at the beginning of the planting seasons, when in many areas of East Africa there is a shortage of planting material as a result of the prolonged dry period and the common problems of goats feeding on the small amount of planting material, that has been carefully cultivated in swampy areas or homestead nurseries. As a result, planting is often delayed and there is little opportunity to select cleaner younger vines parts for planting. (This has implications for both pest and disease build up through infested planting materials). Few early maturing sweet potato varieties exist in East Africa and as a result with delayed planting the crop usually matures after the end of the rains, the soil around the roots dries out and cracks providing easy access to the roots for *Cylas* spp. oviposition.

Many farmers practice piecemeal harvesting removing the larger exposed roots for household consumption as required, but when weevil populations build up, farmers tend to harvest the remaining crop. Fresh storage technologies although traditionally practiced in the Southern Highlands of Tanzania are not widespread throughout the region. As a result, in any areas where sweet potato is not traditionally processed into chips or flour, a glut develops as most local farmers tend to harvest around the same time. Market value is severely reduced by both *Cylas* spp. damage, and the surface feeding of the rough weevil *Blosyrus* spp.. Processing usually involves peeling, slicing or crushing and sun-drying, in some areas roots are parboiled first or salted following crushing.

Processed sweet potato is then stored either in homestead granaries or inside the houses in sacks, and used as required for preparing a porridge type food or as snacks. The stored product is frequently attacked by storage pests.

A number of research projects have been or are currently involved in studying sweet potato pest management strategies in East Africa these strategies include:

- cultivar resistance
- farmers cultural practices (use of clean planting material, crop rotation, removal of volunteer and wild host plants, flooding of sweet potato fields, timely planting and prompt harvesting to avoid a prolonged dry period, piecemeal harvesting, hilling up (in order to cover soil cracks and reduce weevil access to roots and important for storage root development); avoidance of adjacent field planting);
- sex pheromones (for mass trapping and mating disruption);
- biological control agents (entomopathogenic fungi, bacteria and nematodes);
- and chemical dips.

Sweet potato pests are still the most important constraint to sweet potato production in many areas of East Africa and it was felt this problem deserved further attention. Meetings were held between sweet potato researchers, the Crop Protection Programme (CPP) and Crop Post Harvest Programme (CPHP) Managers to discuss the subject. The CPP agreed to support the author's visit to East Africa to liase with organisations and individuals with a current, historical or potential interest in aspects of sweet potato crop management to further develop collaborative proposals for sweet potato research interventions. If considered appropriate the CPP would use these proposals to issue a call for specific research concept notes. A CPP staff member (Andrew Ward) also took part in the visit.

The specific objectives and terms of reference of this study were as follows:

1. to visit East Africa in order to liase with: the CIP sweet potato IPM entomologist Elske van der Fliert (visiting East Africa from Indonesia); farmer participatory research project staff in Uganda; CABI, KARI and ICIPE staff in Nairobi; and researchers and interested NGO's and institutions in Lake Zone, Tanzania. The potential for a further research project concentrating on sweet potato weevil management will be discussed with collaborators of project R 6769 'Investigating the potential of cultivar differences in susceptibility to sweet potato weevil as a means of control' and other stakeholders. The discussions will concentrate on improved farmer practices and cultural control possibilities.
2. to identify prospects and priorities for research interventions in sweet potato pest management.
3. if deemed appropriate, from the findings of the visit, to assist the CPP management in the drawing up of the terms of reference for a call on sweet potato weevil management.

The purpose of this report is to summarise and put in context information obtained during this visit that will be of use in formulating a future strategy.

ACTIVITIES

During the visit the author worked as part of a small team. The team's composition differed by location. However the core team was composed of the following members: Peter Ewell, CIP Regional Representative; Elske van der Fliert, CIP SE Asia IPM specialist; Heather Kindness, NRI CRF project social scientist; Andrew Ward, CPP Assistant Manager; and myself. The above team were joined in Uganda by Berga Lemaga (PRAPACE), Benson Odongo, Gard Turyamureeba (NARO) and Joseph Mudiope (CIP) from 26/4 – 29/4. On 3/5 the team split and Andrew Ward and myself travelled to Mwanza, Tanzania where we were joined by Simon Jeremiah and Edward Kanju (ARI-Ukiriguru), the rest of the team travelled to Western Kenya.

Under the following country headings I have summarised the most relevant points discussed in each country, concluding with an overall summary and proposal for future work areas. Further details are given of individuals met and wider discussion topics in the itinerary. Lists of acronyms and abbreviations, references and bibliography and contact details are attached.

UGANDA

CRF project – Farmer Participatory Research on Integrated Crop Management for Sweet potato in NE Uganda.

While in Uganda most of the team's activities focused on the project on 'Farmer Participatory Research on Integrated Crop Management for Sweet potato in North-Eastern Uganda' which is funded through DFIDs Competitive Research Facility (B0111). This collaborative project between the International Potato Centre (CIP), National Agricultural Research Organisation (NARO), Natural Resources Institute (NRI), Soroti and Kumi Departments of Agriculture, Soroti Catholic Diocese (SOCADIDO) and Soroti District Development Project (SDDP) has been running since April 1998 and has an end date of March 2001. The project plans to achieve the following outputs:

1. Increased understanding of current attitudes and practices in sweet potato crop and pest management in Uganda
2. A "basket" of technologies developed for sweet potato crop management, especially those that reduce pest damage, suitable for use by smallholders throughout semi-arid Eastern Africa.

Although a large amount of survey work has been carried out in both Gweri and Kumi sub-counties of Soroti district on farmers' existing crop management practices and constraints, the project design did not enable the collection and analysis of this data prior to the setting of the research agenda. This has resulted in researcher selected technologies being tested on-farm in researcher managed trials, and a

feeling among some of the project staff that some of the technologies selected are not fully understood and are an inappropriate response to farmers' constraints. The technologies being trialled include: new sweet potato (SP) varieties; clean sweet potato planting materials using vines from different sources including tree nurseries, homestead nurseries, swamp nurseries and volunteer plants; 'hilling up' in order to cover soil cracks and therefore reduce weevil access to roots; adjacent field planting; and fresh root storage.

The issue of farmer understanding of the reasoning behind the technologies appears to have been neglected within this project. For example, farmers are aware of larvae in the SP roots and of adult *Cylas* spp. insects on the foliage. However the subject of farmer understanding of insect metamorphosis and hence the fact that female *Cylas* spp. adults need access to the roots for egg laying seems to be have been neglected. This knowledge is critical for enabling farmers to experiment and discover if and how these technologies could help reduce their constraints. The project team feel that it would be inappropriate to develop a manual describing the SP ICM components as planned in the project memorandum, but that instead a draft set of field guides could be developed which would feed into a more integrative and participatory set of studies and eventually result in field guides developed with and tested by SP farmers in East Africa.

The project has suffered from both the unintentional loss of three project staff during the last year, the distance of most of the researchers from the study sites and lack of feelings of farmer ownership of the trials.

The CRF project has links with a number of NGOs in Soroti district and a two day workshop/field visit was held with project stakeholders and other interested organisations and individuals (see Itinerary for details). The Soroti Catholic Diocese (SOCADIDO) are working with eight groups each of ten farmers (female) on addressing the problems of shortage of SP planting material and fresh storage of roots in the district. The group we met in Kideko, demonstrated the rapid vine multiplication technique and fresh pit storage construction. Traditionally in this area of Uganda, sweet potato is peeled, sliced, salted and sun-dried, or peeled and crushed, and then stored for several months in sacks inside grass and mud built basket granaries at their homesteads. The farmers have now trialled the pit stores (which they line with coiled dry grass and cover with a layer of dry earth, and a thatched roof, hollow grasses are inserted to provide ventilation in the stores) for fresh roots for two seasons. They said they enjoyed being able to consume fresh roots after the harvest season. The pits are opened and closed when roots are required and root quality is checked simultaneously. The farmers mentioned problems of termite and rodent damage to roots in the pits).

Soroti – Busia Integrated Production and Pest Management Farmer Field School

The Soroti – Busia Integrated Production and Pest Management (IPPM) Farmer Field School (FFS) Pilot Programme began in 1999, supported by International Fund for Agricultural Development (IFAD), the Food and Agriculture Organisation (FAO) and the Global IPM Facility. The objectives of this FFS programme are:

- To shorten the time it takes to get research from stations to adoption in farmers' fields by involving farmers in experimentation of their own.
- Enhance the capacity of extension staff to serve as technically skilled and group sensitive facilitators of farmers' experimental learning.
- To increase the expertise of farmers to make logical decisions on what works best for them, based on their own observations of experimental plots in their FFS.
- To establish coherent farmer groups that facilitate the work of extension and research workers, providing the demand for a demand driven system

The Soroti – Busia IPPM FFS initially focused on cotton (an important cash crop grown under a heavy pesticide regime in Soroti district), but farmers have decided that their FFS activities should also focus on other crops such as groundnuts, maize and beans. It was interesting that sweet potato was not mentioned by the farmers as a potential FFS focus crop. When asked why this was, some responded that it was not an important cash crop, others that they had simply omitted to mention it, while others felt that they could adapt the knowledge they had gained from the FFS (frequent crop monitoring, natural enemy – pest ratios, and soil fertility) for other crops such as sweet potato. Since the Soroti – Busia IPPM FFS began in 1999, more than 4,000 farmers have enrolled in the programme, and

members of local groups have been encouraged to join the FFS so that information can also be passed to their respective groups. Nearly 30% of the Soroti – Busia IPPM FFS are now farmer run, with the groups managing their own budgets. Farmers said they felt the FFS approach did not disadvantage those of them that were either uneducated or lacked social standing within the community (unlike the conventional extension system), and that women were able to participate equally. They also felt it had strengthened their ability to work as groups in solving problems. The Soroti – Busia IPPM FFS programme has linked with local NGO and research activities including Promoting Farmer Innovations (PFI), Vegetable Oil Development Programme (VODP), an Italian NGO with a nutrition programme (ACAV), SAARI yam researchers and hope to incorporate the following topics in the future: HIV/Aids awareness; environmental protection and water harvesting. It is surprising that the CRF project has not been more involved in the Soroti- Busia IPPM FFS, particularly as the programme leader James Okoth (a social scientist) was previously one of the CRF project staff. It would be useful for the CRF project, if FFS groups were interested in helping to test and develop the draft field guides, and to experiment with the integration of the technical components which have been studied individually during the CRF project.

Sweet potato product diversification

The Soroti Department of Agriculture nutritionist (Bernadette Ekemu) has been working with groups on the development of acceptable new recipes for sweet potato as alternatives to boiling the roots plain, these include sauces, crisps, chips, mandazis and chapatis (several communal ovens have been built where women bake cakes), these products are also seen as income generation opportunities by women. Men, women and primary schools have been involved in the training. The role of SP cultivars with high Vitamin A content in a healthy immune system is also seen as an important aspect, and of particular relevance to households with HIV+ve members. Collaborators include the Soroti District Development Project (SDDP), CIP and the Ugandan Womens Effort to Save Orphans (UWESO). Demonstrations are planned with some of the Soroti - Busia IPPM FFS groups.

Post-harvest studies, constraints and processing

CIP also has a SP chip storage trial at the CIP office in Soroti, which is evaluating the effect of underground compared to above ground storage of double bagged chips of local SP cultivars. Survey information from Gweri sub-county (CRF project) showed that 74% of farmers ranked storage pests as the main processing and storage constraint. The main pest of dried sweet potato chips in Uganda are *Prostephanus truncatus*, *Araecerus fasciculatus*, *Rhyzopertha dominica*, *Dinoderus minutus*, *Sitophilus zeamais*, *S. oryzae*, *Tribolium castaneum* (Silim *et al.*, 1991). Work by Ambrose Agona during his recent PhD showed that salting, parboiling and solarisation of SP chips led to a significant reduction in storage damage. The farmers we met in Kideko explained that they peeled, sliced, salted and sun-dried their SP chips to increase their storability and prevent rotting. The CRF project has been involved in monitoring farmer's impressions of locally produced slicing machines and had hoped to include some storage trials. A recent post-harvest needs assessment in the Teso and Lango farming systems of Uganda in November 1999 (ZB0194) prioritised sweet potato processing and storage constraints as an important area for further work.

Sweet potato viral diseases

Viral diseases are an important constraint to sweet potato production in Uganda, however the incidence of virus disease in Soroti district is very low. In fact the area is used to trial SP cultivars which are known to be highly susceptible to viral disease and as a result do not survive at the main breeding and screening site at Namulonge which is situated in a high virus incidence area. The CPP funded project 'Promotion of technical support for methods of controlling whitefly-borne viruses in sweet potato in East Africa' (R7492) will focus on high viral incidence districts in southern and western Uganda for evaluating the acceptability of varieties resistant to sweet potato virus disease (SPVD).

Sweet potato cultivar characteristics, susceptibility to Cylas spp. and breeding strategies

The sweet potato breeding programme at Namulonge evaluates locally collected, foreign and crossed planting materials. The criteria they use include: yield; disease incidence (viral & *Alternaria* blight); dry matter content (30-35%); orange flesh colour which indicates Vitamin A content; vine vigour; pest incidence (weevils); skin colour; and root shape. Eight varieties have recently been released and high quality promotional material was developed (in collaboration with PRAPACE & CIP) to help aid their dissemination and provide detailed information about each variety. In Soroti, Erna Abidin of Arapai College is involved in the collection and evaluation of local germplasm. Students at the college have helped differentiate the >100 accessions using morphological characteristics. A number of parameters are being measured for each accession including weevil susceptibility. Erna confirmed she had similar findings in terms of weevil susceptibility for those cultivars tested in Soroti during the CPHP funded work on 'Investigating the potential of cultivar differences in susceptibility to sweet potato weevil as a means of control' (R6769). Gard Turyamureeba (SP breeder, Namulonge) mentioned that farmers relate the high latex content to reduced susceptibility to weevil damage. However, the high latex content causes problems for women during processing as it produces a sticky black layer on the hands. The McKnight foundation is funding a study of biochemical resistance of sweet potato materials to African *Cylas* spp. The plant materials being tested were brought over from the US, where they have been found to have biochemical resistance to *Cylas formicarius*. Benson Odongo is also involved in trialling dimethoate soil drenches and dips of SP planting materials. No results were presented and there is debate as to the appropriateness of chemical pesticides for use by small holder sweet potato farmers in Uganda.

DFID's bilateral assistance to Uganda

Alwyn Chilvers (who has recently taken over the position of the DFID Natural Resources Adviser for Uganda) stressed how important it was that links between DFIDs Research Strategy and bilateral programmes are strengthened. DFID's bilateral assistance in Uganda is focusing on the following areas.

- Rural livelihoods including support for Uganda's Plan for Modernisation of Agriculture (PMA). New innovative extension ideas which are currently being developed, will eventually form the basis for the National Agriculture Advisory Services (NAARS). NGOs and CBOs will compete for funds and use them to contract advisors for specific pieces of work.
- Support for implementation of the land act (through dissemination of information).
- Support for NARO, specifically the Technology Partnership Fund which is based at Serere Agricultural and Animal Production Research Institute (SAARI) in Soroti. The Technology Partnership Fund project is managed by David Rees of Agrisystems, the project is currently undertaking needs assessment and expect to be ready to receive demand driven competitive proposals in six months time (the project has a research budget of ~£600,000 and a dissemination budget of ~£500,000).
- Aquaculture
- Integrated lake management project focusing on Lake Kyoga and Lake George
- Livestock services policy development.
- Support to highlight environmental issues and increase their mainstreaming.
- Forestry.

KENYA

In Kenya we visited researchers working at the International Centre for Insect Physiology and Ecology (ICIPE), CAB International (CABI) and the Kenyan Agricultural Research Institute (KARI) some of whom had previous experience on aspects of sweet potato pest management, others who have skills that could be integrated into future pest management work. A timetable of these discussions is shown in the itinerary, the following is a summary of the important points.

ICIPE and Pheromones or Plant Attractants in Cylas spp. pest management

Markus Knapp explained that ICIPE had traditionally worked on tick and tsetse control, but now has a much broader remit including a large amount of work on horticulture IPM supported by GTZ under the leadership of Bernard Lohr. Although ICIPE has a Behavioural and Chemical Ecology department, they have not been involved in any of the pheromone work against the African *Cylas* spp.. Following the discovery, that the *Cylas formicarius* pheromone was not attractive to either *C. puncticollis* or *C. brunneus*, Nicole Smit then based at Namulonge collaborated with Makerere University students and NRI researchers on identifying and testing the important components of the pheromones of these two species during a three year project on 'Development of Pheromones for Monitoring and Control of Sweet potato Weevils, *Cylas brunneus* and *C. puncticollis*' funded by ODA (R6115(H)). However, the field trials in Uganda found that mass trapping using pheromones of *C. puncticollis* and *C. brunneus* did not reduce *Cylas* spp. damage levels in the developing sweet potato roots (Downham *et al.*, 1998). ICIPE had been identified as the potential pheromone production site, if the pheromones had proved attractive. The ICIPE researcher Peter Njagi was interested in the recent work by Prof. Stanley Kays, on the attraction of *C. formicarius* weevils to specific sweet potato root volatiles. It would be interesting to test whether these volatiles are attractive to the African *Cylas* spp. *(Note: I already have samples of the root volatiles in various solvents at NRI for this purpose)*.

Natural enemies and Cylas spp. pest management

Limited attention has been paid to the natural enemies of sweet potato weevils. Although, Dipteran and Hymenopteran natural enemies were reported in East Africa (Allard & Rangi, 1995) no further studies were undertaken. There are undoubtedly predatory carabid beetles, and the ants *Anoplolepis custodiens* (*Sangara*) and *Pheidole megacephala* (*Sisi misi*) were frequently mentioned as important natural enemies of *C. puncticollis* by farmers in Coastal Tanzania (Stathers *et al.*, 1998b). Note: In Cuba, farmers use the predatory ant species *P. megacephala* and *Tetramorium guineense* as biological control agents (Ames *et al.*, 1997).

Entomopathogens and Cylas spp. pest management

Ground dwelling insect pathogens, such as entomopathogenic fungi, nematodes and bacteria may be well suited as biological control agents in the underground conditions. The fungus *Beauveria bassiana* has been used as part of IPM programmes in Cuba against *C. formicarius* where foliar planting parts were dipped in a *B. bassiana* solution which was also sprayed around pheromone traps (INIVIT, 1995). In China, *B. bassiana* was mixed with soil during planting (Su, 1991). During the early 1990s CABI and CIP scientists carried out field trials with indigenous isolates of *Beauveria bassiana* in Kenya, Uganda and Burundi in collaboration with KARI, NARO and the Institut des Sciences Agronomiques de Burundi (ISABU) respectively as part of an 'Integrated Control of Arthropod Pests of Root Crops' project funded by the International Development Research Centre and the Rockerfeller Foundation. The *B. bassiana* spores suspended in either oil or rice/oil formulations were mixed into the soil. *B. bassiana* infected insects (*C. puncticollis*, *C. brunneus* and *Blosyrus* spp.) were found throughout the trials. However it is only the Ugandan trial which collected any data on damage levels and no significant differences in damage were observed between the control and *B. bassiana* treatments at either the 6 or 9 month after planting harvest (Allard & Rangi, 1995). Nicole Smit felt that the very dry soil conditions which coincide with soil cracking and weevil infestation of sweet potato roots in many sweet potato growing areas of East Africa, may adversely effect survival of the fungal spores in the soil. However, advances in formulation technology since the early 90s may help improve the persistence of fungal spores in the soil. Discussions with the CABI insect pathology team (George Oduor & Ines Dodonou) and management team (Dennis Rangi & Sarah Simons) confirmed that they would be interested in reactivating this area of research. They felt that much of the formulation knowledge gained during the Lutte Biologique contre les Locustes et les Sauteriaux (LUBILOSA) project would be of particular relevance, as would the work they are currently involved in on the use of entomopathogenic fungi against soil inhabiting pests. Discussion focused on: the low value of sweet potato and whether farmers would have the ability to invest in a commercial product; who would be involved in the production of any potential formulation; could it really be produced at the village or district level and with what degree of quality control. Village level virus production in South America for use against insect pests is considered as an example of a much simpler technology. The subject of

registration of entomopathogenic fungal products was also discussed. Sarah Simons mentioned the need to register a Ugandan fungal isolate after it had been mass produced in Kenya before it could be re-used for field trials in Uganda. This process would significantly delay the uptake of any technology. The Nairobi CABI team have excellent skills and facilities for conducting research into and mass production of any isolates developed. No comparative facilities currently exist in either Uganda or Tanzania.

During the 'Integrated Control of Arthropod Pests of Root Crops' project a Sweet potato Database System was constructed to analyse pest management of sweet potato survey data from East and Southern Africa. This information would be useful background information for any future project involved with sweet potato crop management. Dennis Rangi suggested I contact Mathew Cock at CABI Silwood Park to find out where this information is and how to access it.

One of the CABI researchers Martin Kimani has been heavily involved in the FFS in western Kenya which are now beginning to incorporate livestock as well as crop activities. Martin knew the FFS facilitators in Kagera Region, Tanzania who are currently focusing on banana crop management, and mentioned that IFAD were also supporting 5 FFS in the Southern Highlands of Tanzania in collaboration with the Ministry of Agriculture in Mbeya. Martin mentioned that many of the Tanzanian facilitators had attended the Training of Trainers (TOT) in the Philippines. Links could be established between sweet potato crop management researchers in the Lake Zone and the Kagera FFS programme, this might be particularly useful for the CPP funded SP virus project (R7492) which is focusing on Kagera Region.

Two KARI researchers are currently involved in studies into aspects of sweet potato management: Agnes Kihurani is completing a PhD on post harvest rots of sweet potato; and Shelminth Mwaniki has recently completed an MSc at Reading University focusing on the use of the entomopathogenic nematode (EPN) *Steinernema riobravis* against *Cylas* spp.. Shelminth has been surveying for indigenous Kenyan EPNs, with efficacy against *Cylas* spp. to date her studies have been laboratory based due to financial constraints. In Thailand, EPNs are being commercially produced for use against *Cylas formicarius* (D. Grzywacs, Pers. comm), and in Israel field trials have found that EPNs can infect *Cylas* spp. in irrigated sweet potato production systems (I. Glazer & B. Fridlender, Pers. comm). Again, formulation technology may play an important role if EPNs are to be effective during the very dry period when *Cylas* spp. damage becomes most serious in East Africa.

TANZANIA

DFID is currently supporting three sweet potato projects in Tanzania, one CPP project on 'Promotion of and technical support for methods of controlling whitefly-borne viruses in sweet potato in East Africa' (R7492) and two closely linked CPHP projects on 'Maximising incomes from sweet potato production as a contribution to rural livelihoods' (R7498) and 'Sweet potato cultivars with improved keeping qualities for East Africa' (R7520). Project R7492 will focus on Kagera Region in the Lake Zone as it is a high virus incidence area (insect pest damage data will also be recorded for all the SP cultivars which have just been planted), while the other two projects will focus on Ukerewe, Maswa and Meatu Districts in the Lake Zone, and selected areas in both the Eastern and Southern Highlands Zones (to date marketing surveys have been undertaken in the Lake Zones and on-station fresh storage trials will be started at Ukiriguru in June).

Extensive survey work carried out with nearly 900 Tanzanian farmers between 1991 and 1993, found that the major constraints to sweet potato production at the farm level were: insect pests and diseases; continuous use of low yielding varieties; lack of planting materials; limited use of varieties with desired root characteristics; vermin; drought; and post-harvest losses due to limited use of the crop together with lack of good post-harvest handling techniques (Table 1.) (Kapinga *et al.*, 1995). Farmers indicated that the major objectives of sweet potato production are first, home consumption and second sale in local markets to generate income.

The most important pests are sweet potato weevils *Cylas puncticollis*, rough weevils *Blosyrus* sp. and striped weevils *Alcidodes dentipes*. Unfortunately the above mentioned survey did not consider them independently. Market surveys in the Lake Zone have shown that the greatest reduction in value of

sweet potato roots is due to weevil damage, with average discounts of 30-40% for surface attack by *Blosyrus* spp., and over 50% for the deeper *C. puncticollis* damage (Thomson *et al.*, 1997). Observations by researchers suggest that the *Blosyrus* populations and subsequent root damage have been increasing rapidly in the last few years in the Lake Zone, these observations are supported by the increasing frequency of farmers' requests to researchers for solutions to the rough weevil problem. However no supportive quantitative data exists. Very little information exists on *Blosyrus* spp., and even less about effective management methods, although it is found in areas of Kenya, Tanzania, Burundi, Rwanda and Uganda (Allard & Rangi, 1995), South Africa (Daiber, 1994) and Swaziland (Nsibande & McGeoch, 1999).

Ukiriguru ARI links with CARE sweet potato activities

The researchers at Ukiriguru Agricultural Research Institute have strong links with many of the NGOs working within the Lake Zone, particularly through the long running client-orientated research project based at Ukiriguru and supported by the Netherlands Government since 1993. The client-orientated research project works with Farmer Research Groups (FRG) in a number of districts within the Lake Zone (see Fig 1). We visited the CARE office in Magu district (although CARE are present in other areas of the Lake Zone, their only agricultural activities are in Magu district), and met Johannes Osarya their Technology Transfer Co-ordinator. CARE Magu work with about 250 groups of farmers in Magu district using farmer representatives from each group who subsequently train the rest of their group.

CARE PRA surveys found that lack of inputs was a major problem in the district. This resulted in the formation of Input Marketing Associations (IMA). The IMA groups bulk purchase products (e.g. the grain protectant Actellic Super) to help reduce individuals costs. Other inputs the groups are interested in include maize, bean, sunflower, cassava and sweet potato seed and planting materials. Ukiriguru is involved in both the supply of new planting material varieties and training and demonstrations on new cassava flour products such as confectioneries that have become very popular at weddings in Magu. Farmers in Magu often use swamp or irrigated homestead nurseries to produce their SP planting material. *Cylas* spp. and *Blosyrus* spp. weevils are a problem and cultural control practices such as selection of clean planting material, and 'hilling up' are important aspects of the CARE SP IPM training sessions. SP leaves are not commonly eaten by the local Sukuma tribe, but after harvest may be used to feed livestock (livestock are of low importance in Magu district as the proximity to the Lake means fish are a higher priority food). At harvest SP roots are peeled, sliced and sun-dried into *michembe* which is stored (usually in sacks inside the house) and can be traded. Post-harvest pests including the larger grain borer (LGB, *Prostephanus truncatus*) cause serious damage. Chipping machine demonstrations are planned in conjunction with Ukiriguru researchers. If popular CARE hope to train local artisans to make the machines. At present innovative farm implements can be produced by IPI, Faculty of Engineering at the University of Dar, and possibly by KAMATECH in Arusha.

Ukiriguru ARI links with Winrock International sweet potato activities

Winrock International (an NGO funded by both the Winthrop and Rockerfeller trusts) with work programmes in Kenya, Uganda and previously in Southern Sudan), started a programme of technology transfer activities in three districts of Shinyanga Region in January 2000 (see Fig 1.). Moses Ngendello, the Country Co-ordinator (previously an Ukiriguru researcher with strong involvement in the client orientated research project) is currently the only member of staff. Following a small needs assessment exercise Winrock International decided to focus on the following six topics in Shinyanga:

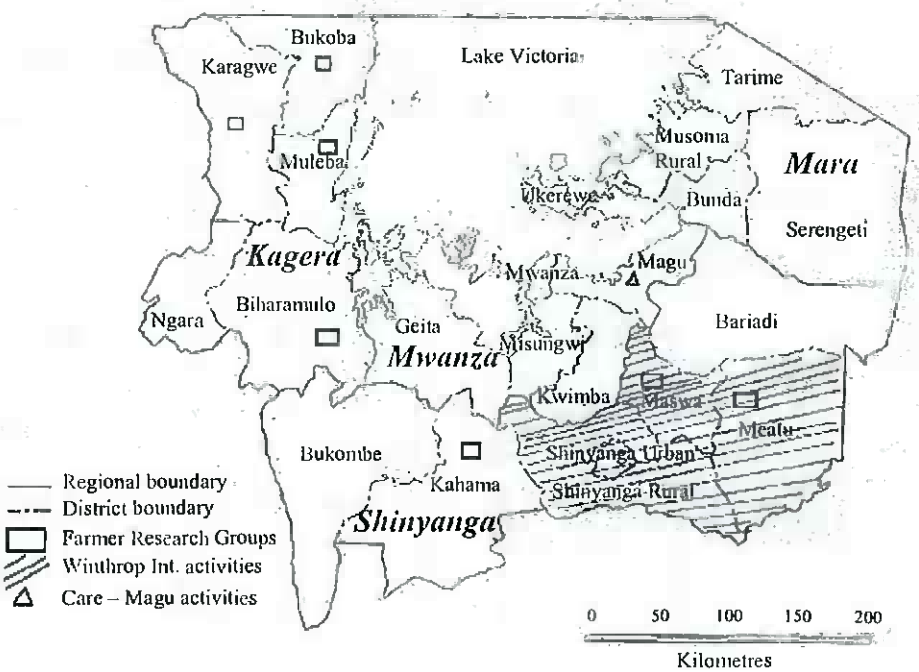
- Animal traction –transportation of crops, rehabilitation of low cost oxcarts
- On-farm planting materials – womens' groups have set up 12 demonstration plot of new SP varieties, and 8 demo plots of cassava cuttings, and sorghum, pearl millet and rice demos in collaboration with Ukiriguru
- Soil management practices – minimum tillage, tie ridges in collaboration with the International Centre for Research into Agroforestry (ICRAF)
- Agricultural training – as demand arises, farmers' suggested topics include: first aid for livestock; post-harvest pest control; and Striga management
- Post-harvest processing and utilisation – will collaborate with Ukiriguru
- Renewable energy – energy saving stoves

Table 1. Major sweet potato production and post-harvest problems facing farmers (percent per zone) in Tanzania

Criterion	Zones						Mean	Rank
	East	South	West	Southern Highlands	Lake	Central		
INSECT PESTS	**75**	**100**	**100**	**75**	**100**	**0**	**90**	**1**
Weevils	75	0	100	75	75	0		
Beetles	25	0	0	0	25	0		
Elegant grasshopper	25	0	0	0	25	0		
Millipedes	0	100	0	0	50	0		
Butterfly larvae	0	0	0	0	75	0		
Termites	0	0	0	0	25	0		
DISEASES	**75**	**100**	**0**	**75**	**80**	**0**	**82.5**	2
Root rot	50	100	0	25	0	0		
Viral	25	0	0	75	100	0		
Fungus	0	0	0	0	0	0		
Wilt	0	0	0	25	0	0		
VERMIN	**25**	**100**	**0**	**75**	**80**	**0**	**75.4**	3
Rats	25	100	0	75	75	0		
Baboons	25	0	0	0	0	100		
Pigs	25	0	0	75	0	25		
Moles	0	0	0	75	25	25		
Monkeys	0	0	0	25	0	0		
Porcupines	0	0	0	0	75	0		
LAND SHORTAGE	0	100	0	50	25	0	29.2	4
SHORTAGE OF PLANTING MATERIALS	0	0	0	100	50	0	25.0	5
LOW SOIL FERTILITY	25	0	0	100	25	0	25.0	5
LACK OF CASH	0	100	0	0	25	0	20.8	6
LABOUR SHORTAGES	0	100	0	0	25	0	20.8	6
DROUGHT	0	100	0	0	0	0	16.7	7
POOR STORAGE	0	0	0	50	50	0	16.7	7
LACK OF PROCESSING FACILTIES	25	0	0	75	0	0	16.7	7
MARKETING PROBLEMS	0	100	0	0	0	0	16.7	7
LOW PRICES	0	0	0	75	0	0	12.5	8
POOR INFRASTRUCTURE	0	0	0	75	0	0	12.5	8
LATE MATURITY	0	0	0	25	0	0	4.2	9
LACK OF KNOWLEDGE	0	0	0	0	25	0	4.2	9

Source: Kapinga *et al.*, 1995

Figure 1. Map of the Lake Zone Tanzania, detailing location of Ukiriguru, CARE-Magu and Winrock International farmer participatory activities.



Winrock International works through village extension staff with existing farmer groups wherever possible, and uses its strong links with Ukiriguru and ICRAF to bring them in as resource people when necessary. Moses had hoped to work with the existing FRG but feels their moral has declined due to low funding and infrequent visits, he is keen to avoid the same problem. Next year two new staff will be recruited to be based in Meatu and Maswa districts. While we were there, the national ITV television channel were filming footage of some of the Winrock International supported farmers activities for inclusion in a documentary to be broadcast later this year.

SP and cassava are very important crops in this low rainfall area (<400mm) where cotton was once an important cash crop. SP vines are grown and sold commercially by women in the swampy areas of the district prior to the planting season, following harvest most farmers process SP into *michembe* which they may store until November and sell as a cash crop during this period of food shortage. The Saturday market at Mhunze is an important market outlet which traders travel from far to attend.

Other organisations and NGOs active in Shinyanga Region include Africa Inland Church (AIC), World Vision, Oxfam, the Tanzanian Association of Women Leaders in the Agricultural Environment (TAWLEA) and the IPM Shinyanga project.

Ukiriguru ARI links with the IPM Shinyanga project sweet potato activities

The IPM Shinyanga project began in 1992 as a collaboration between the Tanzanian Ministry of Agriculture Plant Protection Division (PPD) and GTZ. The period between 1992-1994 was a technology development phase, since 1996 activities have focused on dissemination (involving extensive training of extension officers and development and dissemination of literature). Sweet potato pest management has always been a very important part of the IPM project. During the research phase the project worked closely with Ukiriguru entomologist Simon Jeremiah. The SP recommendations include: selection of clean undamaged planting material, rapid multiplication, hilling up (usually 4 & 8 weeks after planting); pest monitoring, piecemeal harvesting; prompt harvesting when weevil damage levels increase; processing technology of *michembe* and *matoborwa* chips. These recommendations have been visualised in excellent pamphlets and posters developed in consultation with farmers, IPM project staff and Ukiriguru researchers (see Figs 2a-c for examples).

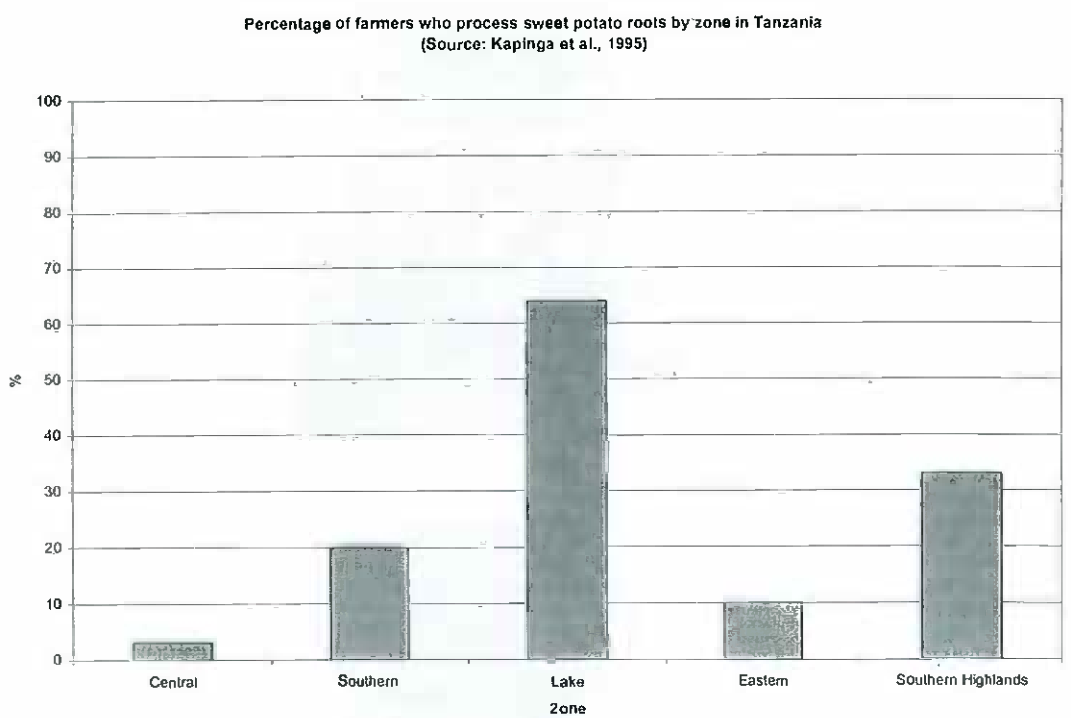
Figures 2a-c. Examples from the Sweet Potato IPM recommendations booklet

Source: Tanzanian –German Project for Integrated Pest Management (1996(3)) Mbinu Bora za Kupunguza Mashambulizi ya Wadudud kwenye Viazi Vitamu. Kijitabu cha Mafunzo Kwa Washauri wa Kilimo, Kanda ya Ziwa.

Unfortunately, no evaluation or feedback information was available on their spread. Regina Kapinga, the previous Root and Tuber Crops Co-ordinator at Ukiriguru and current Director of Research at the Commission of Science and Technology (COSTECH) confirmed that these materials had not been widely distributed in Zones other than the Lake Zone although they would be of relevance (potentially in Kenya and Uganda as well). However, outreach studies conducted by the IPM project in 1996, found that project information (no specifications given as to what information, or the use of that information) had reached 27,000 farm families in the Lake Zone. The IPM project is planning to conduct further outreach studies this year.

The IPM project staff we met (Mkondo Fabian, Henry Kolowa and Martin Katua) are worried by the increasing storage pest problems (particularly LGB) in Shinyanga and issues of seed health (e.g. sorghum smut) which they feel have been neglected to date, and are areas they need more support in. The subject of increasing storage pest damage was also raised by the Ukiriguru post-harvest researchers, who mentioned that in Meatu district farmers used to store large quantities of chips, but now can't store for longer than three months due to pest infestation, which has serious food security implications. These problems are particularly important in the Lake Zone where more than 60% of farmers process sweet potato (Fig 3).

Figure 3.



INDONESIA

Although Indonesia was not visited, detailed information about sweet potato crop management and the farmer field school approach was gained from Elske van der Fliert, CIPs IPM specialist in SE Asia. In Indonesia, sweet potato is grown under an intensive regime as a cash crop. Two crops are often grown each year in between the rice cropping periods (and work with farmers in Java found that sweet potato frequently gave two to three times as high an income as rice). Traders negotiate with farmers prior to harvest for the whole field and then organise the harvest and transport of the crop. Women weren't very interested in learning about sweet potato except for the area of product development, and as a result the ICM activities focused mainly on men who were prepared to spend time to increase their yield. As such it is a very different situation to that of sweet potato grown extensively and as a subsistence crop in East Africa. However, the ICM FFS approach used in Indonesia to enhance

farmers' problem-solving and decision-making skills is very relevant to sweet potato ICM in East Africa. The FFS for sweet potato was developed in East and Central Java over a three year period and launched in 1997, a manual designed for SP ICM FFS facilitators was published in 1999, this could be adapted for use in East Africa. Elske is now involved in pilot sweet potato IPM FFS in Vietnam, China and the Philippines.

The Indonesian FFS farmers experiments focused on: sweet potato varieties; fertilizer application (combinations and rates); intercropping; use of *Cylas formicarius* sex pheromones; vine lifting. Although *C. formicarius* management was initially a prioritised topic, the farmers eventually decided that they could adequately use water management to prevent the cracking of the soil and weevil access to the roots in combination with hilling up. An example of the FFS curriculum developed in Indonesia is given in Table 2.

Table 2. Sweet potato ICM Farmer Field School curriculum developed in Indonesia

Weeks after planting	Session	Farm calendar	FFS activities and special topics (ST)	Group dynamics exercises
-2	0		Preliminary meeting(s)	
-1	1	Field preparation: hoeing, fertilising, ridging	• Pre-test • Field sanitation • Field preparation and fertilisation • ST-1: Introduction to the sweet potato ICM Farmer Field School • ST-2: A healthy soil	1. Line up 2. Family members
0	2	Preparation of cuttings and planting	• Preparation of cuttings and planting • ST-3: Experimental methodology • ST-4: Healthy seed	3. How many squares?
1	3		• ST-5: Observing the environment • ST-6: economic analysis of the sweet potato enterprise	4. Family reunion 5. Nine dots
2	4		• ST-7: A healthy crop	6. The snake sheds its skin
3	5		• ST-5: Observing the crop and its environment • ST-8: Natural enemies: the farmers' friends	7. Know yourself
4	6		• ST-9: Sweet potato pests • ST-10: defoliation experiment	8. Knotty problem
5	7		• ST-11: Sweet potato diseases • ST-23: Sweet potato storage	9. Follow me
6	8	Soil preparation for fertiliser side dressing	• Soil preparation • ST-12: Weeds: friends or foes?	10. Trust each other
7	9		• ST-13: Aphids and other tiny insects • ST-14: Pesticides: medicine or poison?	11. Drawing together
8	10	Apply fertiliser and reform ridges	• Apply fertiliser and reform ridges • ST-15: Fertilisation	12. Play the rope
10	11	Vine lifting	• ST-16: Vine lifting • Vine lifting • ST-17: Field area measurement	13. Mirror game
12	12		• ST-18: Sweet potato stemborer • Defoliation experiment	14. Drawing a house
14	13		• ST-19: Sweet potato weevil	15. Guide the blind
16	14		• ST-20: Cropping pattern • ST-21: Variety selection	16. Collector's items
18	15		• ST-22: Harvesting and marketing • ST-7: A healthy crop (analysis)	17. Wayward whispers
20	16	Harvesting	• Harvesting • ST-22: Harvesting and marketing (yield assessment contest)	
21	17		• Field sanitation • ST-24: Sweetpotato utilization • ST-25: Evaluation of the sweet potato ICM FFS • Closing ceremony	

Source: Fliert, van der E. & Braun, A. (1999)

CONCLUSIONS

The following conclusions are based on a team meeting in Nairobi (following the Ugandan and Kenyan sections of the visit) and on observations and information from the Tanzanian section of the visit. The team strongly felt that further work was required on sweet potato pest management in East Africa, and that there was strong interest by research institutes and NGOs keen to collaborate together.

Any project developed would need to be fairly flexible in its initial design, commencing with a strong needs assessment, and using the information gathered to enable the ***farmers to set the research agenda*** helping to ensure ownership of the process by the farmers, relevance of the research focus and uptake of any successful and appropriate integrated technologies.

The emphasis of the project should be very much on ***farmer discovery and experiential learning***, (as opposed to researcher designed and managed on-farm trials), particularly as many of the pest management components are ***cultural practices*** with labour implications for farmer households. It is important that the project is able to focus not only on traditional field pest management issues but on ***wider crop management issues*** (both pre and post-harvest) if prioritised by farmers.

The existing and potential sweet potato crop management practices discussed during this visit can be roughly divided into two groups.

- The first group includes technologies that can be experimented with and incorporated into management practices by farmers immediately given a strong investment in developing the communication and training approach. For example:
  - varietal selection for virus resistance, weevil escape and market demand;
  - source, selection and multiplication of planting material;
  - field preparation including sanitation, rotation and non adjacent field planting;
  - pest monitoring and hilling up;
  - harvesting timing;
  - post-harvest storage and processing techniques;
  - the augmentation of natural enemy populations such as ants (which may arise as a result of farmer experiments and more detailed understanding of the interactions within the ecosystem);
  - and possibly the use of repellent plants during crop production (a small amount of research has been reported on the use of botanical insecticides from India), which could potentially provide a low cost available component of a SP pest management system.

- The second group includes techniques that still require a substantial amount of laboratory and on-station style research before an understanding of their potential for application within the East African sweet potato farming system is achieved. For example:
  - use of entomopathogenic fungi (expertise within CABI) and nematodes (expertise within KARI/ Reading University) as dips for planting material and/or soil application;
  - efficacy of SP root volatiles for mass trapping (expertise within NRI/ ICIPE).

It is likely that there is still a lot of information that remains unknown to researchers about the traditional farming practices used for pest management in East Africa, which may be both well adapted to agro-ecological and socio-economic conditions and flexible in response to all kinds of risks. The above mentioned techniques are by no means a complete list and it is important that in the project both farmers and researchers learn from each other and integrate the two possibly distinct sets of knowledge to strengthen the foundations of both the indigenous and scientific knowledge.

The ecology of regional ecosystems and arthropod fauna might make it difficult to have a regional approach. However if the project focuses on building farmer capacity to collect, analyse, interpret information and evaluate results, farmers should be able to adapt the technologies to complement their local situations and changes which occur in them. In her PhD thesis Nicole Smit (1997) identified both Soroti district in Uganda and Mwanza and Shinyanga districts in the Lake Zone of Tanzania as suitable pilot areas for SP IPM. This was due to the following combination of socio-economic and agrocecological conditions:

1. Sweet potato is a basic staple food and/or a major cash crop.
2. Rainfall is low and/or poorly spread with one or two long dry seasons.
3. Sweet potato production becomes more important and intensive because:

a) other staple and/or cash crop(s) have declined in importance due to e.g. the emergence of ACMV which in Uganda dramatically reduced cassava production (and is now becoming a threat in the Lake Zone (E. Kanju & S. Jeremiah, Pers. comm))
b) the crop's economic value increased (e.g. after product development leading to an increase in market and quality demands for sweet potato).

A lot of work has already been done in both these locations, and there are also the current projects on virus management, long term fresh storage and farmer participatory research of SP ICM which have collected a lot of relevant information on the role SP plays in the livelihoods of rural farmers in these locations. Work on IPM of SP pests would complement the Tanzanian projects in aiming to extend the availability of both fresh and stored sweet potato produce. In both locations the National Research Insititutions and NGO's have strong links with farmer groups, and a long-term perspective. Both CIP and NRI have a high level of interest and long-term commitment to this work and strong joint collaborative links with actors in both these locations. CIP is expecting to recruit another international scientist to join their team later this year, but this is likely to be a breeder with additional responsibilities for IPM in East Africa. If a new project was approved it would be strengthened by the posting of a researcher (PhD student, APO or post-doc) in the region, CIP could post someone in Uganda, Tanzania or Kenya. The FFS programmes in both Soroti and Kagera (in the Lake Zone) are still fairly new, but provide the opportunity for future large-scale dissemination of sweet potato ICM, and a lot will be learnt from the SP ICM FFS experiences in Indonesia. The manual developed by farmers and FFS facilitators and written by Elske van der Fliert and Ann Braun could easily be adapted and translated and amalgamated with existing East African SP extension materials (e.g. PPD/GTZ (Figs 2)) for use in East Africa.

Within the PRAPACE network, the national programmes of the countries involved (Burundi, Eritrea, Ethiopia, Kenya, Rwanda, Uganda and Zaire) divided up the mandate area and Uganda received the mandate for IPM research. However, the concept of mandates is getting looser, and proposals are accepted from qualified researchers in other countries, as long as the benefits will be wider than just one country and will contribute to a market-oriented "comercialisation of agriculture" (P. Ewell. Pers. comm). PRAPACE facilitates the spread of positive results for adaptation by farmers in the other PRAPACE countries. SARRNET which Tanzania is a member of, has selected pilot countries on the basis of the level and probability of impact for Phase II of its agenda and Tanzania, Mozambique and Zambia will be the focus countries for Crop Management and Ecologically Sustainable Plant Protection (ESPP).

Appendix 1: Itinerary

Date	Location	Contacts	Activity
24/4	Travel to Uganda		
25/4	Arrive Kampala	Alwyn Chilvers, DFID NR Advisor	Update on CRF project, discussion of DFID bilateral projects in Uganda and strengthening their links with research projects.
	Namulongwe ARI	Benson Odongo, SP Entomologist NARO Gard Turyamureeba, SP Breeder NARO	Discussion of current NARO sweet potato activities, links with McKnight foudation, uptake pathways, visit to on-station breeding trial.
26/4	Travel to Soroti	Joseph Mudiope, CIP research assistant Jane, CIP field assistant	Brief discussion of CRF project Visit to sealed underground SP chip storage trials
		Elske van der Fliert, CIP IPM specialist	Discussion of Indonesian sweet potato production and constraints, farmer experimentation, Cuban SP IPM, efficacy of pheromone traps.
27/4	Serere Agriculture and Animal Research Institute, Soroti	CRF project stakeholders: Peter Ewell, CIP/CRF project leader Heather Kindness, NRI/CRF socio economist Joseph Mudiope, CIP/CRF research assistant Benson Odongo, NARO/CRF entomologist Gard Turyamureeba, NARO breeder Michael Opoi, SOCADIDO, Soroti Erna Abidin, Arapai Coll lecturer, CIP PhD Elske van der Fliert, CIP SE Asia IPM Tanya Stathers, NRI storage pest ecologist Bernadette Ekemu, Dept of Ag, Soroti Edward Ahimbisibwe, Kyera FTC, Mbarara Edward Akorimo, Dept of Ag., Kumi Michael Ebwongi, Church of Uganda, Soroti Berga Lemaga, PRAPACE, Kampala Charles Odul, SAARI, Soroti John Okello, Dept of Ag, Kumi James Okoth, IPPM-FFS Soroti, (ex CRF) Andy Ward, Crop Protection Programme	Workshop presentations on: -Overview of CRF project -Findings of Gweri survey work -Kumi survey work -Results of CRF on-station/ on-farm trials -NARO SP breeding trials and releases -SOCADIDOs sweet potato work -Local germplasm collection & multilocational trials -Overview of CIPs SP IPM projects and FFS approach -SP storage root depth and susceptibility to Cylas spp. -Role of SP in local diet and product diversification Group discussion focused on: achievement of CRF outputs and level of integration of the different technologies; level of farmer participation; severe shortage of planting material possible use of tubers; partner collaboration; access to information by all collaborators.
28/4	Kidetok, Soroti district	SOCADIDO staff & participating farmers	Visit SOCADIDO farmer groups practising rapid multiplication of planting material, fresh pit storage, salted dried SP chips. Discuss ventilation of pits, removal of roots, rodent damage, stored product pest damage.
	Kidetok, Soroti district	James Okoth, FAO IPPM FFS project & participating farmers	Visit IPPM FFS groups discuss cotton IPM, farmers keen to use principles learnt on groundnut, SP low priority. FFS approach felt by farmers to be adaptable and not exclusive to only the educated or better off members of the community. FFS now managing their own budgets.
	Arapai Agricultural College	Erna Abidin, Arapai College, CIP PhD student	Visit SP germplasm collection (>100 accessions) differentiated using morphological characteristics; students help assessing morphological characteristics, and will set up experiments using Cylas pheromone traps. College library and lecture rooms visited.
	Agwara, Soroti	Agwara participating CRF farmers	Visit tree and swamp nurseries discuss labour bottlenecks at SP planting time priority given to groundnuts, sale of vines, goat damage, pheromone traps lack of understanding of Cylas lifecycle.
	Soroti district	David Rees, Agrisystems, Serere AARI, Soroti	Brief discussion of competitive research facility at Serere, likely to be looking for collaborative proposals in Sept 2000.
29/4	Travel to Nairobi		Informal discussion with team
30/1	Nairobi	Weekend/ public holiday	Informal discussion with team
2/5	ICIPE, Nairobi	Markus Knapp & Nelson Mwangi, ICIPE	Discuss Nelsons MSc work on popn dynamics of potato tuber moth, which is not a serious pest in East Africa due to limited amount of seed stored. Very little ITK regarding this pest in Kenya, farmer interest in pheromone traps, but in Latin America pheromones traps do not reduce PTM damage. Markus Knapp working on red spider mite control in

			tomatoes. Neem workshop in progress at ICIPE, ICIPE have developed a small scale neem production plant. Very limited work on entomopathogenic fungi against tsetse and western flower thrips at ICIPE, no work on entomopathgoenic nematodes, historical work on GV virus.
		Peter Njagi, Behavioural & Chemical Ecology Dept., ICIPE	Discuss ICIPE research on: tsetse repellents (ex waterbuck) and attractants (ex cattle) for use in push-pull management; habitat management for maize stem borer. ICIPE were approached about producing *C. puncticollis* pheromones in Africa, but following studies on poor field success of *Cylas* pheromones plans changed. I mentioned Prof Kays recent work on SP plant volatiles for attracting female *C. formicarius*. ICIPE would be interested in collaborating in tests vs *C. puncticollis* & *C. brunneus*.
		Bernard Lohr, GTZ IPM Horticulture	Brief discussion on: vegetable IPM and recent changes to maximum pesticide residue limit on export horticulture; FFS in Kenya, problems of excluding research from FFS and key facilitators often having no IPM knowledge at all; GTZ reducing its technical funding; GTZ Shinyanga IPM project previously worked on SP IPM has received IFAD funding to extend its activities; GTZ also involved in a coffee and vegetable IPM project based in Arusha.
		S. Sithanatham & Charles Matoka, ICIPE	Briefing on ICIPE's participatory research activities focusing on export French beans and thrips.
	CABI Bioscience ARC	Sarah Simons, Dennis Rangi, George Oduor, Martin Kimani, Ines Dodonou, CABI	Discussions on CABIs previous Rockerfeller work on *B. bassiana* against *Cylas* spp. in a number of countries in Africa., poor field efficacy could now be improved through using new methods of formulating the spores. CABI currently have work on entomopathogenic fungi against soil borne pests *Cylas* would fit well into this project. SP database of farmer practices in Tanzania in the early 90's. FFS in Kenya now also including livestock issues at the request of farmers.
	KARI, Nairobi	Gilbert Kibata, Agnes Kihurani & Shelminth Mwaniki, KARI	Discussions on SP KARI activities; gentically modified SP against feathery mottle virus, recent permission to bring GM material into Kenya; PhD on post-harvest storage rots; use of entomopathogenic nematodes against *Cylas* (*Steinernema riobravis* showed potential during lab studies, no field studies have been funded). Also ongoing work on the use of EPNs against chafer grubs, *Spodoptera* spp. and leaf miners. Irrigated SP being grown in Kibirigwi to target the ramadan period. Mole rats are also a serious pest of SP.
	Nairobi	Wrap up team meeting: Peter Ewell, Elske van der Fliert, Heather Kindness, Andy Ward & Tanya Stathers	Discussion on future work: feeling that still not enough work has targeted farmer knowledge about pest lifecycle and management strategies, this approach could be used in conjunction with cultural control practices such as hilling up and clean planting material, further study of natural enemies particularly ants augmenting populations. Any approach should be much more integrated crop management. The biocontrol options of *B. bassiana* and EPNs may have potential but will be much more longer term strategies and expensive despite the large amount of work done in the 1990's. Plus due to low value status of SP in E. Africa farmers unlikely to invest.
3/5	Travel to Mwanza, Tanzania	Simon Jeremiah & Edward Kanju, Ukiriguru ARI	SP virus trials have been planted in Kagera, weevil infestation data will also be collected, Jeremiah will visit later this month. Kanju has recently finished his PhD in S. Africa and has taken over from Regina Kapinga as Root & Tuber Crops Co-ordinator. ACMV has been reported but not yet confirmed in Ukerewe Island, Kanju interested in working with community breeding coping strategies against this disease he has experience of this from Naliendele .
	Magu district	Johannes Osarya, Technology Transfer Co-ordinator CARE Magu. Pili Ndaki, Input Marketing Co-ordinator CARE Magu	Discussions about CARE Magu who focus on: Technology transfer; Savings; Inputs. CARE Magu has strong links with the client oriented research project based at Ukiriguru, and with Plan

			International, IFAD Mara, Kagera Agricultural Environment and Management Project (KAEMP) and Extension.
4/5	Ukiriguru ARI, Lake Zone	Theresa Ngendello, Elizabeth Rwiza, Simon Jeremiah, Edward Kanju, Mr Nyango, Root and Tubers Section Ukiriguru ARI.	Discussions on current research activities of the group and feelings on priority areas which included development of high yielding early maturing varieties, and post-harvest storage pest control on SP chips. Farmers in many areas storing smaller volumes for shorter periods due to pest pressure. Ukiriguru staff work with farmer research groups supported by the client oriented project, hilling up and variety trials.
	Shinyanga town	Moses Ngendello, Winrock International, Shinyanga	Winrock International works mainly on technology transfer focusing on: animal traction; on-farm planting materials; soil management practices; agricultural training; post-harvest processing and utilisation; and renewable energy. Winrock collaborates with Ukiriguru and Africa Inland Church, IPM Shinyanga. Working with existing womens groups on SP activities, farmers suffered serious losses to SP chips due post-harvest pests.
	Shinyanga	Mkondo Fabian, Henry Kolowa, Martin Katua, IPM Shinyanga	Since 1996 the Plant Protection/ GTZ IPM Shinyanga project has focused more on dissemination rather than technology development. SP crop management is an important dissemination activity and they developed excellent cartoon pamphlets and posters with Ukiriguru on the subject. Outreach studies showed that by 1996 the IPM project information had reached 27,000 farm families. They feel seed health issues are important and were neglected during the IPM project. The storage pest problem is increasing particularly LGB, the IPM project would like to be able to offer more support to farmers in this area.
5/5	COSTECH, Dar Es Salaam	Regina Kapinga, Director of Research, COSTECH	Discussions on her role as co-ordinator of research projects. COSTECH is developing a retrospective database to facilitate easy access to research records. Regina felt the IPM SP cultural practice extension booklets had not been widely distributed in Zones other than the Lake Zone although they might be relevant. Discussion over potential for work on entompathogenic fungi and EPNs to be carried out in Tanzania.

Appendix 2: Acknowledgements

This report is an output from a Crop Protection Programme development visit funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

I would like to thank Peter Ewell for his organisation of all the logistical arrangements in both Uganda and Kenya, and Edward Kanju and Simon Jeremiah for their logistical arrangements in Tanzania.

Appendix 3: Acronyms and Abbreviations

AIC	Africa Inland Church
CABI	CAB International
CBO	Community Based Organisations
CIP	International Potato Centre
CPHP	Crop Post Harvest Programme
CPP	Crop Protection Programme
CRF	Competitive Research Facility
DFID	Department for International Development (UK)
EPN	Entomopathogenic nematodes
ESPP	Ecologically Sustainable Plant Protection
FAO	Food and Agriculture Organisation of the United Nations
FFS	Farmer Field School
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
HIV	Human Immunodeficiency Virus
ICIPE	International Centre for Insect Physiology and Ecology
ICM	Integrated Crop Management
ICRAF	International Centre for Research into Agroforestry
IFAD	International Fund for Agricultural Development
IMA	Input Marketing Associations
IPM	Integrated Pest Management
IPPM	Integrated Production and Pest Management
ISABU	Institut des Sciences Agronomiques du Burundi
KARI	Kenya Agricultural Research Institute
LGB	Larger Grain Borer (*Prostephanus truncatus*)
LUBILOSA	Lutte Biologique contre les Locustes et les Sauteriaux
NAARS	National Agricultural Advisory Services (Uganda)
NARO	National Agricultural Research Organisation (Uganda)
NGO	Non Governmental Origanisation
NRI	Natural Resources Institute (UK)
ODA	Overseas Development Administration (UK) (now DFID)
PFI	Promoting Farmer Innovation
PMA	Plan for Modernisation of Agriculture (Uganda)
PPD	Plant Protection Division
PRA	Participatory Rural Appraisal
PRAPACE	Programme Regional de l'Amelioration de la Culture de la Pomme de Terre et de la Patate Douce en Afrique Central et de l'Est
SAARI	Serere Agricultural and Animal Production Research Insititute (Uganda)
SARRNET	Southern African Regional Rootcrop Network
SDDP	Soroti District Development Programme
SP	Sweet potato
SPVD	Sweet potato virus disease
TAWLEA	Tanzanian Association of Women Leaders in the Agricultural Environment
TOT	Training of Trainers
UWESO	Ugandan Womens Effort to Save Orphans
VODP	Vegetable Oil Development Programme

Appendix 4: References and Bibliography

Allard, G. & Rangi, D. (1995). Integrated control of arthropod pests of root crops 1989-1995. IDRC Centre File Number 3-9-88-0111, Rockerfeller Foundation.

Ames, T., Smit, N.E.J.M., Braun, A.R., O'Sullivan, J.N., & Skoghund, L.G. (1997). Sweetpotato: Major pests, diseases, and nutritional disorders. International Potato Centre (CIP). Lima, Peru. 152p.

Daiber, K.C. (1994). Injurious insects, spider mites and nematodes on sweet potatoes in southern Africa. *Zeitschrift-fur-Pflanzenkrankheiten-und-Pflanzenschutz.* **101**(5): 550-557.

Fliert van der, E. & Braun, A.R. (1999). Farmer Field School for Integrated Crop Management of Sweetpotato. Field Guides and technical manual. International Potato Centre (CIP), Indonesia. 265pp.

INIVIT (1995). Control integrado del tetuan del boniato. *Boletin de capacitacion.* Instituto de Investigaciones de Viandes Tropicales, Santo Domingo, Villa Clara, Cuba. 18pp.

Kapinga, R., Ewell, P., Jeremiah, S. & Kileo, R. (1995). Farmers perspectives on sweet potato and implications for research in Tanzania. A case study. Joint report by CIP, Kenya and the Tanzanian Ministry of Agriculture.

Nsibande, M.L. & McGeoch, M.A. (1999). Sweet potato, *Ipomoea batatas* (L), cropping practices and perceived production constraints in Swaziland: implications for pest management. *International Journal of Pest Management*, **45**(1): 29-33.

Silim, M.N., Odogola, W. & Amenet, J. (1991). A technical report on the *Post-Harvest Food Losses Prevention in Uganda*, Project PFL/UGA/001. FAO and the Ministry of Agriculture, Kampala, Uganda. 130pp.

Smit, N.E.J.M. (1997). Integrated Pest Management for sweetpotato in Eastern Africa. Thesis Landbouwuniversiteit Wageningen. 150pp. ISBN: 90-5485-727-7

Stathers, T., Kiozya, H. and Mbilinyi, L.B. (1998b). Notes on farmer pest perceptions and coping strategies in sweet potato production in the Coastal Zone of Tanzania. Draft NRI report of preliminary survey project A0627.

Su, C.Y. (1991). Field application of *Beauveria bassiana* for control of sweet potato weevil, Cylas formicarius. *Chinese Journal of Entomology*, **11**:162-168.

Tanzanian-German Project for Integrated Pest Management. (1996 (3)). Mbinu bora za kupunguza mashambulizi ya wadudu kwenye viazi vitamu. Plant Protection Division, Tanzanian Ministry of Agriculture. 18pp.

Thomson, , N., Ndungmu, G.T., Waida, T.D.R., Rwiza, E. & Jeremiah, S. (1997). The relationship between quality and economic value of fresh sweet potato and dried cassava products in Mwanza, Tanzania. NRI Report Project A0500.

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