CROP PROTECTION PROGRAMME

Project Title: Promoting Potato Seed-Tuber Management For Increased Ware Yields in Kapchorwa District, Eastern Uganda.

R8104 (ZA 0494)

FINAL TECHNICAL REPORT

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Project Leader's Institution: AT Uganda Ltd

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**Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>BW</td>
<td>Bacterial wilt</td>
</tr>
<tr>
<td>CABI</td>
<td>CAB International</td>
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<tr>
<td>CIP</td>
<td>International Potato Centre</td>
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<tr>
<td>COMESA</td>
<td>Common Market for Eastern and Southern Africa</td>
</tr>
<tr>
<td>CPP</td>
<td>Crop Protection Programme [DFID]</td>
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<tr>
<td>DFID</td>
<td>Department for International Development [UK]</td>
</tr>
<tr>
<td>DLS</td>
<td>Diffused Light Store</td>
</tr>
<tr>
<td>EAC</td>
<td>East African Community</td>
</tr>
<tr>
<td>ELISA</td>
<td>Enzyme Linked Immunosorbant Assay</td>
</tr>
<tr>
<td>FAAB</td>
<td>Farming As A Business</td>
</tr>
<tr>
<td>FPRA</td>
<td>Farmer Participatory Research Assistant</td>
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<tr>
<td>KASPPA</td>
<td>Kapchorwa Seed Potato Producers Association [Uganda]</td>
</tr>
<tr>
<td>JAGED</td>
<td>Jigegemee Agricultural and General Development Self-help Group [Kenya]</td>
</tr>
<tr>
<td>MoA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MAAIF</td>
<td>Ministry Agriculture, Animal Industry and Fisheries [Uganda]</td>
</tr>
<tr>
<td>MU</td>
<td>Makerere University [Uganda]</td>
</tr>
<tr>
<td>NAADS</td>
<td>National Agricultural Advisory Development Services [Uganda]</td>
</tr>
<tr>
<td>NARO</td>
<td>National Agricultural Research Organisation [Uganda]</td>
</tr>
<tr>
<td>NC-ELISA</td>
<td>Nitrocellulose Membrane ELISA</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental Organisation</td>
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<tr>
<td>PCs</td>
<td>Production Committees</td>
</tr>
<tr>
<td>PDCs</td>
<td>Parish Development Committees</td>
</tr>
<tr>
<td>PIS</td>
<td>Projected Income Statement</td>
</tr>
<tr>
<td>RSA</td>
<td>Republic of South Africa</td>
</tr>
<tr>
<td>SPS</td>
<td>Seed Plot System</td>
</tr>
<tr>
<td>UNSPPA</td>
<td>Uganda National Seed Potato Producers Association [Uganda]</td>
</tr>
<tr>
<td>USh</td>
<td>Uganda shillings</td>
</tr>
<tr>
<td>USS</td>
<td>US dollars</td>
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</tbody>
</table>
TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1. BACKGROUND 2
2. PROJECT PURPOSE 2
3. OUTPUTS OF RESEARCH ACTIVITIES 3
   3.1 Output 1: Training of Extension Staff, Local Authorities and Farmers on Potato Production, Multiplication and Storage 3
      3.1.1 Trainings 3
         3.1.1.1 Farming As A Business (FAAB) 5
         3.1.1.2 Group Savings and Credit Scheme 6
         3.1.1.3 Training on Collective Marketing 6
      3.1.2 Demonstrations 6
      3.1.3 Exchange Visits 6
         3.1.3.1 Internal Exchange Visits 7
      3.1.4 Seasonal Evaluation 7
   3.2 Output 2. Multiplication of Foundation Seed Multiplied by Farmer Group Members 7
      3.2.1 Seed Multiplication 7
      3.2.2 Disease threshold standards 8
      3.2.3 Quality Monitoring and Sustainability 9
   3.3 Output 3. Distribution: 10
   3.4 Output 4. Commercial Sustainability: 11
      3.4.1 Formation Kapchorwa Seed Potato Association (KASPPA) 11
      3.4.2 Potato Impact Survey 12
4. CONTRIBUTION OF OUTPUTS TO DEVELOPMENTAL IMPACT 13
   4.1 Training: 13
   4.2 Multiplication: 13
   4.3 Distribution: 13
   4.4 Commercial Sustainability: 14
5. FOLLOW UP 14
6. KEY PUBLICATIONS/OUTPUTS 14
7. DISSEMINATION OF RESULTS 15
1. EXECUTIVE SUMMARY

The Farmer Led Seed Potato Multiplication For Eastern Uganda is a 3 year project implemented by AT Uganda Ltd funded by DFID Crop Protection Programme and managed by Natural Resources International (NRI) Ltd.

Many poor households could not access healthy seed to grow potatoes in the highlands of Eastern Uganda resulting in poor yields. The project aimed to establish a sustainable system of farmer led seed potato production for improved varieties in Kapchorwa district, in four subcounties of Kaserem, Kaptanya, Kaproron and Bukwa. Emphasis was on establishing a limited number of viable commercial seed producers as well as training farmers to maintain their own healthy seed from season to season. The seed for multipliers is then passed over to the poor farm households who further multiply the seed using small seed plot system.

The project established 20 commercial Seed Potato Multipliers in Kapchorwa and provided them with training in seed potato production, disease monitoring and management. The multipliers formed Kapchorwa Seed Potato Producers Association (KASPPA).

To support production by the primary potato multipliers, the project developed management tools for crop management that aim to provide a best practice, quality assured, identity-preserved pathway of potato multiplication. The main management tools centers on the Crop History Sheet which provides a written record of management practices and pest status at the potato stand level. In addition, recognizing the destructiveness of bacterial wilt in potato an on-farm post harvest incubation test for the interception of infected seed that can be implemented by farmers has been tested with promising results. The KASPPA members have managed to keep BW levels below 1.0%.

About 1,410 small-scale group farmers received seed for further multiplication using the small seed plot system. These include all the project group members plus additional partner groups.

The distribution of seed to the small-scale farmer has been implemented through the of the Parish Development Committee to ensure effective targeting of the poorest of the poor. The project has achieved good recognition at the community level.

The impact survey was carried out in September, 2004, and the finding indicate that, the project has made an impact among the multipliers and direct beneficiaries in terms of changing production practices, eating patterns, and income sources. As expected, impact of the project has diffused to the neighbouring non-beneficiaries to a greater extend than to non-beneficiaries who are more distant from the project.
2. BACKGROUND

The Farmer Led Seed Potato Multiplication For Eastern Uganda is a 3 year project implemented by AT Uganda Ltd funded by DFID Crop Protection Programme and managed by Natural Resources International (NRI) Ltd.

Earlier project (LIFE Project) implemented in Kapchorwa district, identified the need to address the high risk of potato crop failure due to diseases of bacterial wilt and blight during the needs assessment. Availability of healthy seed potato and knowledge on potato production were identified as the major constraints to potato production in the highlands of Eastern Uganda, resulting to poor yields and product quality, though potato production is very profitable in the Eastern mountains. To address this situation, this project promotes farmer led seed potato production, which focuses on the implementation of locally driven and monitored quality-assured production methods that allow for the traceability of the tubers as they move through cycles of multiplication until delivery to the small-scale farmer. This will increase potato production and ensures poor people access to quality improved varieties.

The project started on 1st February 2002 and is implemented in 4 sub counties of Kaserem, Kaptanya, Kaproron and Bukwa. During the course of the three years, seed of improved varieties has been multiplied using the improved seed production system developed by CABI with CPP funding under project R7858, “Promoting potato seed-tuber management for increased ware yields in Kenya, Uganda and Republic of South Africa”.

3. PROJECT PURPOSE

Potato is becoming an important crop in Uganda due to the growing market for chips and crisps. In Uganda, potato production is centered in the highlands and is dominated by smallholder farms. Their major constraint is low yields attributed to the high incidence of bacterial wilt and a shortage of disease-free seed. Current efforts in potato seed development and diffuse of new varieties has shown the potential of on-farm seed delivery. In view of that situation, there was need to engage farmers as multipliers of seed, maintain seed quality, and establish a marketing and distribution structure that promotes seed production.

A small number of farmers are involved as commercial seed multipliers. The multipliers, extension staff and field assistants were trained in potato production, disease management, storage and seed multiplication. They in turn conducted training for Production Committees and Parish Development committees. The Basic seed for new varieties is obtained from Kalengyere Research station for multiplication by the primary multipliers. The multipliers are obliged to handover seed tubers as agreed in the contract as repayment and the remaining seed is bought by the project for the first two seasons. This seed is supplied to the groups of poor farm households. The group members receive one bag each for planting into multiplication plots using small seed plot system to raise their own seed for subsequent ware potato production. Of the ware potato produced, some is reserved for home consumption and the rest used for sale to raise money for purchase of new seed from the multipliers. The objective is to increase seed production and ensure that poor farmers have access to healthy and improved seed potato.
4. OUTPUTS OF RESEARCH ACTIVITIES

The project goals were to achieve through four outputs.

1. Training
2. Multiplication
3. Distribution
4. Commercial Sustainability

4.1 Output 1: Training of Extension Staff, Local Authorities and Farmers on Potato Production, Multiplication and Storage.

4.1.1 Trainings

The project provided training to farmers in potato production through a ‘training of trainers’ approach. Training initially focused on building capacity of the primary multipliers, extension staff, field assistants and the production committee members. These, in turn, have been responsible for training small-scale farmer group members at the time of delivery of seed. The trainings have been done through attendance of a series of workshops, field days at the established demonstration sites, and exchange visits.

Twenty primary farmers and eight extension staff/field assistants were trained in potato crop best management practices i.e. seed potato production, disease monitoring /management, storage and marketing (see the Best Practices developed for KASPPA in Appendix 12: KASPPA Concepts). During every seasonal planning, multipliers have refresher training. As a way of building confidence of multipliers in facilitation, for this last year of the project, the multipliers have been the lead facilitators with AT Uganda and CABI staff only giving technical back stopping.

Local leaders at parish and village level in seven parishes from all four sub-counties and one hundred twenty thousand production committee members in the participating groups were trained in seed production i.e. small seed plot techniques and disease control (see Appendix 13, on Introduction to Potato Seed Plot System and Pest Symptom Class sheets). Each of the farmers received a copy of the Farmers’ Guide to Potato Production.

Training of 1,200 of farmer group members (beneficiaries) on small seed plot techniques was conducted at various levels by the extension staff, Parish Development Committees (PDCs) and Production committees (PCs). Refresher trainings were conducted for all beneficiaries by FPRAs and PCs in this last year of the project.

End of season evaluations were conducted. Results highlighted the importance of disease management and timely production practices in determining yields and maintaining quality seed standards.

Trainings focused on the Best Practices developed by CABI and AT Uganda together with KASPPA members (see Appendix 12) i.e. Agronomic Practices, pest and disease identification and control, harvesting and post harvest handling. Three hundred copies of Farmers’ Guide on Potato Production were prepared and distributed to all potato farmers. The main features advocated best practices as outlined below (See Appendix 13: Farmers' Guide on Potato Production for details and illustrations).
a) Summary of the recommended Agronomic practices for seed and ware potato production.

Table 1. Summary of the recommended Agronomic practices for seed and ware potato production

<table>
<thead>
<tr>
<th>Agronomic Practices</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good site selection</td>
<td>1. Field free from tree shades</td>
</tr>
<tr>
<td></td>
<td>2. Field with no history of solanaceous crops</td>
</tr>
<tr>
<td>Land Preparation</td>
<td>3. A smooth weed free field with broken clods</td>
</tr>
<tr>
<td>Seed source and selection</td>
<td>4. From reliable source and tubers of egg sized.</td>
</tr>
<tr>
<td>Planting time</td>
<td>5. Plant at onset of rain</td>
</tr>
<tr>
<td>Seed rate</td>
<td>6. 44,500 tubers/ha (18,000 tubers/acre). OR</td>
</tr>
<tr>
<td></td>
<td>18 bags of 1000 tubers per acre.</td>
</tr>
<tr>
<td>Fertilizer and application</td>
<td>7. NPK 17:17:17 or DAP fertilizers can be used at planting at rate of 50kg/acre depending on soil type, and can top dress with Urea i.e. Kaproron sub county.</td>
</tr>
<tr>
<td>Weeding/Earthing up</td>
<td>8. A good ridge at planting and during growth encourages more tuber formation.</td>
</tr>
<tr>
<td></td>
<td>9. Earthing up at 2 to 3 weeks after emergence</td>
</tr>
</tbody>
</table>

There are two methods of planting: Ridge furrow and Small Plot System (SPS) see Appendix 12, plates 1a and 1b)  
(a) Seed Plot System (SPS)  
- Prepare a nursery bed the deep seedbed less than 2m wide but of any length.  
- Spacing 20 x 20cm or 30 x 30 cm at 15cm depth.  

Advantage of SPS: Makes good use of limited land size and gives better yield from small tubers (less than 30mm).

b). Ridge furrow.  
- Dig 10 cm deep furrow 75cm apart.  
- Place the seed 30 cm apart along the furrow.  
- Cover up with soil to form a ridge.

b) Pests and Disease Management  

Diseases: The major diseases are Late blight, Bacterial wilt, Fusarium Wilts and virus. The symptoms and control of each of these are included in the Pest symptom class sheet developed for KASPPA (Appendix 13) and Farmers’ Guide to Potato Production –page 6)

The major Insects are cut worms, Potato tuber moths and Ants (details in the Farmers’ Guide to Potato Production).
c) Pre-Harvesting of Seed and Table potatoes.
Dehaulming: is the cutting of stem at 4-6,” at least 2 weeks before harvesting. Dehaulming helps the skin to harden so as to reduce damage at harvest.
For Seed, dehaulming is done at flower drop and for Table it is done at full maturity, when the plants are naturally turning yellow.

d) Harvesting:
For seed potato, harvesting is done in such away that potato crop neighboring the pegs (marked places where green wilted crops were removed) are harvested earlier and used for table (home consumption), and the rest of the crop harvested for seed (Farmers' Guide for Potato Production in appendix 13)
However, medium and large potato tubers are preferred for seed. Small tubers can be used in the seed plot system and the very large ones for table.

e) Storage:
Storage for Seed and table potatoes require different conditions. For seed, the conditions required are for sprouting whereas for table, the tubers are kept for long without sprouting (Farmers’ Guide on Potato Production, section on storage)

Other trainings offered to the seed multipliers include Farming As A Business, Savings and Credit and Collective Marketing.

4.1.1.1 Farming As A Business (FAAB)
Seed Potato Multipliers were introduced to Farming as a Business, in order to learn to operate their seed multiplication as a business. The three main goals and objectives of Farming As A Business:

i) Reducing costs
ii) Increasing profit
iii) Minimize risks

To break out of the subsistence poverty cycle, farmers should change their attitude towards farming and start taking farming as a business.
During the training, the participants were divided into groups. Each group was to discuss the differences and similarities between business and farming (see Appendix 2). It was found that both farming and business require inputs, operational and marketing activities, but farmers do not take or handle farming as they handle their business. The differences are actually with the risks involved. In farming risks are much more while some can be minimized, others are beyond the farmers’ control.

The Projected Income Statement (PIS) was introduced to the participants. It’s a planning tool and an evaluation tool. The production cost per bag was also calculated which helps the farmers to decide on the selling price. A number of projected income statements for potatoes using different farming methods were worked out together (Appendix 3, 4, 5, 6, and 7).

Similarly the groups worked out the PIS for seed potato production both using fertilizers, and without fertilizers. The farmers realized that investing in production inputs like improved seed and fertilizers brings higher returns, hence a bigger profit margin per bag.
4.1.1.2 Group Savings and Credit Scheme

The training was conducted to KASPPA members and FPRAs on how to manage a Group Saving and Credit Scheme. Saving mobilization, emphasized the importance of having a saving culture. Members were trained on how to avoid mishandling of group funds and how a saving mobilization and credit management can be operated. By the end of the training it was agreed that the saving and credit should be treated separately from the core business of the association (KASSPA). Two Saving and Credit groups were formed: Kaptanya Saving and Credit group and Kaproron Saving and Credit group. Each group came up with its own Byelaws (see Appendix 8 and 9).

4.1.1.3 Training on Collective Marketing

The marketing training for KASPPA members and FPRAs was held from 2nd to 3rd June 2003 at Noah’s Arc -Kapchorwa. It was conducted by Mr. Fred Kagimu Bikande (CEDO). He handled contractual marketing, collective bargaining and marketing, quality control and stores management. The time table is presented in Appendix 10). The marketing training was intended to provide KASPPA members with knowledge about the importance of market/marketing and their roles in marketing.

4.1.2 Demonstrations

One demonstration plot was set in each parish using the clean improved varieties of Victoria and Nakapot 5. The demonstrations acted as learning sites for farmers. Five field days were organized at each site and farmers mobilized at the time of (a) planting, (b) one month after planting, (c) at flowering, (d)dehaulming, and (e) harvesting.

4.1.3 Exchange Visits

Twenty multipliers and eight extension staff/field assistants and two artisans participated in exchange visits to the research station in Kabale. The visit to Kabale was organized twice. The first group visited in November 2002 and the second group in November 2003. They visited their fellow seed potato multipliers in Kabale, to share experiences in seed potato multiplication. The full report of the farmers’ experiences on the exchange visits can be found in Appendix 11. The objectives of the exchange visit were

1. To build the capacity of Kapchorwa seed potato producers in potato production management and post-harvest management.
2. To enable farmers from Kapchorwa to share experience with Kabale seed potato multipliers.
3. To expose Kapchorwa artisans to the established DLS in Kabale to help them gain skills on diffused light stores (DLS) construction.

The KASPPA members expressed their need for access to a less costly source of seed, given the high transport costs from Kabale. Its strengthen, Buginyanya a research station in Mbale a neighbouring district, can be a well positioned source of seed for Kapchorwa. AT Uganda Ltd, therefore organized a visit for seed potato multipliers (KASPPA) and field assistants to Buginyanya research in May 2004 to find whether Buginyanya station can be an alternative source of seed for KASPPA. Members. Seventeen multipliers and four field assistants participated in the exchange visit. The overall objective of the visit was to find out whether Buginyanya station can be an alternative source of seed for KASPPA.

1. See the activities being carried out at the station.
2. Understand how seed potato crop is managed at the station.
3. Determine the capacity for seed production by the station.

Buginyaya Research Station is therefore being considered at as a source of seed for Kapchorwa farmers. This calls for continued monitoring of seed health by KASPPA to ensure seed quality. The seed will therefore require routine ELIZA testing to verify seed health. The research station needs to build up its capacity to multiply clean foundation seed in sufficient quantities to meet the needs of Eastern Uganda.

4.1.3.1 Internal Exchange Visits

Four, one-day internal sub-county exchange visits were organized for SPS farmers from 80 groups and 40 partner groups. The objective of the internal exchange visits was to reinforce learning of best practices taught through farmers themselves. The visits were made to successful farmers adopting the recommended practices.

4.1.4 Seasonal Evaluation

Primary Seed Multipliers and SPS farmers hold end of season review meetings. SPS farmers conduct end-of-season evaluation at the group level. They then have a joint review meetings one per sub-county where the key issues are discussed (see Appendix 20, issues raised during KASPPA review meeting held in February 2004). At the same time, farmers carry out the next season’s planning. KASPPA members have developed a Seasonal Planning Sheet (See Appendix 13). KASPPA Seasonal Plan for season 3B, developed by members is presented in Table 1, Appendix 12.

4.2 Output 2. Multiplication of Foundation Seed Multiplied by Farmer Group Members

The project had set out to develop a mechanism of disseminating improved potato seed to small scale farmers through first identifying medium sized landholders as primary multipliers of basic seed that would then distribute small quantities of seed for further multiplication by farmer group members (more numerous smallholders) using traditional [ridge / furrow] or small plot system multiplication. Foundation seed for new varieties was obtained from Kalengyere ARDC for multiplication by the seed multipliers for 2 consecutive seasons. Seed was loaned to multipliers and they repay three times the amount received per season.

The project purchases additional seed from multipliers, to add to the repayments, and distributes it to the farmer group members who use the Seed Plot System (SPS). Though the Seed plot System, the farmers access affordable and small quantities of good quality seed for multiplication. This seed is then used for table production in the next growing season.

4.2.1 Seed Multiplication

Two potato new improved potato varieties (Victoria and Nakpot 5) were multiplied. 395 bags of seed potatoes were procured from Kalengyere research and given to primary seed multipliers to multiply. The multipliers paid back three times as much seed tubers as they received. This seed was supplied to groups of poor farm households for planting into multiplication plots using small seed plot system to raise their own seed for subsequent ware potato production. Of the ware potato produced, some is reserved for home consumption and the rest used for sale to raise money for purchase of new seed potato from the multipliers. (A diagram of the Seed Potato Multiplication system is presented in Figure 1).
Figure 1: Diagram Of Seed Potato Multiplication System.

4.2.2 Disease threshold standards

Special consideration was given to bacterial wilt (BW) disease because of its importance in seed potato. To date attempts have been made to monitor BW among the seed lots by ELISA testing and through a locally developed bacterial wilt on-farm incubation system (see Appendix 13, on Establishing a Field Incubation test for Bacterial wilt). Test results from three seasons have shown a high correlation between these two testing methodologies. An example of data obtained from the 2003A season is presented in Appendix 12 Table 2a & b.

This framework provides KASPPA with a management tool to deliver non-subjective decisions on whether to accept or reject a crop for sale as suitable-for-use in seed or table production, or direct consumption.
This system was still in its first few seasons of implementation and thus the Disease threshold levels can be adjusted to the more exact levels, it requires after several seasons.

However, the farmers must decide at mid-season, when they observe their crop stand, whether the production should go towards table production [consumption] or forward as seed. This is important as it reduces the loss risk to the multiplier of waiting for the final ELISA and On-farm incubation test results when the tubers have already sprouted and therefore have low market value for table consumption. The standards on bacterial wilt incidence observed in the field at flowering should be less than 1% for seed, 1-2% for table production. If it is more than 2%, the field should go for table consumption (see appendix 12, Table 3)

4.2.3 Quality Monitoring and Sustainability
At the outset of the project, first season 2002, seed was purchased from UNSSPA and after 6 weeks growth of the crops, the seed multipliers experienced high incidence of bacterial wilt, which resulted in the loss of the potato stands as seed. The cause was due to infected seed, but UNSPPA could not verify where the seed had come from. In response, the project developed quality management and seed health monitoring protocols. The project developed various materials on Best Practices for potato production (see Appendix 12). The Primary Seed Multipliers were trained. The best practice material on seed production include:

1. KASPPA Farmers Crop History Sheets
2. KASPPA Field Inspection Officers’ Sheet.
3. KASPPA Crop History Support Sheets

8.2.3.1 The KASPPA Farmers Crop History Sheets: Provides a record of the farmer’s field and in-store planning and management practices (Appendix 13). It consists of the following:

1. Seasonal Planning –
2. Farmers’ Diary of Management, including Pest Maps.
3. Notes to Farmers from KASPPA Field Inspection Officers
4. Signing off sheets between farmer and field inspection officers in total agreement with the information provided

<table>
<thead>
<tr>
<th>Table 2. The KASPPA Farmers Crop History Sheet Tools</th>
<th>Purpose</th>
</tr>
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<tbody>
<tr>
<td>Tools</td>
<td></td>
</tr>
<tr>
<td>1 Seasonal Planning</td>
<td>For planning ahead to anticipate actions and resources i.e. timely purchase of input.</td>
</tr>
<tr>
<td>2 Farmers’ Diary of Management, including Pest Maps</td>
<td>Tools for recording the management practices the farmer has undertaken.</td>
</tr>
<tr>
<td>3 Notes to Farmers from KASPPA Field Inspection Officers</td>
<td>Comments by the field inspector on crop management, health and recommendations.</td>
</tr>
<tr>
<td>4 Signing off sheets</td>
<td>Sheets signed on between farmer and field inspection officers in total agreement with the information provide</td>
</tr>
</tbody>
</table>

8.2.3.2 KASPPA Field Inspection Officers’ Sheet: Provides a framework for the Field Inspection officer to observe and record the management practices by KASPPA farmers and to quantify the Pest System Class within their field and store. The Pest Symptom Class assessment is done in the field, during
the store inspection and during Field Incubation (Appendix 13, KASPPA Field Inspection Officers Sheets).

1. For field assessment: inspections are done during post emergence to observe the germination rate; at flowering to quantify the field pest symptom classes in the field and estimate the risk and at pre-dehaulming.
2. For store assessment: inspection is done during entry to verify correct separation on the shelves; prior to distribution.
3. For field incubation for bacterial wilt: This is the main test for bacterial wilt. Potato tubers (approx. 200 tubers) are randomly selected from the harvest products and placed in a sisal bag, along with an equal volume of damp soil. These are laid flat on raised wood under shelter from rain and with an aspect for receiving the morning sun until midday for 6 weeks. These tubers are sliced at the stolon end and observations made on presence or absence of bacterial wilt symptoms (see Appendix 13).

9.2.4.3 KASPPA Crop History Support Sheet: This is a tool to promote a common understanding of Best Management Practices, identification of pests and their control. This material was developed with KASPPA and it focuses mainly on disease or pest recognition rather than identification. The Crop History Support Sheets (Appendix 13) contain:

1. Farmers’ Guide to Potato Production for general best practice management and pest control. This guide was developed with the KASPPA farmers outlining the main features of the advocated best practices in seed and table potato production (Appendix 13) Farmers’ Guide to Potato Production.

2. The Seed Plot System for best use of small seed and limited land in seed production. This guide describes the method of seed multiplication that was developed with smallholder farmers. The tubers harvested are medium sized (Appendix 13, on Introduction to Potato Seed Plot System).

3. Potato Seed Pest Symptom Sheets and Codes: Pest Symptom Classes. These were developed on the basis of the most important pests in the KASPPA area of operation. These include the Late blight, insect damage, Green wilts, Leaf mosaics and Storage pests. The Pest Symptom Class Sheets associate plant pest, symptoms, and an appropriate control (Appendix 13, Pest Symptom Class). These sheets are used together with the farmers’ Guide to Potato Production.

4. Field incubation for bacterial wilt. This is a locally developed bacterial wilt incubation system that is carried out to measure bacterial wilt infestation within seed lots. It is a simple field test which was developed by the KASPPA farmers (Appendix 13, Establishing a Field Incubation for Bacterial Wilt).

The effort of local disease thresholds establishment managed by KASPPA has remarkably improved crop management. Members of KASPPA quality control committee (KASPPA Field Inspection Officers) conduct regular joint field inspections with technical staff from CABI, AT Uganda, MAAIF (National Seed Certification Services) and NARO (see technical reports in Appendix 14, 15, 16, 17,18 and 19). KASPPA has managed to keep Bacterial wilt level below 1% for the tubers passed as seed.

4.3 Output 3. Distribution:
Multipliers Return Equal Amount of Planting Materials Received for Redistribution and Further Multiplication.
The local leaders i.e. Production Committees (PCs), at the group level, and Parish Development Committees (PDCs) at parish level, have been involved in planning, implementing and monitoring the seed distribution. A seed potato distribution plan for each group of farmers was developed and agreed upon with the local authorities in each community.

A total of 395 bags were purchased from Kalengyere Research Station and loaned to the Primary Seed Multipliers. From repayments and additional purchases by the project, a total of 1,340 bags of seed (420+ 400+ 520) were distributed to small seed plot farmers and partner groups. As a result of further multiplication, from the compiled field reports, 550 acres of potatoes were planted with the seed multiplied under the small plot system. The production estimates for season B, 2004 indicate that the seed tubers harvested by small seed plot multipliers can plant 1,907 acres if all the harvest will be committed to seed.

Seed was distributed to small farmers three times during the project lifetime. The quantities planted in each distribution and the reported harvests are indicated in the tables below. While we know that a good proportion of the harvested seed was later used to plant additional fields for both seed and ware production, it is not possible to estimate accurately the exact proportions that went for each use.

Table 3. Seed distribution process

| First distribution by the project: |  |
|-----------------------------------|  |
| Season 2003 A, distributed 420 bags to small scale farmer |  |
| Season 2003 A Total production = 1,260 bags |  |

| Second distribution by the project: |  |
|-------------------------------------|  |
| Season 2003B, distributed 400 bags |  |
| Season 2003B Total production = 1,100 bags |  |

| Third distribution by the project: |  |
|------------------------------------|  |
| Season 2004A, distributed 520 bags |  |
| Season 2004A Total production = 1,394 bags |  |

Source: Field reports

4.4 Output 4. Commercial Sustainability:

**Process of Procurement of Clean Seed, Multiplication and Sales Collection and Redistribution of Multiplied Seed-Tubers Effectively Handed Over to Local Branch of the Uganda Seed Potato Producers Association.**

4.4.1 Formation Kapchorwa Seed Potato Association (KASPPA)

The project had set out to develop a mechanism of disseminating improved seed potato to small-scale farmers through first identifying primary multipliers of basic seed that would then distribute small quantities of seed for further multiplication to small scale farmers. The production and distribution of good seed from the primary multipliers to the small-scale farmers is the primary focus of the project.

Kapchorwa Seed Potato Producer Association was formed in 2003 in Eastern Uganda to provide a sustainable commercial source for quality seed potatoes. Currently, KASSPA member are those primary multipliers of basic seed. The KASPPA constitution provides for various types of memberships in the
interest of exploiting both seed and table potato markets. The KASPPA constitution is given in the Appendix 21, and this document is recognized by KASPPA as an evolving document.

It is important to note that KASPPA is not registered as a seed producer with the MAAIF and is therefore not producing seed in the strictest of senses. Instead, it is providing potato of improved quality that is suitable for planting.

The tools development for KASPPA as the Best Practice and documented in Appendix 12 and 13. include:

1. Best Crop Management Practices
2. Best Working Practices
3. Best Marketing Practices

Recognized disease threshold levels are being established. KASPPA has been specifically restructured to handle the seed health monitoring procedures by managing and monitoring the compliance with seed health procedures. Seed health monitoring procedures include crop history sheets, labeling, on-farm incubation and bacterial wilt tests.

4.4.2 Potato Impact Survey

A potato impact survey was carried out in September 2004. The survey was conducted in order to assess the impact of the project on the local cropping system, diet, income of the beneficiaries, and non-beneficiaries and how the challenges have been addressed. The impact survey was conducted in Kapchorwa district in the four project sub-counties; Kaserem, Kaptanya, Kaproron and Bukwa.

In order to assess the extent of technology diffusion, the non-beneficiaries were categorized into 3 control groups; (a) immediate neighbours to the beneficiary; (b) same parish but different village and (c) outside parish. A total of 16 multipliers, 64 beneficiaries, and 240 non-beneficiaries (80 from immediate neighbour, 80 from immediate village, 80 from immediate parish) were interviewed. A detailed report of the findings is presented in Appendix 22.

The results indicate that the project has made an impact on both the multipliers and direct beneficiaries. The impact has further diffused to the neighbouring non-beneficiaries to a greater extent than to non-beneficiaries who are more distant from the project.

The results indicate that more land has been put under cultivation by beneficiaries since the project started (2002). The land allocation to potato production after the project intervention has increased and potato is now ranked second in area by multipliers and third by beneficiaries. The outcome of the project activities show a clear influence on household income. The results also indicate that potato has gained preference as a staple food among the beneficiaries and multipliers, with a current consumption of 1-2 times a week, yet before the project, potato was rarely eaten.

The results also indicate that beneficiaries are increasingly adopting technologies like improved variety and regular field inspections, while multipliers now adopt all the technologies. Adoption of potato growing since 2002 among the non-beneficiaries is more prominent with the neighbours to the beneficiaries than those in non-beneficiary villages and parishes.

The problem ranked as most important was potato diseases. Among the diseases, the bacterial wilt disease was ranked highest.
Conclusion: The impact results show clearly that beneficiaries and multipliers are adopting the potato production technologies introduced by the project. Increased income and food security among the beneficiaries and multipliers has contributed to improvement in the standards of living for their families. The major challenges were pests/diseases and drought, but these were being handled through Best Management Practices.

5. CONTRIBUTION OF OUTPUTS TO DEVELOPMENTAL IMPACT

5.1 Training:
Through the trainings, which have been done through workshops, end of seasonal evaluations, field days, and exchange visits, the following results have been achieved:
(a) The level of on-farm incidence of bacterial wilt has been reduced leading to production of high quality seed.
(b) The level of proficiency in seed and ware potato production has increased leading to higher yields and better quality of ware potato.
(c) It provided a clear understanding of the difference between producing potato for seed and for table consumption. In particular, the training emphasized the need to manage bacterial wilt and also optimize the choice of tuber size for seed as compared to what is best for food.
(d) Farmers have begun to appreciate the use of suitable stores (Diffused Light Stores) for seed, which encourages strong healthy sprouts and resulting plant vigor.

5.2 Multiplication:
Through a multiplication system, which involves basic seed obtained from Kalengyere NARO that is multiplied by the primary seed multipliers using ridge/furrow system under strict monitoring, seed quality has been assured. From the harvested seed, primary multipliers pay back three times the quantity of seed they received. This seed is distributed to numerous small-scale farmers (beneficiaries) who further multiply it for their own use employing small plot techniques. The poor farmers, who had previously failed to access healthy seed potato, now have access to clean seed as a result of this multiplication system. All 1,200 of the target number of farmers and 420 other partner group members have received the improved seed, Victoria, which they further multiply for one generation, and then produce table potato. Some of this table potato is sold and the money used to purchase clean seed from the primary multipliers. An agreement on disease threshold levels has not yet been finalized with NARO. Best Crop Management Practices have been developed, and are being implemented by the Primary Seed Multipliers.

5.3 Distribution:
The seed potato distribution has been successfully tracked by the local leaders i.e. Production Committees (PCs), at the group level, and Parish Development Committees (PDCs) at parish level. The local leaders have been involved in planning, implementing and monitoring the seed distribution. As a result, a total of 1,200 target farmers received the seed. Additional seed was even distributed to 420 members of the partner groups. A total of 1,340 bags of improved seed were distributed to small seed plot multipliers. As a result of the further multiplication, we estimate that 550 acres of potatoes were planted with the seed multiplied under the small plot system - more than the overall project target of 400 acres. The production estimates for season B, 2004 indicate that there is sufficient seed tubers to plant 1,907 acres if all the harvest will be committed to seed. This is much more than the end of project target of 300 acres.
The Primary Seed Multipliers and small poor households who benefited have improved in terms of financial returns (from selling seed and ware potato respectively) and food security, leading to improved livelihoods.

5.4 Commercial Sustainability:
The seed multipliers formed a local association KASPPA, which carries out procurement of clean basic seed from the research stations, manages the Crop Best Practices thus carrying out seed health monitoring to ensure production of quality seed (planting material). This has led to:
(a) Improved maintenance of on-farm seed health;
(b) The flushing out of degenerated on-farm seed.

6. FOLLOW UP

What action/research is necessary to promote the findings of the work to achieve the development benefit?

As a result of the strong foundation that has been laid in this project, a new project entitled ‘Sustainable Potato Seed - Tuber Management and Marketing through Commercialization’ is to be implemented by AT Uganda. AT Uganda is now well placed to expand project impact to new communities and to facilitate linkages through greater market orientations, using the funding by CPP under a 9-month extension. The project extension will contribute towards the following outputs:
1. Expansion and Training
2. Strengthening of KASPPA
3. Market linkages

The proposed activities will build on previous efforts by:
1. consolidating farmer awareness of the importance of seed health,
2. expanding the distribution network to reach an additional 600 secondary level beneficiary farmers,
3. strengthening the seed producer’s association to ensure commercial sustainability, and
4. building market linkages that will provide a clear incentive for farmer investment in potato production.

Doing so will cement the local management and sustainability of the project and ensure continued impacts.

In addition there may be opportunities for sharing of ideas and approaches with other CPP potato projects in Kenya and Bolivia – in particular the introduction from Bolivia (R8044, R8182) of IPM training for potato producers in Uganda. It is also worth noting that the model being piloted here is even adaptable to other vegetatively propagated crops, so there is the potential for diffusion to other promotion projects such as R8040 and R8167 for sweet potatoes and R8278 for yams.

7. KEY PUBLICATIONS/OUTPUTS

1. Smith, Julian (2002); Farmer’s Guide on Potato Seed Plot System
2. Smith Julian (2002); Potato Pest Symptom Sheets and Hazard to Tuber Health

4. Namisi, Sarah and Julian Smith (2004); Promoting Potato Seed Tuber Management for Increased Ware Yields in Kapchorwa, Eastern Uganda, a paper prepared for the A Paper prepared under Theme 4: “Technological Options That Respond To Demand” for the NARO Conference, September, 1 - 4, 2004, Kampala


8. DISSEMINATION OF RESULTS

1. Farmers’ Guide on Potato Production, 3000 copies were distributed to farmers, district authorities, and extension staff.

2. Copy of the summary of the final project report to be submitted to the District and four sub-counties.


Biometrician Signature, Not applicable as the project started in February 2002, not after August 2002.

I confirm that the biometric issues have been adequately addressed in the Final Technical Report.

Signature:
Name:
Position:
Date: