CROP PROTECTION PROGRAMME

The development of management strategies for maize streak virus disease

R7429 (ZA0310)

FINAL TECHNICAL REPORT

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Acronyms

CBO	Community-based organisation
DFI	District Farm Institute
FOSEM	Food Security and Marketing for Smallholder Farmers
LC3	Elected Local Councillor, Level 3; a sub-county leader
MSV	maize streak virus
MSVD	maize streak virus disease
NAARI	Namulonge Agricultural and Animal Production Research Institute
NARO	National Agricultural Research Organisation [of Uganda]
NGO	Non-governmental organisation
OPV	open-pollinated variety
VBT	village-based trainers

Dedication

On behalf of the project team, participant farmers and their families involved in this project I would like to dedicate the work reported here to the memory of Grace Acola who died on 1st July 2000 after a short illness. It was largely through her enthusiasm, wonderful personality and dedication that the rest of the team embarked on the project and were carried along to its successful completion. We hope that others will benefit from her efforts and that the approach adopted by the project team will prove to be a useful model for other similar initiatives in the future. She will remain with us in our memories.
Dick Cooter

Executive Summary

[A very brief summary of the purpose of the project, the research activities, the outputs of the project, and the contribution of the project towards DFID's development goals. (Up to 500 words)]

Streak-resistant cultivars provide an effective means of controlling maize streak virus disease (MSVD) in many farming systems in Africa. In Uganda, the National Cereals Programme has released the streak resistant cultivar Longe 1 for use by low-input subsistence farmers. This cultivar is an open-pollinated variety (OPV) and should therefore be able to be propagated more-or-less indefinitely by farmers. Despite this, socio-economic studies during an earlier phase of the maize streak project highlighted the importance of seed quality and availability for farmers in managing maize streak disease. Commercially available seed was reported by farmers to be of unreliable or poor quality and expensive.

The project completed the validation of a system whereby farmers were provided with knowledge of how to produce good quality seed of a superior MSV-resistant maize variety (Longe 1) through researchers collaborating with an NGO and several community-based organisations with locally developed training materials and farmers trained as trainers. The quality of the maize seed produced by the farmers was validated by on-station trials and the efficiency of the various training methods used was assessed by interviewing participitants. A novel aspect of the training was to use a locally-produced video shown through existing mobile video TV systems which normally show popular video films in the villages. The study included an analysis of the current techniques used by farmers to maintain local landraces, both in terms of how these impact on the streak resistance and how traditional approaches can be incorporated beneficially into future seed production methods.

Background

[Information should include a description of the importance of the researchable constraint(s) that the project sought to address and a summary of any significant research previously carried out. Also, some reference to how the demand for the project was identified]

Reports of the streak resistance of Longe 1 (hereafter referred to as Longe) seedstocks maintained by farmers gradually breaking down were identified in an earlier project (R6642). Likely causes were identified as:

- crops of Longe were not isolated allowing cross-pollination with susceptible landraces.
- farmers' traditional seed selection criteria may not be neutral for MSV resistance and perhaps favour loss of MSV resistance.

These observations led researchers and farmers to come to the consensus that a method was needed by which farmers could access good quality seed at a reasonable price, particularly seed of the open-pollinated varieties released by the Ugandan National Cereals Programme. As a consequence, in a pilot system farmers in two villages received Longe seed plus training in how to prevent contamination or other change of Longe seed stocks by use of 'bagging' of unfertilised maize ears and artificial pollination.

Towards the end of R6642, the initial reaction of farmers to this new method of farmer seed production was evaluated. During the 1998b planting season, farmers in Namukubembe and Bugodi villages (Iganga District) had received basic training on

seed production from Cereals Programme staff at the Namulonge Agricultural and Animal Production Research Institute (NAARI) facilitated by the NRI MSV disease project and Longe seed had been produced in the villages. The evaluation showed enthusiasm from the farmers involved, although at that stage the quality of the seed was not clear because it required evaluation against criteria appropriate for seed certification. A main thrust of this present short project was therefore to meet the strong local interest and demand for the outputs of the farmer seed selection and production study, building on this early farmer enthusiasm. The overall aim of this project was to evaluate the quality and sustainability of farmer-based seed production in mid-altitude Uganda.

Village-based interviews of farmers confirmed that seed of nationally-released varieties of maize such as Longe often germinates and performs poorly, and seed may also be unobtainable either because of lack of availability or through being too expensive. Farmer-produced seed is often not true to type. Farmers (particularly those associated with women's groups) requested assistance through training to show them how to maintain the quality of their seed and to produce it themselves for their own use and for sale to other farmers. Furthermore, there are a number of programmes promoting maize in Uganda, including the USAID-funded programme, Food Security and Marketing for Smallholder Farmers (FOSEM) with funding from the PL480 programme. These programmes are promoting the Ugandan National Cereals Programme-bred variety Longe. A method was therefore devised for farmers by which they could receive training in the use of bagging ears plus artificial pollination, or by isolation in time and/or space to enable uncontaminated Longe seed to be produced by village farmers. The project built on pre-existing FOSEM farmer-linkages as a means of testing the use of NGOs to enable techniques to be scaled-out. The limited numbers of farmers that have so far been involved have enthusiastically adopted the method. The FOSEM programme has already been involved in farmer maize seed production in districts where sufficient land is available to grow seed in isolation and Mr Ezra Okoth (Iganga District FOSEM co-ordinator) has appreciated that bagging of individual maize ears (to prevent uncontrolled pollination) and tassels (to permit the bulk collection of uncontaminated pollen) permits uncontaminated seed to be produced without isolation. Dr Denis Kyetere (the head of the Cereals Programme and a cereal breeder who has been responsible for the development of maize hybrids in Uganda) is enthusiastic about promoting farmer maize seed production.

Project Purpose

[The purpose of the project and how it addressed the identified development opportunity or identified constraint to development]

The project aimed to enhance the sustainable livelihoods of small-scale, village-based farmers by developing and evaluating methods by which they can maintain and produce high quality seed of open-pollinated varieties (OPVs) of high-yielding, disease-resistant maize free of genetic contamination. It also aims to develop and assess methods by which knowledge of these methods can be disseminated widely through local institutions such as farmer trainers, village video shows and NGOs. Major findings, prior to the inception of this project, from the on-farm trials and in-village observations undertaken by Cereals Programme staff were that:

- access to viable seed at a reasonable price was of critical importance to the sustainability of released MSV-resistant maize varieties;
- MSV-resistance (and other valuable characteristics) of OPVs could be diminished by lack of isolation from susceptible landraces and / or by farmer selection.

The MSV-resistant Longe, released by the National Cereals Programme, is favoured by farmers but the supply and quality of seed are often poor and unreliable. Farmers (particularly those associated with women's groups) requested training and information to enable them to maintain the quality of their maize seed so that they can produce it themselves for their own use and for sale to other farmers. A method by which farmers can control pollination was initiated during a previous project. The main aims of this short project were to:

- further develop and evaluate this method;
- assess the seed quality produced by farmers;
- examine the sustainability of farmer-based seed production in mid-altitude Uganda, particularly the potential for scaling-out the method through the use of farmer trainers and NGO networks.

The Project was also expected to learn more about how to disseminate information through local channels. Farmer trainers received training at NAARI and their understanding, and their success in passing on an understanding of how to maintain the benefits of MSD-tolerance afforded by Longe was assessed. The effectiveness of other local channels, such as NGOs and the use of local village video systems was also assessed.

Expected Impact

The direct impact of this work will be to enable the OPVs released by the Cereals Programme, particularly the MSV-resistant Longe, to reach and be maintained by a large number of farmers including, because of its lower cost, poorer farmers. Those farmers who have been trained will be empowered by their increased knowledge and also less vulnerable to changes in the seed marketing system. Through linking with FOSEM, it is anticipated that there will be impact on farmers' livelihoods in villages throughout two sub-counties in Iganga District. The "status" of nationally released maize varieties and of the Ugandan Cereals Programme will be enhanced since the MSD resistance of Longe will be maintained through appropriate seed management by farmers.

Research Activities

[*This section should include detailed descriptions of all the research activities (research studies, surveys etc.) conducted to achieve the outputs of the project. Information on any facilities, expertise and special resources used to implement the project should also be included. Indicate any modification to the proposed research activities, and whether planned inputs were achieved]*

The **Project activities** carried out just prior to and during the project are summarised in the Table 1 below.

Table 1: Summary of project activities

SEASON	ACTIVITY	OUTCOME	REPORTING
1998a	In response to request from farmers, 8 participants from Namukubembe (4 women) and Bugodi (3 women and 1 man) villages receive training at NAARI in maize seed production.	8 farmers trained in maize seed production techniques. Depart with 10 kg of (breeder) Longe seed.	
	In Namukubembe and Bugodi Longe 1 is planted.	Namukubembe: 5 kg planted by 4 individuals in 5 plots (1 large plot planted in 'partial isolation'); Bugodi: 5kg planted in one group (St Ngondwe) plot.	NAARI Evaluation report Namukubembe (10/12/98) and Bugodi (20.1.99.)
	NAARI staff and farmers carried out pollination using bags	A proportion of the planted maize is pollinated and protected	As above
	Harvesting of Longe 1 by farmers	Namukubembe: total of about 210 kg of Longe seed produced. Most (175 kg?) sold at Ush 700 / kg to 39(?) individuals Bugodi: small amount produced (20 kg?).	NAARI update report (May 1999)
1999b	On-station trial (Masaka) comparing breeder v certified v farmer (Grace Bakaira) Longe 1 seed	Farmers' maize seed compares favourably with certified seed	
	Farmers in Namukubembe (and other parishes in Bukanga) plant Longe seed they harvested or bought from original 4 who visited NAARI. Farmers in Bugodi plant Longe 1 seed from the St Ngondwe plot	19 farmers reported to have planted Longe1 8 farmers reported to have planted Longe 1	NAARI evaluation report (July 1999)
	Farmer Seed Management Baseline Survey	Survey completed	Farmer seed management practices: A case in Iganga district- Grace Acola Survey report

Table 1: Continued

1999b	On-station trials at Namulonge and Masaka comparing farmer (trained v non-trained and small v large plots) v certified v breeder seed		
	FOSEM become formally involved. Emphasis changes to Bukanga sub-county and Buwaya sub-county as a means of assessing possibilities for scaling out.	LC3 Bukanga sub-county selects 2 TOTs from each of the 6 parishes in Bukanga sub-county FOSEM co-ordinator selects 2 TOTs from each of the 6 parishes in Buwaya sub-county	
	Cereals Programme distribute seed through sub-county chairman (LC3) and FOSEM to parish groups to establish training plots	Training plots established (at least one in each parish)	Mid-season (1999b) evaluation report 1- November 1999
	TOTs workshop at NAARI (25-26th October)	24 TOTs and FOSEM co-ordinator trained	Workshop report.
	Training video produced and shown in Bukanga and Buwaya sub-counties	Farmer evaluation of training video	Mid-season (1999b) evaluation report 1– November 1999- video evaluation.
	Pollination activities in each parish of Bukanga and Buwaya sub-counties	1468 cobs hand pollinated/ covered 2000 bags bought.	Mid-season evaluation report 2 – February 2000
	Harvesting of Longe1 seed	430.5 kg of Longe 1 seed produced in the 12 parishes of the two sub-counties	Mid-season evaluation report 2 – February 2000 and Final evaluation (March 2000)
	Use of Longe1 seed		Mid-season evaluation report 2 – February 2000 and Final evaluation (March 2000)
	Researchers to assess if and how farmers determine whether pollination has been successful in producing good quality Longe 1 seed		Final evaluation (March 2000)
2000a	NAARI/ FOSEM/District Extension Next steps?		

1. *Monitor seed production activities in Namukubembe, Bugodi and selected FOSEM sites over the 1999a and 1999b seasons.*

1.1 The quantity of seed produced in 1998b will be established and how it has been used in 1999a and following on from this in 1999b growing season. This will include establishing which farmers have obtained the seed, how much and whether they have then produced seed themselves.

The production of Longe seed by farmers in targeted villages in Iganga District during the second rains of 1998 (1998b) is detailed in Annex 4. Annex 4 also details the amounts of seed planted during the first rains of 1999.

1.2 Facilitate farmer-researcher interaction with a view to improving the seed production system

Farmer training focused primarily on knowledge transfer with technique transfer following on from, and being based on, this knowledge transfer. In particular, it was agreed that farmers should be informed of the reasons and need for preventing cross-pollination so that they could themselves choose between the use of bags and isolation either by distance, barriers or period of pollen release. Groups were identified by sub-county Chairman (LC3) and Grace Baikaira (CBO Chairperson) in Bukanga and FOSEM co-ordinator in Buwaya. Two, group-selected farmers, from each of the parishes of Bukanga and Buwaya sub-counties received training in seed production from the Cereals Programme at NAARI to become Village-Based Trainers (VBTs). Longe seed, provided by the Cereals Programme, was planted by the trainers in their home parish and seed was produced from these plots using pollination bags, on at least some plants, to prevent any cross-pollination. Background to the villages and to each CBO are given in Annex . The VBTs were then required to train fellow farmers in their village. To support them in this, a video was produced showing them participating in the various stages of the seed production course and this was shown a number of times in each sub-county through hiring of local, mobile video outfits.

1.3 Describe farmers' existing systems for selecting and producing maize seed

Preliminary descriptions of farmers' existing systems for selecting and producing seed were done in Tororo, Busia and Iganga Districts as part of the previous project R6642. The present project focused on the local seed management systems in place in the villages in Iganga targeted by the present study. Activities included individual farmer surveys and group interviews summarised in the Farmer Seed Management Practices report (Annex 1) and the preparation of a manuscript for scientific publication (Annex 2).

2. *On-station trial comparing farmer-produced seed with certified seed*

Trials were planted at the Masaka District Farm Institute (DFI) at Kamenyamiggo in both the first and second rains of 1999 (A trial was also planted in the second rains of 1999 at NAARI but this failed due to drought and will not be mentioned further).

The trial planted in the first rains compared Longe breeder seed, Longe certified seed and Longe seed multiplied by about 10 farmers and bulked to form a pooled sample.

Seed of Longe harvested in 1999 by farmers at Namukubembe who had been trained in the use of bags to prevent cross-pollination and supplied initially with high quality (breeder) seed, was compared with both certified and breeder seed in a randomised block (3x4) field trial at Masaka. The resulting crop was subjected to natural infection with MSV and we assessed the incidence and severity of MSD on mature plants in each plot on 24 July 1999 (See Annex 9).

3. *Provide appropriate training of village-based trainers at Namulonge. Training of farmers by these trainers in Bukanga and Buwaya sub-counties. Preparation of training materials, including a training video.*

3.1. Pre-training

A number of activities were necessary before training could take place. These included:

- early planting of a maize stand at NAARI for training of VBTs in early September. An early maturing type, LC16, was planted early and irrigation was provided in order to ensure a good stand of maize at an appropriate stage to demonstrate pollination.
- selection of farmer groups and VBTs from each parish in the two sub-counties by LC3 chairman and community-based organisation (CBO) leader in Bukanga and FOSEM co-ordinator in Buwaya.
- Longe seed (2 kg per group) provided by the Cereals Programme, was distributed to groups and planted by the trainers in their home parish.

3.2. NAARI training workshop

A one day training session in seed production was provided at NAARI by Cereals Programme research scientists and technicians for two (ideally one male and one female) farmers to become the VBTs from each of the parishes of Bukanga and Buwaya sub-counties. The Iganga FOSEM representative also received training. District Agricultural Extension representatives were invited, but unfortunately were unable to participate. See workshop programme and report prepared by Grace Acola et al. (Annex 8).

3.3. Village-based training

The VBTs carried out their own training programmes in their respective parishes. It was envisaged that key elements would be the training plots of maize already established in each parish and video presentations made through commercial video outfits. It was originally anticipated that back-stopping of VBTs would be provided by FOSEM and district public extension staff. However due to public extension not being able to participate in the Namulonge training, Grace Bakaira took on this role in Bukanga.

3.4. The use of video

A video was produced showing the various stages of maize seed production. This was initially used in the Namulonge workshop and then parts of the workshop itself were edited into the tape. We felt that it was important that the VBTs be shown participating with researchers in their training at the research station to give them the confidence and credability to pass on what they had learnt to their fellow farmers. This work was led by a commercial Kampala-based company called 'Videorama' with inputs from a Namulonge technician. The aim was to provide the VBTs with a tape that they could take away with them after the workshop. However, preparing this tape took longer than anticipated, but after some delay one copy was provided to each of the sub-county co-ordinators (i.e. Grace Bakaira and Ezra Okoth). These were shown a number of times in each sub-county through hiring of commercial, mobile, video cinema outfits from Iganga town. One of the aims was to assess the feasibility of using commercial video outfits for training purposes.

4. *Monitoring performance of village-based trainers as an indicator of whether the approach is appropriate as a means of scaling-up.*

The success of the use of VBTs was evaluated both by interviewing the VBTs (Annex 5) and by interviewing villagers trained by these VBTs (Annex 6). Group interviews of the VBTs focused primarily on discovering what activities had been done, who by, when and why, and their analysis of the strengths, weaknesses, opportunities and threats of the approach.

The survey of trainees aimed to evaluate who had been trained, how successful the training had been and whether trainees were going to make use of any new knowledge. This was achieved through a questionnaire survey of 60 trainees (5 from each parish) randomly selected from lists of farmers provided by VBTs. At the same time further background information was collected about the groups in each parish to help assess the potential for further scaling-out.

Outputs

[The research results and products achieved by the project. Were all the anticipated outputs achieved and if not what were the reasons? Research results should be presented as tables, graphs or sketches rather than lengthy writing, and provided in as quantitative a form as far as is possible]

Output 1: Improved farmer seed production system developed and validated

Output 1.1 Introduction As detailed earlier in this report, farmers were reporting considerable difficulties in obtaining access to good quality seed of Longe, their preferred maize variety. They were also encountering problems in maintaining Longe themselves as their home-saved seed appeared to become genetically contaminated by out-crossing with their local and other maize varieties. This output targeted these problems and comprised two main activities:

- understanding and describing the farmers' current system for selecting and improving seed; and
- validating improved maize seed management by farmers.

The purpose underlying the study of farmers' current practices was to be able to fit the improved method, as far as was technically possible, within existing practice so as to facilitate its adoption and likely sustainability. The options for improving farmer maize seed management were based on methods already used by the Cereals Programme scientists for improving and maintaining their own maize varieties. These involved the use of pollination bags both as a simple physical means of preventing uncontrolled pollination of the silks of maize ears and as a means of collecting uncontaminated pollen from bagged tassles so as to pollinate the silks directly. They also provided technical knowledge of pollination, partly gained from practical experience using the pollination bags. This promoted an understanding of the concept of isolation from other maize varieties either by distance or in time by ensuring that nearby crops were not shedding pollen when silks of plants selected for seed production were exposed. Validation of farmers' improved maize seed management was assessed by the research team in formal trials to compare the progenies of farmer-produced Longe for conformity to type with progenies of breeder seed and certified seed of Longe.

Output 1.2 Farmers' systems for selecting and improving seed prior to training

Farmers in Bukanga and Buwaya sub-counties of Iganga grow one local main-crop landrace of maize and one popcorn landrace. They also grew released varieties, particularly Longe and various Kenyan hybrid maize varieties (Table 2).

Table 2: Numbers of farmers (out of 10) in four villages in Iganga growing different maize types.

Type of seed	Busanda	Budoma	Isikiro	Nabitu
Local	6	10	6	10
Katulika	2	1	0	0
Longe	4	3	7	0
Kawanda	2	3	0	0

In some cases, totals exceeds actual number of farmers interviewed. This is because of multiple responses by the farmers.

Though initial seed of the latter varieties was largely bought-in, it was subsequently "maintained" by home production (Table 3).

Table 3: Numbers of farmers (out of ten) in four villages in Iganga who saved seeds during the 19998b and 1999a seasons.

	Busanda	Budoma	Isikiro	Nabitu
1998 – second rains	7	6	5	4
1999 – first rains	1	9	8	6

In some cases totals exceeds actual number of farmers interviewed. This is because of multiple responses by the farmers.

The existing system of home seed production seemed to involve no conscious planting of crops in isolation in order to prevent genetic contamination. Seed for the local main-crop landrace was obtained by selecting cobs (rachis plus seed kernels but minus sheath leaves) from within the general harvest of the farm. Superior cobs were identified when the parent crop had matured and dried out; and cobs had been removed from the parent plant. Selection was mostly done at the homestead though it was sometimes done in the field immediately after harvest (Table 4).

Table 4: When and where ten farmers in each of four villages in Iganga said they select their maize seeds.

	Busanda	Budoma	Isikiro	Nabitu
When				
Post-harvest	6	4	9	10
Dried plants	4	6	1	0
Where				
Home	9	4	9	10
Field	1	6	1	0

Preferred cobs were large, with numerous and regularly-spaced seeds. Desirable seeds were of uniform size, large and white (Table 5). For the main-crop landrace, farmers often selected seeds with a red spot where it had been connected to the rachis. Associated with this, the surface of the rachis was also a rusty-red. Farmers associated this red marking with seeds being dense. Women considered they had a predominant role in maize seed selection although men considered they participated equally.

Table 5: Criteria used by farmers of four villages in Iganga in the selection of maize seed

Criteria/Village	Busanda		Budoma		Isikiro		Nabitu	
	W	M	M	W	M	W	M	W
Kernel size (big)	+	+	+	+	-	+	+	+
Large cobs	+	+	+	+	+	-	+	+
Rachis and kernel attachment colour (red)	+	+	+	+	-	-	-	+
Fully-filled cobs	+	+	+	-	-	+	-	-
Long and straight cobs	-	-	-	-	+	+	-	+
Clean seed (free of rot)	-	-	-	-	-	-	+	+
Variety type	+	-	-	-	+	-	-	-
Shrivelled seeds are not selected	+	-	-	+	-	-	-	-
Uniform colour	-	-	-	-	-	+	-	-
Dry seeds	-	-	-	-	+	-	-	-
Seed viability	-	-	-	-	+	-	-	-

M = Men; W = Women; + = mentioned by group; - = not mentioned by the group

The main feature of this procedure as regards selection for MSV-resistance is that it affords no opportunity for farmers to assess the tolerance of the parental plant to MSV. Indeed, it seems likely to select for escapes. Their system also allows no means of isolating one maize variety from another. Inspection of the seeds did allow the rejection of cobs cross-pollinated by yellow-seeded popcorn but, as all other varieties (including Longe) of maize grown by the farmers had a white seed, this method could not identify cobs of Longe cross-pollinated by the local landrace or by other varieties. When the farmers' selection method was applied by researchers to an isolated crop of Longe, there was no significant effect on streak tolerance of the progenies, though a trend towards increased susceptibility suggests a possible link between cob/seed size and MSV-susceptibility, a link which is also suggested in the literature. However, if contamination with the larger-seeded local landraces occurred, it seems likely that genetically contaminated cobs of Longe would be preferentially selected as these would tend to have the larger seeds. The results of a crossing experiment are summarised in Table 6, below.

Table 6. Experiment 2: weights of seed, based on 40 cobs each of Longe x Longe (LxL), Kawanda x Kawanda (KxK) and Longe x Kawanda (LxK) crosses.

Cross	Mean number of seeds /cob	Mean weight of 100 seeds ± SE
L x L	291	39.7 ± 1.2g
K x K	292	43.2 ± 1.3
L x K	314	42.5 ± 1.6

The full report of surveys of farmer practices and their implications are given in Annexes 1 and 2. An analysis of the skill and knowledge of local farmers in distinguishing their local landrace and other varieties is given in Annex 5.

Output 1.3 Options for improving farmer produced seed management

Stability of varieties of an out-crossing, wind-pollinated crop such as maize requires the use of special mechanisms to prevent pollination by pollen blown in from crops of another variety. Various options are available. Seed plants can:

- be isolated by being grown >200m from crops of another variety;
- be isolated by being planted at a time such that their silks will not be exposed when pollen is being shed by crops of another variety;
- be grown in a locality where only that variety is being grown;
- have their silks and heads protected from pollination, for example, by bagging them, and then they can be pollinated artificially by pollen collected from a number of plants of the same variety.

The first three methods will, for smallholder farmers, almost always require collaboration with neighbouring farmers. The last can be done independently but requires additional inputs of time and money for bagging. All four methods were taught to farmers; farmers were also provided initially with high quality (breeder) seed of Longe and with sturdy pollination bags.

Output 1.4 Seed production activities and outcomes over three seasons in Namukubembe, Bugodi and other FOSEM sites

Table 1 summarises these activities. Maize seed was produced by farmers from their plots using a range of techniques.

Output 1.5 Outcomes over three seasons

Table 7 summarises farmer maize seed production during the three seasons (1998b, 1999a and 1999b) using the techniques that they had learnt.

Table 7: Farmer seed production (kg) over 3 seasons in Iganga

SUB-COUNTY/ parish	1998b	1999a	1999b
BUKANGA: Namukubembe parish Other parishes	210	N/a	315.5
BAITAMBOGA Bugodi	20	N/a	N/a
BUWAYA: All parishes	Not yet producing	Not yet producing	115

N/a = not available

A detailed breakdown of production in the 199b season is shown in Table 8, below.

Table 8: Farmer maize seed production in Iganga - 1999b season

SUB-COUNTY/ Parish	Name of group	Seed received (Kg)	Seed planted (Kg)	Cobs hand pollinated (number)	Pollen bags (Kg)	Rest of field (Kg)
BUKANGA						
1. Bukondo	Akibono Okubi Group	2	2	500	18	25
1b	Kyozira	0.5				
2. Busalamu	Kyebata tobona	2	1.5	150	6	5
3. Buwologama	Gemafa	2	2	15	3	110
3b	Local teacher at school	2				
4. Kiroba	Tukolere Walala	2.5	2.5	100	10	15
5. Nabubya	Dhikusoka	2	2	150	3.5	15
6. Namukubembe		2	2	265	65	40
		14.5	12	1180	105.5	210
BUWAYA						
1. Buwaiswa	Buwaya Mothers Union				10	20
2. I sikiro	Isikiro Horticultural Group	2	2	100	7	20
2b	Isikiro Horticultural Group	2	2	35	1	20
3. Kyete	Kyebajakobone	2	2	80	5	10
4. Mugi	Wamulonge Horti. Group	2	2	53	10	25
5. Wairama	Bakusekamajja	2	2	20	2	15
		10	10	288	25	90
Grand Totals		24.5	22	1468	130.5	300

Comments (numbers refer to farmer groups in Table 8)

Bukanga

1. The 500 cobs included 300 packets / bags bought from Grace Bakaira and 200 from the market (Ush 20/ packet)
1.b Individual plot-farmer didn't attend the training.
2. Fearing drought, 0.5 kg were preserved with ash for planting in 2000a.
3. Demonstrated with 15 bags only -plot was isolated.
3b This was a teacher, who has left the area. He was not trained.
4. Planted 2kg originally; after this failed, planted a further 0.5 kg. 60 out of the 100 cobs were stolen.
5. Out of the 150 cobs pollinated only 40 were harvested.
6. Grace also planted 1.5 kg on her own, pollinated all and harvested 72 kg (sold about 60 kg).

Buwaya

1. Same as Isikiro Horticultural Group
2. Harvested about 80 of the pollinated cobs some destroyed by termites).
2.b Harvested only 11 pollinated cobs. Termites;Hailstorm; diseases(GLS and MSV).
4. About 20+(out of 53) cobs harvested, but some mixed with those not pollinated.
5. All 20 pollinated cobs were harvested.

Output 1.6 Discussion of issues, constraints and opportunities

The use of bags to control pollination provided an effective tool to teach farmers about maize pollination as well as being a means by which farmers could control maize pollination. This approach also required that farmers understood that MSV-resistance was under genetic control in Longe and that MSD is an insect-transmitted disease rather than the result of adverse soil or climatic conditions. An important issue is the amount of maize seed lost through pests, disease and theft. Future activities should consider a more intensive approach to growing maize for seed compared to grain. Detailed results are given in Annex 6.

Output 2. Maize seed quality verification

The reactions to MSV of progenies of breeder seed, bulked farmer-produced seed and certified seed grown at the Masaka DFI at Kamenyamiggo during the first rains of 1999 (1999a) are shown in the Table 9, below. Drought prevented the crop reaching maturity so yield results could not be obtained.

Table 9: Comparison of bulked Longe maize seed produced by farmers, certified seed and breeder seed (1999a season)

	No. of plants	% plants without MSV	No. of plants with cobs	MSV severity score*
Farmer seed	24	9.52	18.3	2.58
Certified seed	24	7.14	17.5	2.91
Breeder seed	30	19.72	25.5	2.50
Mean	25.8	12.123	20.4	2.666
LSD	6.9	8.253	4.986	0.683
P	0.1605	0.0211	0.0142	0.35
Significance	Ns	0.01	0.01	Ns

* 1 = very mild (few or no streaks); 5 = bleaching of leaves, severe stunting, death.

The data on the above parameters show that farmer-produced seed performed at least as well as certified Longe seed (the best grade available on the market). Although not highly significant (P>0 05), the progenies of farmer-produced maize seed tended to perform better than those of certified seed, having a performance intermediate between certified seed and breeder seed.

In the second rains of 1999 (1999b), the performance of the maize seed produced by individual farmers in Iganga was compared in a field trial with the performance of certified seed of Longe, breeder seed, Longe 1 topcross and LP16, an early maturing variety newly released as Longe 4. Despite the trial being planted late and in the second rains, both of which usually predispose a crop to being infected by MSV, virus spread was negligible. The results are therefore restricted to growth parameters. The performance of seed produced by individual farmers and full statistical analysis is given in Annex 9. Table 9, below shows the combined results.

Table 9: Key growth parameters and yield of farmer-produced Longe and other seed.

Source of maize seed	Farmer	Certified Longe	Breeder	Topcross	Longe 4
50% days to silk	75.1	71.7	72.9	76.1	70
50% days to anthesis	72.6	69.3	71.1	73.3	67.7
% off types	3.7	5	0.1	4	2
Yield (kg/ha)	4422	4224	5680	3733	3963

Although detailed examination of the progenies of seed produced by five individual farmers (see Annex 9) suggests their seed had become contaminated, farmer-produced seed of Longe generally had an acceptable performance compared with certified seed. Indeed, an outside consultant funded by CIMMYT from the Kenyan Agricultural Research Institute (Dr Lawrence M'Ragwa, Assistant Director of KARI, Kaptagat Road, Loresho, Nairobi, Tel +254 2 583301-20 or Fax +254 2 583344) to review projects in Africa targeting local maize seed production indicated (verbal

communication) that he would report that the approach being developed in Iganga was the most successful he had inspected.

Output 3. Farmer capacity to improve their own maize seed through acquisition of researcher knowledge validated

Output 3.1 Introduction This section considers the process by which farmers were to acquire researcher knowledge. It then considers the question of whether researcher knowledge improves farmers access to better seed.

Output 3.2 Description of the process to provide farmers with researcher knowledge

3.2.1 Pre-training

There were a number of pre-training activities to be carried out prior to the Namulonge training workshop and they were carried out successfully. However, the process was not without difficulties and this was partly due to the short duration of this project. With more time farmers could have come to NAARI and observed maize grown under normal conditions which had not had to be specially planted and irrigated – an expensive operation! Maize seed could then have been distributed after the training for planting in the next season. It was originally anticipated that the groups would buy the seed, but this didn't happen.

3.2.2 NAARI training

The overall aim of the workshop (Annex 8) was to train trainers so that they can go back to their community and train farmers in their farming groups how to produce good quality seed.

Training was provided by scientists and technicians from the Cereals Programme over a period of one and a half days. The training included: seed production systems (formal and informal); types of seeds; methods for producing seed; strengths and weaknesses of methods; demonstration of techniques; development of action plans by the VBTs (See Annex 8).

There were 26 trainees at the workshop, of whom ten (seven from Bukanga and three from Buwaya) were women. The aim had been for each group to provide one woman and one man but for various reasons this turned out not to be possible.

The participants evaluation of the workshop is shown below in Table 11.

Table 11: Summary of trainees comments on the quality of the training workshop

	Excellent	Good	Fair	Poor	No response
General arrangements	64	8	12	4	12
Accommodation	20	28	40	0	12
Meals	48	12	16	0	8
Field demos	64	12	16	0	8
Time factor	32	20	24	16	8
Workshop duration		Too short = 68	OK = 24	Too long = 0	No response = 8

The trainees were encouraged to give their impressions of what was good (or bad) about the training workshop and to make suggestions for improvements for future training sessions (see Table 12).

Table 12: Specific comments on benefits and suggestions for improvements

Farmers' benefits from the workshop	**Farmers' suggestions for future improvement**
1. Can differentiate good and bad things in maize production	1. Scheduling more workshops to train farmers
2,. Knowledge of producing maize seed communally	2. Duration of workshop should be long enough
3. Knowledge of production and storage of improved seeds	3. Training in other crops eg cassava, beans, sweet potatoes
4. Got pocket money	4. Conduct such similar training at village level
5. Learnt how to maintain seed purity and viability	5. Working together so that we can be trained on other crops
6. Learn how to pollinate maize	6. Such training should be continued
7. Learnt how to produce good own seeds, there would be no need of buying seeds again	7. Carry out such a workshop in other places for more people to learn
8. How to pollinate and avoid disease spread and good seed selection	8. Continue training other farmers and inform them of the disadvantages of planting other local maize varieties
9. Maintenance of new seeds	9. Working together for development
10. Knowledge of uplifting villages as cultivation is a key factor	
11. Production of pure maize seeds from the available seeds	
12. Hi-tech knowledge in seed production in the fields	
13. Good relationship	

The farmer participants on the course were asked to prepare their action plans for future seed production activities. Both groups from Bukanga and Buwaya groups suggested different ways forward.

Bukanga: Selected hand pollination as the method to maintain seed purity. Reasons given were: enables timely planting and does not create conflict with the community.

Buwaya: Selected planting in isolation in time. Reasons given were: Less expensive; lack of enough land; high population; saves time; encourages time consciousness; encourages other communities in the neighbourhood to learn new technologies.

3.2.3 Village-based training

The actual training given by the VBTs at the village level appears to have varied between the sub-counties and parishes and it proved to be a difficult process to monitor from an external perspective. The perspectives of trainers and trainees are summarised below.

3.2.3.1 Trainers' perspectives on village training

Group meetings were held in both sub-counties to get feedback from the VBTs. In each sub-county a SWOT analysis was carried out. In Bukanga, the results suggest a very positive attitude towards seed production, but a range of concerns including: costs of pollination bags, perceived need for further support in training on specific aspects of seed production (e.g. planting and storage of seed) and other aspects of maize farming (Table 13 summarises the responses of the Bukanga VBTs).

Table 13: SWOT analysis; Bukanga VBTs

STRENGTHS	WEAKNESSES
Bukanga	
Always have good seeds at the beginning of the season	Spend a lot on paper bags
Self certainty about seeds purity	Never learnt about how maize seeds are properly planted
Costs of seeds are low	Never learnt about good maize storage
Many people need the purely produced seeds	Never learnt about how to preserve seeds
We trust the purity of our seeds	Never learnt about how to keep records
Farmers have a enough pure maize seeds	The training was too short
Yield increase	Never learnt about how apply fertilizers
Income from pure seeds is better than local seeds	Theft of purely produced maize seeds
The posho quality is good	
Fight against starvation in farmers	
Early maturity maize	
Longe maize is resistant	
OPPORTUNITIES	**THREATS**
Bukanga	
Farmers shall continue with good maize seeds	Lack of knowledge of how to plant
Market for the pure maize seeds	Lack of transport to visit other farmers
Now experts in this maize seeds production	Failure to know the pests control mechanism in maize plants
Relationship between farmers and researchers shall continue	Poor conservation of soils
Bukanga sub-county is an example in Iganga district	Poor storage of maize seeds
Hopping to get merit letters proving that they are VBTs	Poor weather conditions eg drought spell
Starvation will be over	Failure to balance the economic status
Video will encourage the training	Failure to get more training
If NAARI team abandons farmers, we may fail	
If video does not continue it may be difficult to train other farmers	

3.2.3.2 Perceptions of maize types

VBTs ability to assess whether they have produced the desired seed is a key element to assessing the success of training. Table 14, below, lists some of the attributes used by farmers to distinguish maize types from the cob alone. In a blind test, farmers' and researchers' ability to distinguish between what the owner had reported as local, Longe and popcorn, varied. Selecting maize seed on the plant would provide a number of other indicators for the farmer to determine whether they have produced the desired seed.

Table 14: Characteristics used to differentiate cobs of maize varieties

Attributes	Descriptors
Bukanga	
Length of Grain	Long Short
Colour	Yellow Red cob
Cob length	Short
Silk	Started down
Appearance	Rotten at the end
Grain colour	Spotted
Buwaya	
Grain colour	Spotted/White/Yellow
Maize cob colour	Red and white/ White

Grain line	Not in straight line/ Straight/ Down lines are not straight/ Straight with mixed colour
Grain appearance	Not sharp/ Straight/Small and sharp at the end
Cob filling	Compacted/ Too compacted together and did not reach top/ Too compacted up and small, big grains down/Reached top
Size of cob	Big/Not so big/Small

Individual farmers, especially those from Buwaya, often failed to identify cobs of claimed cv Longe and the local landrace (Table 15). This was probably not because the original owners of the cobs had named them inaccurately, since the consensus decision of the farmers was generally in close agreement with the name claimed by the original owner of each cob. The popcorn, which has very distinctive, small, orange seeds and a small cob was always identified successfully. The two researchers working in the Ugandan Cereals Programme, working solely with maize, were individually rather more accurate than individual farmers (who work with many crops other than maize), especially at identifying cv Longe which was bred by their Programme.

Table 15: Stakeholders ability to recognise different maize types from the characteristics of the cob alone

Owner's claim for maize type	Longe	Local	Popcorn
Bukanga farmers (12)			
Individually	135/179 *(75%)*	32/38 *(84%)*	20/20 *(100%)*
As a group	8/8 *(100%)*	3/3 *(100%)*	1/1 *(100%)*
Researchers (2)			
Individually	42/44 *(95%)*	10/10 *(100%)*	6/6 *(100%)*
Buwaya farmers (23)			
Individually	93/203 *(46%)*	150/274 *(55%)*	46/46 *(100%)*
As a group	8/9 *(89%)*	8/10 *(80%)*	2/2 *(100%)*
Researchers (2)			
Individually	17/18 *(94%)*	15/24 *(63%)*	4/4 *(100%)*

The views of the VBTs on the way forward were collected and are summarised in Table 16.

Table 16: The VBTs' expected ways forward

Bukanga	**Buwaya**
- Continue training other farmers	Lusoga/ Luganda version only (to be translated)
- Shall open up a farm supply shop	
- Continue producing good pure maize seeds	
- Farmers' meetings to review and discuss the next strategy.	
- Continue to inform the researchers the extent we have reached	

3.2.3.3 Trainees perspectives on village training

Participation / access to training

Overall, 58% of trainees saw the training video, with little difference between the two sub-counties and slightly higher viewing by women. The video was scheduled to be shown in every parish, the reasons for not being seen by 40% of the trainees are not

clear. Training sessions varied from zero to three. The mean number of training sessions attended per respondent were higher in Bukanga (1.9) than Buwaya (1.3).

Table 17: Summary of comments on participation in and access to training

		Video view (% of respondents)	Training sessions (mean no. per respondent)	Number of training sessions attended (% of respondents)			
				0	1	2	3
Bukanga	30	60	1.9	0	20	67	13
Buwaya	30	57	1.3	23	37	30	10
Female	32	63	1.4	10	47	43	7
Male	28	54	1.8	14	11	57	18
Total	60	58	1.6	12	28	48	12

Trainees' expectations

Trainees were asked what they had expected from the training (Table 18). Interestingly, 60% of trainees were expecting what the project had aimed to deliver. However, other expectations included training in maize production (28%) and general farming (18%).

Table 18: Expectations of training (Percentage of respondents)

	Respondents	Maize seed prodn.	New maize farming skills	New general farming skills	Receiving maize seed	Other	None/ no response
Bukanga	30	63	20	20	7	7	0
Buwaya	30	57	37	17	0	0	13
Total	60	60	28	3	0	3	7

Note: Some trainees gave more than one response and therefore percentage total exceeds 100

Trainees' understanding

Trainees were asked to explain any method which they know to produce maize seed. Enumerators (technicians from NAARI Cereals programme) evaluated whether each method was not known (or mentioned), partially understood or fully understood. The results are shown in Table 19, below. The most complicated method (use of pollination bag) seems to be the most understood and the apparently more straightforward methods least well understood. There are at least two likely explanations for these results. Firstly, if a respondent did not mention a method it may have been because the method was not known by them or because the method had been rejected as inappropriate. In Bukanga, for example, where land is particularly scarce, 60% of respondents either were not aware or rejected isolation in space compared to only 30% in Buwaya. The same may be true of isolation in time and all farmers growing one type of maize. For many farmers these don't appear to be viable options. Secondly, the pollination bag method was introduced into Bukanga in the 1999a season, the leading co-ordinator is enthusiastic about this method and this was the main focus of their action plan. This may explain the high level of understanding in this sub-county compared to Buwaya and also compared to other methods.

Table 19: Trainees' understanding of seed production methods

		Isolated in space			Isolated in time			All gr owing one type			Use of pollination bags		
		N	P	F	N	P	F	N	P	F	N	P	F
Bukanga	30	60	27	13	50	20	30	67	17	17	3	23	73
Buwaya	30	30	43	33	57	7	37	73	7	20	13	47	40
Total	60	52	25	23	53	13	33	70	12	18	8	35	57

N = none; P = partial; F = full

Trainees - future plans

Overall, 87% of respondents said that they expected to carry out seed production (Table 20, below). There is clearly a divergence between the two sub-counties in the choice of method. In Bukanga the pollination bag method emerges as the favoured approach. In Buwaya, the pollination bag method is again favoured, but isolation in time and space are also chosen by a significant number of farmers.

Table 20: Choice of seed production method (Percentage of respondents)

	Respondents	Space	Time	Everybody growing	Pollination bag	Unsure	None
Bukanga	30	0	7	0	80	3	10
Buwaya	30	20	17	0	40	7	17
Total	60	10	12	0	60	5	13

The VBT had been or are expected to be the source of seed for most farmers planning to produce seed (Table 21). Many farmers (42% overall) hope to receive starter seed which is free or on loan, but 32% expected to pay (Table 22).

Table 21: Planned source of seed to produce seed (Percentage of respondents)

		% Producing	VBT	Dealer	Own	Friend/family	None
Bukanga	30	90	67	10	10	3	10
Buwaya	30	83	67	3	10	3	17
Total	60	87	67	7	10	3	13

Table 22: How Longe seed has been/ is to be procured

		Producing	Buy	Loan/Free	Own	Not known
Bukanga	30	90	37	40	10	3
Buwaya	30	83	27	43	10	3
Total	60	87	32	42	10	3

Training video presentations in parishes through commercial video outfits

Overall 58% of the trainees sampled had seen the training video. The commercial, mobile, video outfits appear to have been responsive and provided a reasonable service.

Farmers' evaluation of the video is only partial, but gives some indicators. There were technical criticisms with the sound not always clear. Certain voices were preferred and Lusoga/ Luganda was preferred to English. Farmers were keen to see how maize seed is planted by researchers and to learn whether planting to produce seed is different from planting to produce grain. Although not intended by the project

personnel, farmers were looking beyond seed production and wanted to see agronomic practices, pest and disease control. Positive points included: showing cob selection; seed selection for planting; selection of plants for pollination; the idea of roguing diseased plants and differentiating between OPVs and hybrids.

Trainers reported the benefits of being able to show a video which showed them being trained.

Output 3.3 Does acquisition of researcher knowledge improve farmer capacity to improve their own seed?

How might knowledge acquisition be assessed ? One-off training of VBTs has resulted in a significant number of farmers being able to demonstrate to researchers an understanding of seed production methods. However, in many instances there was a lack or only partial understanding. Assessing knowledge acquisition is difficult and this would become much more of an issue on a wider scale.

From acquiring knowledge to deciding/ being able to change - even with improved knowledge, other resource constraints may limit farmers' ability to put what they have learnt into practice. For many farmers, purchasing start-up seed and pollination bags is likely to be difficult. Various scenarios could be tested i.e. perhaps through seed merchants contracting a limited number of farmers to produce seed to sell to them to certify and market.

It is not yet clear what the costs and benefits are to producing seed either for their own use or for sale. This would need to be assessed with farmers and other stakeholders.

Who produces, who buys and who benefits ? In the communities with whom we have been working we have not yet been able to answer these questions during the life of this project.

Short term v long term. Over what time period should an initiative such as this be implemented and evaluated? Clearly there are opportunities for producing a significant impact on farmers' livelihoods and the maize seed initiative could easily be expected to affect other crops and agricultural practices.

The trainees indicated a number of other training needs, some relating to seed and others to general maize production (Annex). Who should respond to this training need ? There are a number of initiatives involving the devolution of research need decision making and identification to district level in Uganda being proposed and implemented. The success of this current project indicates that there are potentially huge opportunities to harness the hunger for knowledge by farmers, which if channelled effectively, could lead to many improvements in agricultural production at farm level.

Before further work, various issues would need to be debated and clarified. It is clear that, even on the small scale and low level of intensity possible in this one year project, maize seed production knowledge and technology can be transferred to farmers. Given the process in an uncertain institutional environment and that the majority of farmers are already using locally supplied seed, the argument for strengthening local institutions would still appear to be strong.

In order for researchers to document the process significant resources were invested in monitoring and evaluation which is about communication for learning and decision-making and is based on sharing information future interventions of this kind may benefit from exploring the potential for further participatory monitoring of activities and outcomes.

Output 4. Potential for scaling out of improved farmer-based seed production assessed and promoted

Output 4.1 Introduction The project necessarily focussed on a limited number of farmers with a high ratio of research resources to each farmer. Can this approach be scaled-out ? Table 23 gives some indication of the numbers involved in maize farming in Uganda. Widespread uptake of these approaches would involve a large number of trainers having the capacity to train farmers.

Table 23: Orders of magnitude for scaling out

Country	District	Sub-counties	Parishes	Villages	Farmers
Areas where maize is a significant crop	Tens	Hundreds	Thousands	Tens of thousands	Millions
	Iganga district	Tens	Hundreds	Thousands	Tens of thousands
		Bukanga	6	40 (approx)	Thousands
		Buwaya	6	40 (approx)	Thousands

Output 4.2 Potential for scaling-out

4.2.1 Which farmers were trained in Bukanga and Buwaya sub-counties?

Background information was collected about the trainees primarily to provide some indication of the extent to which different members of the communities were represented.

Overall, just over half of the trainees were female (53%), but significantly more women were trained in Bukanga than Buwaya (Table 24). Only two female trainees were reported as heads of households, which almost certainly considerably under-represents the wider population. The trainees were relatively young, with a mean age of thirty four and 72% being under the age of forty. Female trainees were generally older than male trainees. There was particularly low representation from farmers of fifty years and over.

Table 24: Gender, mean age and age frequency distribution of trainees (Percentage of total respondents)

		No. of respondents	Mean age	<30	30<40	40<50	>=50
Bukanga	Female	18	34	10	8	10	2
	Male	12	31	10	8	2	0
Buwaya	Female	14	38	5	8	5	5
	Male	16	34	7	15	3	2
Total	Female	32	36	15	17	15	7
	Male	28	32	17	23	5	2
	Total	60	34	32	40	20	8

Table 25 shows the formal education experience of trainees ranged from none (12%) to beyond secondary year 4 level (5%). Overall, 75% of respondents had completed primary school education (P7). The results reflect the broader situation in Uganda with educational attainment for females significantly lower than for males.

Table 25: Gender and education of trainees (Percentage of total respondents)

		No. of respondents	None	P1-P6	P7	S1-S4	Beyond S4
Bukanga	Female	18	3	3	10	13	0
	Male	12	0	0	10	8	2
Buwaya	Female	14	7	8	7	2	0
	Male	16	2	1	7	13	3
Total	Female	32	10	12	17	15	0
	Male	28	2	2	17	22	5
	Total	60	12	13	33	37	5

Iganga is a densely populated district and land is a scarce resource. In this sample, the mean area of land per household was 3 hectares, but in Bukanga it was only 1.8 hectares, compared to 4.3 hectares in Buwaya (Table 26). In both sub-counties at least 50% of respondents had less than 2 hectares/ household, but whereas no farmers reported having more than 5 hectares in Bukanga, 13% did so in Buwaya. One farmer reported having 54 ha in that sub-county. The mean area of land occupied by maize per season is reported as 0.5 ha in 1999a and 0.43 ha in 1999b. Assuming these figures are fairly representative of the wider population, a much higher proportion of land is planted with maize in Bukanga than Buwaya.

Table 26: Mean and frequency distribution of household land ownership (hectares) and area of maize grown in the 1999a and 1999b seasons (hectares)

	Number	<0.5	0.5<1	1<2	2<3	3<4	4<5	>5	Mean	Maize 1999a	Maize 1999b
Bukanga	30	20	10	23	27	10	10	0	1.8	0.54	0.39
Buwaya	30	17	10	23	17	10	10	13	4.3	0.47	0.47
Total	60	18	10	23	22	10	10	7	3.0	0.5	0.43

Trainees appear to represent a wide range of farmers according to gender, age, land ownership and education. However, it was beyond the scope of this study to compare directly with that for the wider population in these two sub-counties and Iganga district.

4.2.1 Farmer Capacity for training

The performance of VBTs provides an indicator of whether the approach is appropriate as a means of scaling-out. The VBTs identified major strengths as including guaranteed access to high quality seed at a reasonable cost; major weaknesses identified were the cost of pollination bags and a lack of general training in maize production.

From interviews with the trainees we identified the following key points:

- one-off training of VBTs resulted in a significant number of farmers being able to demonstrate an understanding of seed production methods. However, in many instances there is a lack or only partial understanding of all or some of the techniques.
- the trainees have indicated a number of other training needs, some relating to seed and others to general maize production. Who should respond to this training need?

4.2.2 Use of video for scaling-out

The use of commercial, mobile, video outfits using small generators to show videos in rural areas without access to mains electricity worked well in Iganga. Videos themselves, however, would need to be part of a training programme based around capable trainers. One approach to widening the usefulness of videos would be to have different soundtracks and introductory sections in the appropriate languages for use in different parts of the country.

4.2.3 Number of farmers buying and producing maize seed

Ideally the opportunity should be taken to monitor future production now that this project has finished by funding a further small-scale survey following the current season's (2000a) maize harvest. It is estimated that this would cost between £500 and £1000. The results could then be taken-up as part of a planned CPP-funded maize cropping system project.

Indicators might include, for example, the number of farmers continuing to buy maize seed from VBTs and other trained farmers who have opted to produce seed to sell.

4.2.4 Other issues

Will resources, financial and human, be sought by the trained groups ? Will success attract further funding? We already know that FOSEM and Bakusekamajja (Grace Bakaira's CBO) are linking with a COOPIBO-funded project. What other initiatives might develop or could be encouraged ?

The changing role of stakeholders in training would need to be appreciated in the light of expected future developments in the way research, extension and outreach are implemented, managed and funded in Uganda in the future. An example might be that the DFIs and new zonal research centres deliver certified, 'hands-on' training in seed production building on experience of various initiatives e.g. those of CIAT (*Phaseolus* bean seed), various NGOs, and this project.

New joint donor initiatives (involving DFID) aimed at co-ordinating and pooling resources which could be utilised at the sub-county level to commission organizations to carry out training in their sub-county by local demand might be developed in the near future.

The role of various media e.g. mobile video shows, radio, newspapers, etc. needs to be explored and the involvement of schools in training has not been studied.

Contribution of Outputs

[Include how the outputs will contribute towards DFID's developmental goals. The identified promotion pathways to target institutions and beneficiaries. What follow up action/research is necessary to promote the findings of the work to achieve their development benefit? This should include a list of publications, plans for further dissemination, as appropriate. For projects aimed at developing a device, material or process specify:

a. What further market studies need to be done?
b. How the outputs will be made available to intended users?
c. What further stages will be needed to develop, test and establish manufacture of a product?
d. How and by whom, will the further stages be carried out and paid for?[

In the context of DFID's Sustainable Rural Livelihoods framework.
The project has specifically contributed to the human capital base of the people in the project focus areas and has successfully developed and tested methods and approaches which may facilitate contributing to the human capital base of others.

The project outputs contribute to DFID's goals of poverty alleviation and sustainable development. The project has developed methods by which smallholder farmers have access to techniques that they can use to maintain open-pollinated maize varieties more-or-less indefinitely. Seed of cv Longe that they produced following application of the training that they have received has been confirmed to be true-to-type and has maintained its tolerance to MSV. The method has been adopted enthusiastically by farmers, resulting in increased production of Longe, both for seed and consumption and sale as grain thus aiding food security and generating cash income. The technique targets smallholder farmers and women have been amongst the keenest adopters.

The project has been able to target only two sub-counties in Iganga. However, the project worked through the local NGO, FOSEM. This NGO has links throughout Iganga and in other districts too, allowing potential to scale-out the process. The process should be transferable to other NGOs, indeed testing its compatibility with other NGOs would seem to be an important additional research target.

The project has only had a limited, two growing season opportunity, to test the method taught to the farmers but various logistical problems were evident. We provided each participating farmer with some few thousand seeds of high quality (breeder seed) yet farmers were provided with only about 100 pollination bags each, so most of the ears of the resulting maize plants could not be bagged. The bags are also not locally available and are somewhat expensive. For these reasons, farmers have already adapted their approach and some have began to use isolation either in time or space to produce their Longe seed. That they have been able to do this helps to confirm that the training that they received has left them with a good understanding of the biology of maize seed production.

Farmers have also realised that as a single cob contains so many seeds (a well-filled cob may have >500) it should be possible for them to grow only a few Longe plants either in very careful isolation, perhaps off-season in an area where they could be watered or in valley bottoms to make use of residual moisture or by using a few, specially obtained bags. Whether this might be done communally or individually is unclear. It is certainly feasible that the purity of seed stock be maintained down the

generations in this way and perhaps even improved by judicious selection. The bulk of the maize seed could then be grown "fairly-well" isolated during the normal season. This seed could be used either by the farmers for normal use or sold as grain. The farmers also seemed to be developing their own methods and testing them. Whether they were technically appropriate was unclear and the uncertain future of the project gave no meaningful opportunity to sit down with the farmers in order to develop a method that would better suit the local constraints. Consequently, one essential next step for the project would be to continue working with the same groups of farmers, in order to develop their ability to grow the best maize in ways that are more appropriate for their local conditions. This is likely to vary within and between communities. The initiation of the process needs to be de-centralised with the role of Namulonge possibly retained for training the trainers.

The use of a video coupled with mobile video projection equipment used by local entrepreneurs to provide entertainment in the villages proved to be a very effective (and cost-effective) way of providing farmers with information. However, the video needs to be updated in line with new information on the best way for farmers to maintain and improve maize production. The video potentially provides a means by which other organisations (NGOs, Extension, etc.), could quickly utilise the outputs of the project. A further need therefore is to market-test the video approach with other organisations, with the aim of assessing how appropriate this medium is as a way of scaling-out the outputs of the project to maximise its impact.

In relation to the sustainable rural livelihoods framework, the project identified a weak formal maize seed production sector. It suggests that the advantages of localising the seed production process will result in improved local accountability and a reduction in the need for the public sector involvement as participation between public, NGO, CBO and private groupings is strengthened. In terms of capital assets, human capital has been increased through the imparting of knowledge, the social capital was strengthened through the empowerment of existing farmers' groups, issues of financial capital were addressed to a limited extent through the enhance ability of some farmers to sell maize seed rather than grain, and finally the natural capital was increased (potentially) through an increase in productivity as a result of having better maize seed more often.

Dissemination outputs

Quarterly and annual reports and visit reports were produced.

Peer-reviewed publication:

GIBSON, R.W., ACOLA, G., LAMBOLL, R.I., IMANYWOHA, J., SOLOMON, PAGE, W.W., JIMMY, COOTER, R.J., KAYONGO, J. (submitted) Maize seed selection by Ugandan smallholder farmers and its effect on resistance to maize streak virus. *Annals of Applied Biology*. (Annex 2)

ACOLA, G. (2000). Farmer seed management practices: A case in Iganga district (Annex 1).

Unpublished report: Seed Management Questionnaire (2000) (Annex 3)

Unpublished report: Community Seed Production In Iganga District (1999) (Annex 4)

LAMBOLL, R. (2000) Management strategies for MSVD:farmer-based seed production in Iganga District - Final evaluation: village based trainers. (Annex 5)

LAMBOLL, R. (2000) Management strategies for MSVD:farmer-based seed production in Iganga District - Final evaluation: trainees (Annex 6)
Appendix 1: Village-Based maize seed production: survey of farmers trained by village-based trainers
Appendix 2: Farmer Group Questionnaire
Appendix 3: Trainees response to 'What was missing from the training?'
Appendix 5: Trainees response to the question 'What will you different in the way you produce maize after the training?'

Unpublished report: Seed types brought by farmers during the group evaluation of the seed works in Bukanga (Annex 7)

ACOLA, G., IMANYOHWA, J., KYETERE, D. (1999) Training of village-based trainers (VBTs) on maize seed production. Namulonge Agricultural and Animal Production Research Institute (NAARI) 25-26 October 1999. (Annex 8)

IMANYWOHA, J. and KAYONGO, J. (2000) Quality of Farmers' maize seed. Performance of community-based seed with regard to genetic purity. (Annex 9)

Annex 1 Farmer seed management practices: A case in Iganga district

Draft report prepared by Ms Grace Acola

Introduction

1.1 Background

Maize is produced throughout Uganda but the main production zones are in the West, East, North and Southeast. Currently maize is a major staple and is consumed in the form of roasted or steamed green cobs, maize flour and porridge. Maize stover and bran also constitute major ingredients in the livestock industry. Maize is thus a strategic crop in Ugandan food security, largely as a result of increasing urbanisation, and has the potential to become a non-traditional agricultural export crop.

Overall, seed is the most important input in agricultural development in general and crop production. It is a vehicle of crop technology transfer to farmers, hence it has received special attention in most parts of the world. However, despite the development and transfer of improved seeds, Ugandan maize farmers still continue to rely on home-saved seeds or farmer-to-farmer exchange of seed of traditional varieties. There is very scanty information on how they select and manage their home-saved seeds. It is against this background that this study was proposed and conducted in Iganga, one of the major maize growing districts in Uganda.

1.2 Objectives

The overall objective of the study was to assess maize seed management practices. The specific objectives were to;

- assess the type of maize seed being grown by the farmers;
- evaluate farmers' seed selection criteria;
- establish constraints to seed selection;
- establish the different storage methods used by farmers;
- provide baseline information for any future activities.

1.3 Study area

The study was conducted in Iganga district. The district borders Bugiri in the East, Jinja in the West, Kamuli in the north and Lake Victoria in the south. Two agro-ecological zones cut across the district; the southern and western tall grasslands, where perennial and annual crops are produced, mainly in mixed farming systems and the northern and eastern short grasslands, where annual crops are produced. The district is basically rural with only 4.7% of the population living in urban areas. Agriculture is the major economic activity. The main food crops grown in the district are cassava, maize, finger millet, sweet potato, sorghum and until recently rice. The major cash crops are coffee and maize.

The district was selected for the study because of the importance of maize as a major subsistence and commercial crop. The district accounts for about 10% of the maize produced in Uganda. There are ready markets for maize in the major towns of Jinja and Kampala and some of the maize finds its way to external markets especially to Kenya. In particular the study area, Bukanga and Buwaya sub-counties, were selected because maize is ranked as a major food and cash crop and thus occupies the greatest

proportion of land. The farmers in Bukanga, Namukubembe parish have been involved in maize research activities for over 5 years, they therefore had a wealth of information on seed management practices of both the local and improved seeds. Buwaya is one of the sub-counties being managed by FOSEM, an NGO interested in restoring food security in the district. It was anticipated that by involving this NGO, project outputs might be sustained and the welfare and livelihood of the rural poor would be improved.

2.0 Methodology

The survey was conducted in two subcounties of Bukanga and Buwaya. In each if these counties, a parish was selected randomly and in each parish 2 villages (Table 1). From each of the 4 villages, ten farmers were selected randomly from a list provided by the LC111 Chairman.

A structured questionnaire meant for individual responses was developed and pre-tested prior to the actual survey (Appendix 1). A checklist was also developed and this guided the group discussions (Appendix 2). In each of the selected villages discussions were held with two farmer groups (male and female).

Table 1: Counties, subcounties and villages covered during the survey

Counties	Luuka	Bunya
Subcounties	Bukanga	Buwaya
Parishes	Kiroba	Isikiro
Villages	Budoma, Busanda	Nabitu, Isikiro

The information gathered from the farmers was summarised and is presented below.

3.0 Results

3.1 Seed types grown by farmers and their sources

The major seed types grown by the farmers are presented in Table 2. Amongst the individual farmers, the major types being grown were 'local' and 'Longe' as expressed by the high percentages of farmers' responses.

Table 2: Maize types being grown by individual interviewed farmers

Seed	Busanda (n=10)	Budoma (n=10)	Isikiro (n=10)	Nabitu (n=10)
Local	6(60)	10(100)	6(60)	10(100)
Katulika	2(20)	1(10)	-	-
Longe	4(40)	3(30)	7(70)	-
Kawanda	2(20)	3(30)	-	-

Note: n= Number of interviewed in the villages; (x) Percentage response of the farmers.
In some cases totals exceeds actual number of farmers interviewed, this is because of multiple responses by the farmers.

'Omusoga' which means native variety was the most common name being used for the local variety/seed type. From their description 'Omusoga' included a number of seed types which could easily be identified by the colour of the kernels or husks (pink, purple, red, yellow and white). Amongst the improved types, Longe was the most common. Hybrid maize was only mentioned by the men and women groups in Isikiro

village. The variety types that were being grown in all the study villages were the local, Kawanda which was being referred to as Longe by the farmers in Budoma; Longe, Katulika (popcorn type) and hybrid.

Farmers often have different sources of seed. The major source particularly of the local type has been farmers own seed which is usually saved from the previous season's harvest. Variety Katulika was given freely or sold to other farmers but at a low price. The improved varieties, Longe and hybrid were obtained from various sources including; Uganda National Farmers' Association (UNFA), FOSEM, farm supply shops, local council leaders and other farmers. Farmers indicated that usually, for any planting of the improved seeds, the initial starter seed is bought from any of the sources outlined above, subsequently, they continue with what they have saved from the season's harvest until productivity goes down.

4.0 Seed Management practices

Farmers seed management practices range from seed selection, planting to storage. Farmers are faced with a number of problems in each of these management practices.

4.1 Seed acquisition

Farmers mentioned a number of problems they face in acquiring seed for planting from the various seed sources (Table 3).

High seed cost was identified by nearly all the farmers' groups interviewed. This was followed by the sale of fake seeds in the market and distance to the source of seed. Seeds sold in the markets are often of poor quality. This has led to lack of confidence by the farmers in the seeds sold by the seed dealers, farmers therefore prefer to use the home-saved seeds because they are sure and confident that these seeds would not disappoint them.

The farmers have used different strategies to cope with these problems, including:

- buying from other farmers rather than from seed dealers;
- using their own-saved seeds; acquiring seed at no cost from other farmers;
- purchasing a lot of seeds such that when establishment is poor, farmer has some seed to gap-fill with;
- timely planting and early land preparation; recycling same seed across three seasons;
- expanding the area under maize such that in the event of any disaster like drought, pest/disease attacks, hailstorm, they don't lose out completely;
- continued use of the locally available seed types.

Table 3: Problems faced in acquisition and production of good quality seed by women and men interviewed in the study area

Problems	Budoma		Busanda		Isikiro		Nabitu	
	M	W	M	W	M	W	M	W
High Seed price	_/	_/	_/	-	_/	_/	_/	_/
Fake seed from market	_/	_/	_/	-	_/	-	_/	-
Long distance to obtain seed	_/	-	_/	_/	-	_/	-	_/
Poor establishment (germination)	_/	-	-	-	_/	_/	-	-
Lack of money (capital)	-	_/	-	_/	-	_/	-	-
Mixed up seeds in market	-	-	-	-	-	_/	_/	-

Land shortage	- _/	- -	- -	- -
Termites	- _/	- -	- -	- -
Lack of sustainability of improved seeds especially hybrid	- _/	- -	- _/	- -
Lack knowledge on good seed source	- -	- -	- -	- _/
Dual role maize plays in the absence of cassava*	- -	- -	- -	- _/
Lack farm supply shops	- -	_/ -	- -	- -

***** Cassava was a major food crop before the CMD epidemic and maize a major cashcrop. However, because was lost to CMD, maize took up a role as a food and cash crop. This has in effect reduced on the quantity of seed that the farmers are able to retain for planting.

4.2 Seed selection practices

Ugandan farmers have been practising seed selection and preservation for many years and the bulk of the national seed requirements are still met through the informal system of local seed maintenance and exchange.

In the study area, selection is done both after harvesting and from dried plants (Table 4).

Table 4: Percentage response of farmers of when and where they select their seeds

	Busanda	**Budoma**	**Isikiro**	**Nabitu**
When				
Pre-harvest	0	0	0	0
Post-harvest	60	40	90	100
Dried plants	40	60	10	0
Where				
Home	90	40	90	100
Field	10	60	10	0

It is evident from the results that all farmers select their maize seed after harvesting and at home. This practice may inevitable lead to rapid spread of diseases since selection would have been done without considering the level of disease on the plant. If farmers are to select clean seeds for planting, it is very critical that they should be made aware of the dangers of selecting after harvesting, rather, they should be encouraged to select at an earlier stage of plant growth.

There were varying responses by the groups interviewed as to who selected the seeds. These are summarised in Table 5.

Table 5: A summary of who selects seeds in the four villages

Busanda	Budoma	Isikiro	Nabitu
Response from women • Depends on family but usually women and children	• Women select for planting, men for sale	• Women select for planting, men big cobs for sale	• Done by the family (men, women, children of above 6 years) • Some farmers do not select, they just shell and plant
Response from men • Men, women, children above 12 years	• Men and women	Men, women , children	Men and women

4.2.1 Selection criteria

Farmers' selection criteria varied across the villages. However, the four major criteria that were mentioned in at least three of the villages were (and see Table 6):

- seed size;
- kernel colour;
- cob size, and;
- fully-filled cobs.

Various reasons were advanced for the selection practices:

- big seeds are usually good seed;
- one is assured of its germination;
- it is a practice that has been passed on from generation to generation;
- the bigger the seed size, the more the weight (important when selling);
- less seeds in a kg compared to when smaller seeds are sold;
- red kernel cobs preferred because they are sweet when roasted.

Red kernel cobs were also heavy and therefore very good for sale and took longer to mature (3-4 months) so when the early maturing varieties have been consumed, the long-term varieties serve as a buffer against food insecurity , they can be used as a short-term 'store'.

Large cobs were preferred because yields from such cobs are usually good and their germination very good. The fully-filled (from tip to base) cob is another selection criteria preferred by the farmers. This is because of the high quantity of the seeds that one can get. Uniformity of seed colour was considered important by women in Isikiro, this was because it is easier to find a market for uniform-coloured (white) seeds. The coloured seeds (yellow, purple) do not attract buyers. Variety type was considered important by men in Busanda and Isikiro villages. The different groups

interviewed indicated that selection was much easier in cob form. There was no difference in selection criteria across seasons.

Table 6: Criteria used by farmers in the selection of maize seed

Criteria/Village	Busanda		Budoma		Isikiro		Nabitu	
	W	M	M	W	M	W	M	W
Seed size (big seeds)	_/	_/	_/	_/	-	_/	_/	_/
Kernel colour (red)	_/	_/	_/	_/	-	-	-	_/
Large cobs	_/	_/	_/	_/	_/	-	_/	_/
Shrivelled seeds are not selected	_/	-	-	_/	-	-	-	-
Fully-filled cobs	_/	_/	_/	-	-	_/	-	-
Long and straight cobs	-	-	-	-	_/	_/	-	_/
Uniform colour	-	-	-	-	-	_/	-	-
Clean seed (free of rot)	-	-	-	-	-	-	_/	_/
Variety type	_/	-	-	-	_/	-	-	-
Dry seeds	-	-	-	-	_/	-	-	-
Seed viability	-	-	-	-	_/	-	-	-

M = Men; W = Women; _/ = Mentioned by group; - = Not mentioned by the group.

4.2.2 Problems encountered by farmers during selection

The problems reported are summarised in Table 7. Problems varied from village to village and between men and women. The major problem identified was seed rotting either in the field or during storage. Other problems mentioned included; pests notably termites, stem borer and rats are a menace both in the field and in storage; lack of good storage methods; theft, lack of knowledge on selection of good seeds; consumption of the seed prior to planting.

In an attempt to try and address the above problems, farmers have used their own methods. One method is frequent drying in the sun, however, seeds may be lost in this process, eaten by animals and birds or not all seeds may be recovered. By bringing the seeds frequently, the rate of infestation by the weevils will be reduced. Seeds are mixed with wood ash or soil dust to control pest damage as farmers believe that soil dust application darkens the colour of the seeds hence making them less attractive to the pests. Poisons are used against some pests, especially the rats, which is a very destructive and can destroy up to half of the seeds stored. To prevent consumption and sale of seeds to meet food or other needs, some farmers dress their seeds with chemical dust, others, immediately the rains set in, plant their seeds.

On how they want these problems addressed, they made the following suggestions; training on different agronomic practices, good storage methods and how to produce and select and acquire good seed; more new varieties be developed; chemicals for dressing and seeds be provided at subsidised rates that the farmers can afford.

Table 7: Problems encountered by farmers in seed selection

Problem / Village	Busanda		Budoma		Isikiro		Nabitu	
	M	W	M	W	M	W	M	W
Pests								
Stem borer	-	-	-	-	_/	-	-	-
Termites	-	_/	-	_/	-	_/	-	_/
Rats	-	_/	-	-	-	_/	-	-
Storage pests (weevils)	-	_/	-	-	_/	-	_/	_/
Rotten seeds	_/	_/	_/	_/	-	_/	-	_/
Poor storage methods	-	-	-	_/	_/	-	_/	-
Lack of knowledge on good storage	-	-	-	-	_/	-	-	-
Theft	-	-	-	-	_/	-	-	-
Disease (MSV)	-	-	-	-	_/	-	-	-
Lack of selection knowledge	-	-	-	-	-	-	_/	-
Mixed seeds on cob	_/	-	_/	-	-	-	-	-
Shrivelled seeds	_/	-	-	-	-	-	-	-
Frequent drying is tedious and time consuming	-	-	-	-	-	_/	-	-
Poor germination of the seeds	-	-	-	-	-	-	-	_/
Seeds may be consumed prior to planting	-	_/	-	-	-	-	-	-
Seeds may be sold to met household requirements	-	_/	-	-	-	-	-	-
Seeds may be sold by men to pay tax	-	_/	-	-	-	-	-	-

4.3 Planting

One farmer in Namukubembe in Bukanga sub-county reported that seed priming by soaking in water for 2-3 days enhanced quick germination of the seeds and fast growth of the plants. Longe seed was not primed in this way because the germinated seed was more fragile than primed seed of local varieties. Seed priming was not a common practice in all the sites selected.

4.4 Seed storage

4.4.1 Form of storage

There are two forms in which maize is stored by the farmers, as cobs and shelled seeds. Of the individual farmers interviewed in all the four villages, 53% indicated that they stored their seed in cob form while 45% indicated that they stored seed after shelling. Farmers remarked that when seeds are stored in cob-form, they are rarely disturbed by rats, chances of total damage by termite is reduced and it lasts longer than the shelled. When the seeds are stored after shelling, they dry faster and are ready for planting immediately the rains set in.

4.4.2 Storage methods used by farmers

Farmers use different methods for storing their seeds after selection. Some of these methods include; storage on the flour in houses, on roofs especially kitchen roofs, granaries, jerry cans, drums and gunny bags. Various reasons were mentioned by the farmers for the storage methods used (Table 8).

Table 8: Farmers reasons for using different storage methods

Method	Reasons
Cobs in gunny bags	• In case the seeds unshell on their own, the grains fall in the bag; • Stays longer without being attacked by weevils; • Rarely disturbed by rats; • Avoid total damage by termites; • Easy to bring out for drying regularly; • There is little wastage of the seeds; • Only alternative method known; • Lack of storage space.
Shell and dry	• Seeds are ready by time rains starts; • It is a cheap method.
Kitchen with iron roof	• Dries faster; • Seeds stored in the house are for home consumption whereas those kept on the roof are for seed.
Shelled in gunny bags	• The bags are perforated and this allows air to flow into the bag hence reducing heat.
Storage in drums	• Protect seeds from damage by rats.
Hangs cobs above a fire place	• Seeds not disturbed by termites and weevils.
Pour seed on flour	• Lack of storage facilities; • When the seeds are stored in bags, they rot very fast.

4.4.3 Seed storage and viability

The majority of the individual farmers interviewed indicated that they only kept their seeds until the next season (Table 9). However, one farmer indicated that depending on how you store the seed, they can be kept viable up to a maximum of three seasons after harvesting.

It is evident from the above results that majority of farmers only store seed until the next season between 3 to 9 months. Farmers who store their seed until the season after next, between 1 - 1.5 years, usually dressed them using any storage chemical to preserve them from weevil attack and consumption by the family members before planting.

Table 9: Percentage response of the farmers of the period in which they can store seed and still be able to use it

	Busanda	Budoma	Isikiro	Nabitu
How long farmer stores seed				
Until next season	80	100	70	90
Season after next	10	-	20	10
None response	10	-	10	-
Seed viability				
Until next season	30	70	40	60
Season after next	40	10	50	30
Three seasons after harvesting	10	10	-	-
None response	20	10	20	10

4.4.4 Problems encountered in seed storage

Table 10: Problems encountered by the different groups of farmers interviewed in the four villages

Problems	Busanda		Budoma		Isikiro		Nabitu	
	W	M	W	M	W	M	W	M
Storage weevils	_/	_/	_/	_/	_/	_/	_/	_/
Rodents	_/	_/	_/	-	_/	-	_/	-
Termites	_/	_/	_/	-	_/	-	_/	-
Lack of storage facilities	_/	_/	_/	_/	_/	-	_/	-
Poverty sometimes forces them to sell their seeds before the planting season	-	-	-	-	_/	-	-	-
Poor management of seeds in each household may lead to rotting and seed wastage	_/	-	-	_/	_/	_/	-	-
Roasting of seeds for tea accompaniment reduces on seeds available for planting	-	-	-	-	_/	-	-	-
Theft	-	-	-	_/	-	_/	-	-
Husbands steal seeds and sell	_/	-	-	-	_/	-	-	-
Lack of storage methods	-	-	-	-	- -		- _/	
Drying is tedious	-	_/	-	_/	-	-	-	-

The three major problems encountered by the different groups interviewed were storage weevils, lack of good storage facilities and rodents. Other problems mentioned are summarised in Table 10. Much as the farmers encountered these problems they devised ways and means of how to cope with them (Table 11). Some have been effective whereas others have not.

On how the storage problems should be addressed, farmers suggested that following; knowledge of good storage methods; provision of chemicals for dressing the seeds; a number of varieties be developed so that farmers have a wide range of varieties from which to choose; control methods for termites be developed and training on how to make good storage facilities.

Table 11: How farmers have tried to address the storage problems using their own methods

Problems	Method used to address problem	Effectiveness
Storage weevils	• Frequent drying • Dressing seeds with ash • Putting the bags with seed raised above the floor • Store cobs with ears on	• Effective only during the first nine months • Not effective • Good because seeds do not come into contact with the cold floor. • Effective because takes long before seed is attacked by the weevils
Rodents	• Use rat poison	• Partially effective because not all the rodents are killed at once
Lack of good storage facilities	• Store in bags, tins, drums and jerry cans • Keep bags on raised ground preferably on stones	• Effective
Termites	• Dust the seeds with dust powder	• Not effective
Tea accompaniment	• Grow popcorn type variety for this purpose	• Effective
Management of seed by household members poor	• None	•
Poverty which drives them into consuming the seed	• Try to expand the acreage of maize	• Effective, however the seeds are expensive and some of them may not afford large quantity for planting

4.4.5 Use of home-saved seeds

The number of farmers who saved seeds for the 1999a season were more than the 1998b season (Table 12). This was attributed to the long dry spell at that time which affected the yields, what was harvested could not meet the dual demands for food and seed. However, the 1999a season was characterised by stable weather conditions which led to good harvest hence more seeds available for planting in the next season. The majority of the farmers indicated that the seeds saved were used individually by each of them. This is an indication that most farmers usually prefer to use their own saved seeds because of the less cost incurred in acquiring the seeds. Farmers were more keen to give seed to close relatives either within the household or relatives from other areas (Table 14). The majority of the farmers acquired free seeds from either relatives, friends or businessmen.

Table 12: Number of farmers (%) who saved seeds during 19998b and 1999a seasons.

	Busanda	Budoma	Isikiro	Nabitu
1998b	70	60	50	40
1999a	100	90	80	60

Table 13: Farmers response (%) of who used the seeds during each of the seasons

Who	Busanda		Budoma		Isikiro		Nabitu	
	1998b	1999a	1998b	1999a	1998b	1999a	1998b	1999a
Self	40	80	40	90	30	80	80	90
Relatives	30	60	10	30	40	30	20	30
Other household members	30	50	10	50	10	30	20	20
Friends	10	20	-	-	20	30	20	20
Businessmen	10	-	-	-	-	10	-	-

Table 14: How the seeds were acquired by the farmers (percentage response by the individual farmers interviewed

How acquired	Busanda			Budoma			Isikiro			Nabitu		
	F	E	S	F	E	S	F	E	S	F	E	S
Relatives	40	20	10	30	-	-	50	-	-	30	-	-
Friends	20	20	-	-	-	10	30	10	10	20	10	-
Other household members	20	-	-	50	10	-	40	-	-	20	-	-
Businessmen	-	-	20	-	-	-	-	-	-	-	-	-

F - Free; E - Exchanged; S – Sold

Annex 1: Appendix 1

Maize seed management questionnaire, 1999

Parish..... Village..... Date.....
Name of farmers..... Male/Female..... Age.....

1) What area of maize (acres) did you plant, how much maize have you used and what was the source in 1999a and 1998b seasons?

	1999a	1998b	Comments
Area of maize (acres)			
Quantity of seed			
Type and source* of seed:			
(i)			
(ii)			
(iii)			

* Source = Bought/Home-produced/Exchanged/Other

If any seed is home-saved, go to Q2, if not finish interview

2) **Ask to see the seeds which the farmer has saved**

2.1 Which types of maize seeds are these (shown by the farmer)?

2.2 When were these seeds selected (e.g. on green plant/dried plant/postharvest)

2.3 Where did you select the seeds? (Home/Field)

2.4(a) Ho did you store your maize seed?

(b) Why did you store it that way?

2.5 How long do you normally store your maize seed ? Until next season/ The season after next/ Other

2.6 From your experience, how long can you store and still be able to use maize seed? Until next season/ The season after next/ Other.

2.7 Did you save maize seeds in each of 1999a and in 1998b?
Who used the seeds and how did they get it?

Who	Given free		Exchanged		Sold		Other	
	1999a	1998b	1999a	1998b	1999a	998b	1999a	999b
Self								
Other members of household								
Relatives								
Others								

2.8(a) Did you have sufficient home-saved seeds to plant the area you wanted in 1999a and 1998b season? Yes/No
(b) If no, explain why?

2.9 Did you use any seed other than your seed in 1999a and 1998b> Yes/No
(b) If YES, how did you get this seed and from who?

Who	Given free		Exchanged		Sold		Other	
	1999a	1998b	1999a	1998b	1999a	998b	1999a	999b
Self								
Other members of household								
Relatives								
Others (be specific as possible)								

Annex 1: Appendix 2
Checklist on Farmer Maize Seed Management

- **Seed types**
  - Types of maize seed planted in 1998b and 1999a seasons
  - Sources of these seeds
- **Seed management practices**

(If seeds were saved for this season, request farmer to bring them)

- How was this seed acquired (bought/own/free/exchanged).
- If bought: - which type
  - how much
  - where from
  - distance from source.
- Problems faced in buying good quality seed:
  - How they have addressed this problems?
  - What they think should be done to these problems?
- If exchanged, - for what?
  - who did you exchange with (relative, friend etc.)?

- **Seed selection practices**
  - If exchanged, did they select, how did they do it
  - If own how was it selected (green/dried/post harvest etc)
  - Who selected (Men, Women, Children, hired labour)
  - What criteria did you consider during the selection process?
  - Do you use same selection criteria across seasons?
  - Problems encountered in farmer own seed selection:
    - How they have addressed?
    - Opinion on what they feel should be done.
- **Storage**
  - How maize seed stored**, (**in cob, above fire place, threshed etc.), most common storage practices:
  - (If farmers mention various storage methods, then find out why it is
  - stored that way);
  - How long can you keep seeds that way before planting (viability
  - of seeds)?
  - Problems encountered in storage (rank).

  How they have addressed this problem?
  - How they want these problems addressed.

Annex 2 Maize seed selection by Ugandan smallholder farmers and its effect on resistance to maize streak virus

By

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Summary

The method by which small-scale maize farmers selected home-saved seed in Iganga, Busia and Tororo Districts in Uganda was studied, with the aim of understanding how this might interact with the maintenance of a maize streak virus (MSV) -resistant maize variety, Longe, recently released there. Most farmers both home-saved and purchased seed; home-saved seed was used because it was cheap, readily available and of known quality; seed purchased from local traders often germinated poorly or was not the specified variety. The main cultivars grown in Iganga were a maincrop landrace, a MSV-resistant variety Longe, a popcorn landrace and an old composite variety Kawanda. Farmers, especially in Busia and Tororo, also grew various Kenyan hybrids. Farmers saved seed of all cultivars to varying extents. Seed selection was done when the ears had been harvested, the outer husk leaves had been removed to reveal the cob and the cobs had been collected together either in the field or at the homestead. For the maincrop landrace, large cobs with many, regularly-arranged, large seeds were preferred; seeds also needed to be predominantly and uniformly white, though a small area of red where the seed connected to the rachis was a characteristic of the maincrop landrace (and the rachis also typically had a rusty-red surface coloration). This form of seed selection seems to allow no opportunity for farmers to select seed from MSV-resistant parents. Indeed, it seems most likely to select for parents which escaped infection or have vector resistance. Simulation of this selection process on-station in a crop of Longe and in crosses with cv Kawanda did not select for MSV resistance.

Key words: Maize, maize streak virus, resistance, farmer selection, Africa

Introduction

Maize (*Zea mays*) is Africa's main grain staple, especially in fertile, high rainfall areas, and is grown on both small-scale and large-scale "commercial" farms. Maize streak virus (MSV), a geminivirus transmitted by a range of leafhoppers in the genus *Cicadulina* (Storey, 1925), causes maize streak disease (MSD), the most damaging virus disease of the crop in Africa (Storey, 1936; Geddes, 1990; Thottappilly, 1992). Resistance to MSV has been known since the 1930's and used widely in African breeding programmes to produce resistant cultivars. It has been found in exotic landraces but the cultivar "La Revolution" from Reunion has been

particularly important in breeding programmes. Resistant genotypes develop mild symptoms, suffer only slight yield loss when infected (Gorter, 1959; Soto, Buddenhagen & Asnani, 1982; Efron, et al., 1989; Barrow, 1993) and have low virus titres (Peterschmitt, Quiot, Reynaud & Baudin, 1992). In order to stabilise resistance in new cultivars, plant breeders inoculate plant populations with large numbers of artificially reared MSV-viruliferous leafhoppers, aiming to infect all plants and to select plants expressing mild MSD (Soto, Buddenhagen & Asnani, 1982; Efron, et al., 1989). The resistance seems to be inherited oligogenically (Kim, Effron, Fajemisin & Buddenhagen, 1989), perhaps with one major gene and several minor genes (Storey & Howland, 1967). The open-pollinated cultivar Longe, bred by a collaboration between the Ugandan Cereals Programme and the International Institute of Tropical Agriculture, incorporates this form of resistance and was released in Uganda in 1991.

Farmers in South and Central America, where maize was originally domesticated, cultivate a diversity of maize races. In Mexico alone, at least 59 races differing widely in cob shape and size, number of kernel rows, cob and kernel colour, time of maturity and number of tillers are grown (Sanchez, Goodman & Stuber, 2000). Maize is a predominantly out-crossing species. Despite this, Amerindian farmers traditionally maintain local varieties by selecting seed from ears with preferred appearances, sometimes assisted by isolation either in time (staggered flowering) or space (Johannessen, 1982; Bellon, 1991; Zimmerer, 1991; Bellon & Brush, 1994; Louette, Charrier & Berthaud, 1997). Selection of genotypes with large ears and seeds is thought also to have been important in the early stages of domestication (Harlan, 1992). Sorghum is a comparable traditional cereal staple in Africa and similarly *ca*. 60 landraces of it were found in just two districts of Ethiopia (Teshome et al., 1997).

In Uganda, maize is an introduced crop and most production is by smallholder farmers. Maize is produced throughout Uganda but especially in eastern districts. It is a major staple consumed mainly in the form of cooked dough (ugali) or porridge made from flour (posho) from the milled ripe grains (kernels) or as roasted or steamed unripe cobs. It is also sold as a grain crop both for urban consumption and for export, largely for consumption in neighbouring countries (Anonymous, 1993). Maize stover and bran may also be fed to livestock. Maize production is increasing in response to improving markets and biotic and abiotic constraints on other crops such as bananas. Despite the importance of maize, few data have been collected on the diversity of varieties grown in Africa. Since maize is naturally cross-pollinating, farmers need special skills and methods to prevent uncontrolled crossing between open-pollinated varieties or landraces if they are to produce their own seed. The following work was done as part of a larger project aiming to improve the control of MSV, particularly through the increased use of cv Longe. It recorded the diversity of maize grown by smallholders in Iganga District in eastern Uganda and how diversity is maintain and controlled. It also sought to examine how traditional selection procedures might affect the maintenance of MSD-resistance in Longe, since severe attacks of MSD in this cultivar have occasionally been notified. Resistance to MSD has seldom been reported in African landraces and some feature of seed selection by farmers might be predicating against resistant genotypes.

Method

Village interviews

A situation analysis was done in 1997 in four villages in eastern Uganda to initiate village-based research activities on improved MSV management. The four villages were selected on the basis of high maize production, based on the advice of district extension officers. The four villages were: Kisoko in Tororo District, Ajuket in Busia District, and Namakubembe and Bugodi in Iganga District. Iganga, Tororo and Busia Districts all lie in eastern Uganda, the latter two bordering Kenya. It was subsequently decided to target activities (1998- 2000) to Iganga District, focusing on Budoma and Busanda villages in Bukanga sub-county, and Nabitu and Isikiro villages in Buwaya sub-county. Iganga accounts for about 10% of the maize produced in Uganda and, unlike the other two districts, has two main planting seasons, the first rains (in March/April) and the second rains (in September/October). Iganga has markets for maize in the nearby major towns of Jinja and Kampala, some of the maize being exported, especially to Kenya.

District extension staff helped to organise and participated in activities in each village. For the interviews in March 1997, villagers in each village were divided into three groups, namely men farmers, women farmers and village elders (both female and male). Each group generally comprised 10-30 villagers plus two researchers, one acting as a facilitator and the other recording the discussion. Discussions generally lasted 2-4 hrs, but were open-ended. The discussions were guided with a checklist and various participatory techniques were used to investigate the major characteristics and problems of farming in each location; here, we describe only the outputs relating to maize seed and seed selection. Initial interviews were in March; clarification interviews were done during June 1997.

For the study conducted in Iganga District in 2000, group discussions guided by a checklist were held in each of the four villages with separate women's and men's groups. Ten farmers were also selected in each of the 4 villages randomly from a list provided by the village chairman. These were interviewed using a structured questionnaire to provide quantitative data. All these studies indicated the importance of seed selection based on the appearance of the entire cob (kernels plus rachis but minus the sheath leaves). Tests were therefore done to assess whether villagers in the two sub-counties could distinguish between locally-produced cobs of cv Longe, the local maincrop landrace and a popcorn landrace. Farmers had been asked to bring specimen cobs of their own maize cultivars. These were all coded and mixed together before farmers were asked individually to identify the cultivar of each cob. A consensus decision was subsequently sought from the farmers as a group, and two Ugandan Cereals Programme researchers also identified each cob.

Simulation on-station of farmer' maize seed selection

These experiments were located at Namulonge Agricultural and Animal Production Research Institute (NAARI), *ca.* 30 km from Kampala. They were done in order to assess the effect of traditional farmer seed selection practice on MSV resistance in the released variety Longe. They examine how this might interact with the effects of cross-pollination by local cultivars and as well as selection within Longe.

Selection within Longe. Longe seed obtained from the Uganda Seed Project was planted in a plot 15 m wide by 90 m long, single spaced at 0.3 apart in rows 0.75m apart on 7 October, 1996, giving a total plant population of about 6,000. The plot was located at the International Institute of Tropical Agriculture (IITA) Eastern and Southern Africa Regional Center (ESARC) research station farm in Uganda at NAARI. This farm was chosen because no other maize was growing there (the plot was surrounded by bananas and yams) and the plot was >0.5 km from farmers' maize crops. Plants were scored for infection and severity at maturity on 17th December (MSD develops only on growing leaves (Gibson & Page, 1997)) and grain yields recorded. A 0 - 5 scale devised by maize breeders was used (0 = no symptoms, 5 = severe symptoms (Soto, Buddenhagen & Asnani, 1982; Barrow, 1992)) such that plants with symptom scores >3 are considered susceptible and would be rejected by plant breeders. At harvest, ten cobs were selected visually on the basis of being large and well-filled with large, white, evenly spaced seeds, and ten were selected visually as just having large, white, evenly spaced seeds. The seed was removed from each selected cob and the seeds from each batch of ten was mixed together. The seed was then removed from all remaining cobs and the weight of maize seeds produced by each infected plant and by 100 randomly selected symptomless plants was recorded. The seed from all these remaining cobs was bulked and mixed, and a batch similar to that obtained from each of the previous two batches of ten cobs was retained.

In order to examine relationships between cob or seed size, and severity of MSD, seed from each of the three seed batches was planted in plots at NAARI during the following rains on 30th April, 1997 in a randomised block design replicated five times. Each plot comprised 10 seeds planted in a single row at 0.3m spacing. Each resulting plant was inoculated with MSV by caging on an upper leaf for 2 days three laboratory-reared *C. mbila* which had been kept for 2 days on an MSD-affected maize plant found in a field. Plants were then scored for severity of symptoms on several subsequent dates over the growing season.

Cross-pollination of cv Longe by a large-seeded, MSV-susceptible cultivation. Kawanda composite is a large-seeded, MSV-susceptible composite variety based on Ugandan landraces and released many years ago. Forty ears of Kawanda enclosed in paper bags were hand-pollinated with Kawanda pollen, 40 cobs of Longe (MSV resistant) were hand-pollinated with Longe pollen and 40 cobs of Longe were hand-pollinated with Kawanda pollen. The weights of each seed in a random sample of 100 seeds taken from each treatment were measured to examine the effect of pollen source on the size of seed. Seeds from these were then planted at NAARI Farm during the second rains of 1998 using a similar experimental design and planting distances as before to assess the susceptibilities of the resulting progenies to MSD. In order to examine relationships between seed size and severity of MSD, cobs were distinguished into large, medium and small ones (10 of each) and these also were sown at NAARI farm. Plants were all inoculated with MSV using viruliferous *C. mbila* as before and plants scored for severity of symptoms when crop growth was complete.

Results

Interviews in Tororo, Busia and Iganga districts in 1997

Cultivars. In the villages selected in Tororo, Busia and Iganga, most farmers planted home-saved seed. This was mostly of a single local maincrop landrace, referred to under the nonspecific name of "local" or an equivalent in the local language. They also grew small amounts of a local popcorn landrace. Farmers generally seemed to have only one local maincrop landrace. Some elders remembered a small, red-grained maize but the larger-grained type now described as local supplanted it several decades ago. Some villagers planted bought seed instead of or in addition to the local landrace: they bought predominantly the Ugandan-bred, MSD-resistant cv Longe or, in Busia and Tororo, "hybrid". The latter originated from Kenya and seemed likely to include several hybrid cultivars. Many farmers retained seed from both Longe and hybrid through several cropping cycles, continuing to retain their names. Major problems of bought seed identified in this early survey were that it was costly, often of poor quality (damaged, low germination percentage) and incorrectly named. Hybrid was bought because of its good yield, though it was generally considered more susceptible to MSD than either the local landrace or Longe. Longe was appreciated mainly for its good early yield and sweetness when roasted as well as, by some, for its MSD-resistance.

Seed selection. In all four villages, some small or medium-sized (but not large) ears were harvested early for roasting - and consequently were eliminated from use as seed. In all villages, further selection of seed was delayed until after the parent plants were dead and the ripe ears had been harvested. The outer husk leaves were stripped from the ears to reveal the cob (rachis + seeds). Selection was done on a whole-cob basis when the cobs were collected together, sometimes in the field but more often at the homestead. In Tororo and Busia, cobs which were large and evenly filled with large, white seeds were generally selected. In Iganga, cob size seemed less important but cobs with large, white seeds were again selected. For the local variety, preference was also expressed for cobs which had some surface reddening of the rachis and of the seed where it was attached to the rachis. Enough cobs to provide seed for the future crop only were selected, and were stored separately from the main crop, often in the smoky rafters for protection against vermin.

Local perceptions of MSV. Villagers recognised MSD as a problem, appreciated differences in cultivar susceptibility ("hybrid" was generally reported to be susceptible whereas both Longe and/or local were considered to be resistant) and that it was often more severe in crops planted in the second rains. Some recognised it as a disease but none were aware of its true cause or means of spread. Most villagers interviewed linked MSD to a soil characteristic or thought it was seedborne and none realised MSD was leafhopper-borne.

Interviews done in Iganga in 2000

Seed types grown by farmers and their sources.

The major seed types grown by the farmers are presented in Table 1. Amongst the individual farmers, the major type being grown was the local maincrop landrace (often called 'Omusoga' meaning "of the Busoga", the local people). Its kernels were

large and predominantly white, though often with some pink or red coloration where the kernel had been attached to the rachis. The rachis ranged in colour from white through pink to a deep red. Amongst the formally bred cultivars, the recently-released cv Longe was the most common. Cv Kawanda, released several decades ago, seemed rare and confused with the local variety. "Hybrid" maize was only mentioned by the men and women groups in Isikiro village. Katulika is a popcorn landrace with small, often orange kernels and a small cob.

Table 1: Numbers of farmers in four villages in Iganga growing different maize types.

Type of seed	Busanda (n=10)	Budoma (n=10)	Isikiro (n=10)	Nabitu (n=10)
Local	6	10	6	10
Katulika	2	1	0	0
Longe	4	3	7	0
Kawanda	2	3	0	0

In some cases, totals exceeds actual number of farmers interviewed. This is because of multiple responses by the farmers.

Most farmers had several sources of seed. The major source, particularly of local, was seed saved from the previous season's harvest (Table 2). Cv Longe and "hybrid" were initially obtained from various sources such as the Uganda National Farmers' Association and other non-government organisations, farm supply shops, local council leaders and other farmers. Farmers mentioned a number of problems they face in acquiring seed for planting from the various seed sources.

Table 2: Numbers of farmers (out of 10) in four villages in Iganga who saved seeds during the 19998b and 1999a seasons.

	Busanda	Budoma	Isikiro	Nabitu
1998 – second rains	7	6	5	4
1999 – first rains	1	9	8	6

In some cases, totals exceed actual number of farmers interviewed. This is because of multiple responses by the farmers.

The high cost of seed was again mentioned as a problem by all but one of the men and women farmers'groups interviewed. There were several complaints about seed quality including the sale of fake and/or mixed seeds and poor germination. Another group of complaints involved poor access to seed (too expensive, often unavailable and sales outlets too distant). These problems accounted for the preference for farmer-saved seeds, either grown themselves or obtained direct from other farmers. Farmers indicated that, having bought the initial starter seed, they subsequently usually use seed saved from the previous season's harvest until productivity went down.

Seed selection practices.

As in the earlier surveys, farmers mentioned removing medium-sized cobs from immature crops for roasting or boiling as a snack. Otherwise, both group and individual farmer interviews confirmed that selection was *done* when the parent crop was dead. It was done mostly at home but also in the field on dried plants of the ripe

crop or on harvested cobs (Table 3). Interviews with the groups of women farmers suggested that selection was mostly by women; in contrast, the men suggested that selection was mostly done by men and women together, sometimes helped by older children.

Table 3: When and where ten farmers in each of four villages in Iganga said they select their seeds

	Busanda	Budoma	Isikiro	Nabitu
When				
Post-harvest	6	4	9	10
Dried plants	4	6	1	0
Where				
Home	9	4	9	10
Field	1	6	1	0

Selection criteria for seed varied across the villages. However, four that were mentioned in at least three of the villages were seed size, seed colour, cob size and cob filling (Table 4).

Various reasons were advanced for the selection practices. Big seeds were preferred because they generally germinate well, resulting plants produce crops also with large seed, and these weigh more and therefore realise more money if sold. For the local variety, again white seeds attached by a red tip to a red rachis were preferred because they are sweet when roasted, are dense and therefore weigh heavy when sold, and produce a late-maturing crop (3-4 months) available when early maturing cultivars (eg Longe) have been consumed. Large cobs were preferred because the seed germinates well and yields of plants grown from such cobs are usually good. Cobs should also be filled with seeds from the base to the tip. Uniform white seed colour made the crop easier to market. The different groups interviewed all indicated that selection was done, for ease, on the cob. There was no variation in selection criteria between growing seasons.

Table 4: Criteria used by farmers of four villages in Iganga in the selection of maize seed

Criteria/Village	Busanda		Budoma		Isikiro		Nabitu	
	W	M	M	W	M	W	M	W
Kernel size (big)	+	+	+	+	-	+	+	+
Large cobs	+	+	+	+	+	-	+	+
Rachis and kernel attachment colour (red)	+	+	+	+	-	-	-	+
Fully-filled cobs	+	+	+	-	-	+	-	-
Long and straight cobs	-	-	-	-	+	+	-	+
Clean seed (free of rot)	-	-	-	-	-	-	+	+
Variety type	+	-	-	-	+	-	-	-
Shrivelled seeds are not selected	+	-	-	+	-	-	-	-
Uniform colour	-	-	-	-	-	+	-	-
Dry seeds	-	-	-	-	+	-	-	-
Seed viability	-	-	-	-	+	-	-	-

M = Men; W = Women; + = mentioned by group; - = Not mentioned by the group

A major problem identified in using home-saved seed was seed loss either in the field or during storage, mainly due to rotting but also to pests (termites, stem borers, weevils and rats), theft and family consumption or sale of the seed prior to planting. Once selected, maize seed was stored either as entire cobs or as shelled seeds. Of the individual farmers interviewed in all the four villages, 53% indicated that they stored their seed in cob form while 45% indicated that they stored seed after shelling. Some farmers remarked that seed stored on the cob is rarely eaten by rats or termite and remains viable longer than when shelled. However, shelled seed dries faster and is ready for planting immediately the rains set in. Most farmers kept their seeds only the few months between the two growing seasons but one farmer indicated that seed can be kept viable up to three seasons after harvesting.

Farmers' abilities to identify different cultivars.
Individual farmers, especially those from Buwaya, often failed to identify cobs of claimed cv Longe and the local landrace (Table 5). This was probably not because the original owners of the cobs had named them inaccurately, since the consensus decision of the farmers was generally in close agreement with the name claimed by the original owner of each cob. The popcorn which has very distinctive, small, orange seeds and a small cob was always identified. The two researchers working in the Ugandan Cereals Programme, working solely with maize, were individually rather more accurate than individual farmers (who work with many crops other than maize), especially at identifying cv Longe which was bred by their Programme.

Simulation on-station of farmer selection
Experiment 1. Selection within Longe. About 10% of the Longe plants grown at the IITA farm at NAARI were affected by MSD, the majority developing quite severe (MSD categories 4 - 5) symptoms. However, few plants exhibited the extremely severe symptoms in which new foliage is completely bleached and plants can even die. Plants

Table 5. The frequency by which the name given by farmers from three villages in Iganga for different types of locally available maize by observation of the cob coincided with the name given by the owner.

Owner's claim for maize type	Longe	Local	Popcorn
Bukanga farmers (12)			
Individually	135/179 *(75%)*	32/38 *(84%)*	20/20 *(100%)*
As a group	8/8 *(100%)*	3/3 *(100%)*	1/1 *(100%)*
Researchers (2)			
Individually	42/44 *(95%)*	10/10 *(100%)*	6/6 *(100%)*
Buwaya farmers (23)			
Individually	93/203 *(46%)*	150/274 *(55%)*	46/46 *(100%)*
As a group	8/9 *(89%)*	8/10 *(80%)*	2/2 *(100%)*
Researchers (2)			
Individually	17/18 *(94%)*	15/24 *(63%)*	4/4 *(100%)*

with mild to moderate symptoms (categories 1-3) yielded less, but not significantly so (P>0.05), than 100 randomly selected symptomless plants whereas the more severely diseased plants yielded 40-60% less (P<0.001)(Table 6).

Table 6. Experiment 1: the severities and yield (gms dried seed) of individual maize plants cv Longe affected by MSD and from a random selection of 100 symptomless plants.

Severity	0 (Symptomless)	1	2	3	4	5
Number of plants		39	72	99	83	206
Yield	101.4	89.8	93.4	91.0	61.4	47.0
St. Dev	46.3	61.4	55.7	54.6	46.9	47.6
S.E.	4.7	9.8	6.6	5.5	5.1	3.3

Kernel samples (100) taken from large cobs with large seeds weighed 34.6 ± 0.58 g, seed samples from cobs with large seeds weighed 34.2 ± 0.42 g whereas seed samples taken from the bulk sample weighed only 28.6 ± 0.46g. Most plants grown from all batches of seeds were successfully inoculated with MSV. More plants grown from the seeds from either large cobs with large seeds or cobs with large seeds had severe symptoms than plants grown from the bulk batch although this was not significant (P>0.05) (Table 7).

Table 7. Experiment 1: severity scores at four different dates of inoculated maize seedlings grown using seed batches from (A) bulked cobs, (B) large cobs with large seeds, (C) cobs with large seeds.

Severity		1	2	3	4	5	% 4 & 5	Probability
29 May	A	0	1	7	10	4	64	
	B	0	1	8	12	6	67	NS
	C	1	2	8	14	9	68	NS
12 June	A	0	0	4	10	5	79	
	B	0	0	1	12	13	96	NS
	C	0	0	3	6	27	91	NS
1 July	A	0	2	8	9	3	55	
	B	0	1	10	13	4	61	NS
	C	0	1	7	15	10	76	NS
7 July	A	0	1	9	10	2	55	
	B	0	0	8	15	4	70	NS
	C	0	0	7	16	10	78	NS

Probability of the percentage plants in the severe categories 4 and 5 are calculated against batch A using Chi-squared; NS = not significant (P>0.05).

Cross-pollination of cv Longe by a large-seeded, MSV-susceptible cultivar.
The crossing experiments showed that ears of cv Longe pollinated with cv Kawanda had heavier seeds then ears of Longe pollinated with Longe (Table 8). Progenies grown from the seeds of Longe cross-pollinated with Kawanda were also more susceptible to MSD (mean severity 2.8) than plants of Longe (mean severity 2.5), though both were less severely affected than plants of cv Kawanda (mean severity 3.3). A greater proportion of progenies grown from large and medium-sized seeds of Longe x Kawanda were severely affected by streak than progenies grown from small seeds (Table 9), though again not significantly (P>0.05).

Table 8. Weights of seed, based on 40 cobs each of Longe x Longe (LxL), Kawanda x Kawanda (KxK) and Longe x Kawanda (LxK) crosses.

Cross	Mean number of seeds /cob	Mean weight of 100 seeds ± SE
L x L	291	39.7 ± 1.2g
K x K	292	43.2 ± 1.3
L x K	314	42.5 ± 1.6

Table 9. Experiment 2: severity scores at two dates of inoculated maize seedlings grown using seed batches from (A) cobs with small seeds, (B) cobs with medium seeds, (C) cobs with large seeds.

Severity Date		1	2	3	4	5	% 4 & 5	*Probability*
27 Nov, 1998	A	3	7	9	11	7	49	
	B	4	5	11	9	14	53	NS
	C	2	3	7	10	9	61	NS
18 Dec, 1998	A	0	2	9	14	11	69	
	B	0	1	8	16	18	79	NS
	C	0	0	6	11	14	81	NS

Discussion
The survey work suggested that in all villages most farmers grew only one main landrace of maize and one popcorn landrace. This is in marked contrast to the situation reported in Central America, where the crop was domesticated. In Mexico, farmers may each cultivate three or more landraces, perhaps 15 may be grown within a community (Bellon & Brush, 1994; Louette, Charrier & Berthaud, 1997) and at least 59 are grown in the whole country (Sanchez, Goodman & Stuber, 2000). It seems unlikely that Ugandan farmers do not need a range of maize landraces as they grow many landraces of sweet potato (Bashasha et al., 199%), cassava, and beans (Teverson, personal communication). All these latter crops were, like maize, introduced into Africa *post*-Columbus from the Americas but, unlike maize, their vegetative propagation (cassava and sweet potato) or self-pollination (beans) allows their variation to be controlled easily. Maize is a relatively recent crop in Africa, and historical charts developed with the farmers suggested that it had been important in the target villages for <100 yrs. The presence of only one main landrace in a community may reflect the need for time for more to differentiate and for the

communities to gain specialist knowledge in controlling variation in a cross-pollinating species. Individual farmers also seemed relatively poor at distinguishing cobs of different maize varieties (Table 5), perhaps consistent with a lack of inherited knowledge.

In addition to their local maincrop maize variety and popcorn, many of the Ugandan farmers grew the early maturing, MSD-resistant maize cv Longe. The older MSD-susceptible cv Kawanda and hybrid cultivars of maize were also grown. The Ugandan farmers interviewed made no mention of preventing cross-pollination between their different cultivars of maize using either spatial separation though *c.* 200 m is required to isolate one maize cultivar from another (Villena, personal communication in Bellon & Brush, 1994). There was also no mention of manipulating planting to avoid cross-pollination by arranging different times of flowering for each cultivar. Despite this, they retained the name of the original seed through succeeding generations.

Seed selection in Central America is traditionally based on the visual characteristics of cobs (Bellon & Brush, 1994) and is done mostly around the homestead rather than in the crop itself (Johannessen, 1982; Belloni & Brush, 1994; Louette *et al.*, 1997). A similar system was used in all the villages surveyed in Uganda. This congruence probably indicates that it is for reasons of convenience and appropriateness for the crop that selection is done at home on the cob. The farmers' traditional system of selecting their seed for the next growing season includes no selection in the growing crop. This allows no opportunity for selection for resistance against MSD or other foliar pathogens except through indirect effects on seed and cob sizes. The farmer's concept of MSD being soil-derived also might not readily suggest the feasibility of selecting resistant genotypes. Farmers selected large, well-filled cobs. Since a well-filled cob may have 600 – 700 seeds, farmers need retain for seed perhaps only 0.2% of harvested cobs. As even mildly diseased Longe plants seemed to yield slightly less than uninfected ones (Table 2), the few large cobs selected are all likely to derive from plants which escape infection, Such selection of "escapes" would also allow no selective advantage for MSD-resistant genotypes. However, it could select strongly for vector resistance such as described by Kairo *et al.,* (1995).

Ugandan farmers selected for large, well-filled cobs with large seeds together with certain varietal characteristics such as a red rachis. When the farmers' selection procedure was simulated on-station using a population of either Longe or Longe x Kawanda, it did not select for increased resistance against MSD. Indeed, there seemed to be a trend towards selecting for susceptibility. Yield of 20 South African maize hybrids was also positively correlated to their yield loss when affected by MSD ($P<0.05\%$: analysis of data in Table 12, Barrow, 1992), resistant and highly resistant hybrids yielding on average 13% less than susceptible ones when uninfected. This is consistent with an association sometimes found between high yield and MSD susceptibility (Parnell & McDonald, 1943; McDonald, Ruston & King, 1944), perhaps associated with pest resistance involving some cost (Van Emden, 1991; Harlan, 1992; Crute, 1998). Cv Longe also has relatively small seeds. Ears of cv Longe pollinated by cv Kawanda had larger seeds and the preference of farmers for cobs with large seeds should tend to result in selection of Longe which have been cross-pollinated with Kawanda or the similarly large-seeded local landrace. Since

these large-seeded cultivars are more susceptible to MSD than Longe, this would also inadvertently select for susceptibility.

This study describes the farmers' system of selecting maize seed in a major maize-producing area of Uganda. In so doing, it has identified several ways in which MSD resistance appears to have little or no selective advantage within that system, consistent with the otherwise surprising scarcity of reports of MSD-tolerant landraces in Africa. However, this does not imply that resistance is not a worthwhile character - indeed MSD can devastate susceptible landraces. Instead, our study has identified how the farmers' system fails to select for resistance. Explaining to farmers the true cause of MSD, how it spreads and how to select for resistance by examining the growing crop may help correct this situation, by giving farmers the option of selecting more resistant genotypes. In addition, knowledge of how to avoid cross-pollination of resistant varieties by local susceptible landraces would enable farmers to maintain resistant varieties. Both these aspects have been addressed in the villages we are working with in Iganga but a larger scale project is needed if African farmers elsewhere are to understand how to maintain superior resistant varieties such as Longe. This study has also highlighted the importance of cob characteristics to maize farmers. Although plant breeders are required to produce varieties that are distinct, it may therefore be crucial for maize varieties likely to be maintained by farmers that the cobs of released cultivars are distinct.

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Annex 3 MAIZE SEED MANAGEMENT QUESTIONNAIRE 1999

Parish: Village: Date:

Name of Farmer Male or Female Age

1) What area of maize (acres) did you plant, how much seed have you used and what was the source in 1999a and 1998b seasons?

	1999a	1998b	Comments
Area of maize (acres)			
Quantity of seed used			
Type and source* of seed:			
i)			
ii)			
iii)			

* Source = Bought / Home-produced / Exchanged / Other

IF ANY SEED IS HOME SAVED GO TO Q2, IF NOT FINISH INTERVIEW

2) Ask to see the seed which the farmer has saved

2.1 Which types of maize seed (shown by farmer) are these?

2.2 When were these seeds selected (eg on green plant/ dried plant/ post-harvest)?

2.3 Where did you select the seed? (eg Field/ Home)

2.4 How do you store your maize seed?

2.5 How long do you normally store your seed? Until next season / The season after next/ Other

2.6 From your experience how long can you store and still be able to use maize seed? Until next season / The season after next / Other

2.7 Did you save in each of 1999a and in1998b?
Who used this seed and how did they get it?

Who	Given free		Exchange		Sold		Other	
	1999a	1998b	1999a	1998b	1999a	1998b	1999a	1998b
Self								
Other members of household								
Relatives								
Others								

2.8 (a) Did you have sufficient home-saved seed to plant the area of maize you wanted in 1999a and 1998b? YES/ NO
(b) If NO, explain why

2.9 (a) Did you use any seed other than your own in 1999a and 1998b? YES/ NO
(b) If Yes, how did you get this seed and who from?

Who	Given free		Exchange		Sold		Other	
	1999a	1998b	1999a	1998b	1999a	1998b	1999a	1998b
Other members of household								
Relatives								
Others (Be as specific as possible)								

Annex 4 COMMUNITY SEED PRODUCTION IN IGANGA DISTRICT

The number of parishes in Bukanga Sub-county with the number of people in each parish undertaking seed production is as below:

Bukanga Sub-county

Parish	No. of persons
a. Namukubembe	24
b. Kiroba	16
c. Nabubya	06
d. Buwologa	08
e. Budondo	15
f. Busalamu	03

Seed quantities harvested by some farmers in 1998b season in Namukubembe parish.

Name of farmer	Quantities harvested (Kg)	Amount sold (kg)
a. Waiswa George	?	
b. Misango Patrick	100	50
c. Kagweri Florence	180	
d. Kifuko Margaret	46	

The seed bought from 1998b were planted and not yet harvested. However the following people below bought seed and planted during 1999a.

Name	Quantity bought(Kg)	Received training
a. Kalali Lovisha	1	No
b. Kadaala Harriet	1	Yes
c. Muwega David	5	No
d. Misango P.	6	Yes
e. Alice Florence	8	No.
f. Matande James	3	No.
g. Waiswa Emmanuel	3	No.
h. Isabirye	0.5	No.
I. Balirwa tape	14	No.
j. Kawalya	2	No.
k. Namukose	1	No.
l. Kifuko Margaret	1	No.
m. Yenusu Hajira	2	No.
n. Wabiha Naume	5	No.
o. Namwase Dulaina	3	No.
p. Nalumansi Irene	5	Yes
q. Nantale Madina	5	No.
r. Kagweri Florence	5	Yes
s. Bakaira Grace	17	Yes

The seeds were bought due to the following reasons:

1. Early maturing
2. Heavier in quantity than the local variety

3. Too sweet
4. Resistant to stress
5. High yielding
6. Resistant to environment and diseases

Some people never buy and grow longe due to the following reasons:
1. It rots soon
2. It is expensive
3. It has no market
4. Expensive land rent i.e. 30,000UgSh
5. Termite problem
6. Businessmen need local varieties
7. About 20 Kgs rot in soil (UGMA seed)
8. Longe is not resistant to dry spell

Good things about pure seed maintenance
1. Sure of seed purity
2. Avoid buying seed at high prices
3. Early maturing
4. It is better than local varieties
5. A farmer takes as his responsibility to look after his field

Bad things about pure seed maintenance
1. There are no packets
2. There is no money
3. There is maize theft
4. Lack of dryers
6. Lack of extension services

The objectives of the project are
1. To enable a farmer have pure good Longe1 seeds
2. To have good seeds in time
3. To have seeds which are heavier in quantity
4. To have food

Methods of pure seed maintenance
1. Not to plant Longe at the same time with local
2. Plant Local 400m away from Longe 1
3. Plant one type of variety in a given area
4. Use half-sib method (one of pollination methods)
5. Isolation of maize field

Way forward
1. To have packets for pollination
2. Pesticides for termites
3. To have seeds for the season
4. To reduce the price of maize seeds
5. Bukanga to be the centre for pure seed maintenance
6. Have seminars in every parish in Bukanga Sub-county

7. Seminars should continue
8. Look for market

Group Associations in Parishes, Bukanga sub-county

Namukubembe Parish	Kiroba Parish
1. Bakusekamajja-Bamanyi	1. Busanda-Tweweyo
2. Yebukyaku	2. Mukisa-Gwamukama
3. Gemakumwinho	3. Bakusekamajja-Bulonde
4. Balikyewunia	4. Alikibona-Bigunhu
5. Obumuobwabatukuvu	5. Kyabaja Tobona-nawantale
6. Gemakumwinho Bukwasira	
7. Bumanya General Machandise	
8. Abasiga Mukama	
9. Agali awamu-kantega	
10. Alikibona	
11. Tugezeku	
12. Yolikubobera-Bumanya	
13. Waiwa George Horticulture Project	

BUGODI VILLAGE

People who planted maize this season, 1999a

Name	Quantity (Kg)	Pollinated
1. Abdumali Kinto	1	Yes
2. Musubika E.	2	No.
3. Kiseke Scovia	2	Yes
4. Mr. Byekwaso	2	Yes
5. Timuntu Patrick	2	Yes
6. Farida Hadija	2	Yes
7. Hadija Muyingo	2	Yes
8. Kunya	?	Yes

Reasons why they bought seeds
1. Early maturing
2. Resistant to harsh conditions
3. Resistant to diseases and pest
4. Its good for consumption

Good things with paper pollination method
1. Germinates well
2. Resistant to pest
3. Birds don’t eat it in field
4. It doesn’t rot
5. Yields big
6. Resistant to diseases
7. Early maturing
8. Water cannot enter into the cob
9. Good cob filling

Bad thing with paper pollination method

1. Dies if not weeded
2. It is laborious
3. Difficult to get packets
4. Termites cut it

Different ways of pure seed maintenance

1. Plant one type of maize variety and later after two weeks plant another variety
2. Separate the longe plot 400m away from local plot
3. Plant one type of variety all around
4. Use half-sib method (one of pollination methods)

Way Forward

1. Putting in more effort
2. Pesticides for termites.
3. Visits
4. Field demonstrations.
5. Materials to use in pollination.
6. Mobilisation of people for seminars.
7. Loans for materials to use.
8. Market
9. Get fertilisers

Annex 5 Management Strategies For MSVD:Farmer-Based Seed Production In Iganga District- Final Evaluation: VILLAGE BASED TRAINERS

Draft prepared by Richard Lamboll

Introduction:
Two Village Based Trainers (VBTs) from each of the parishes of Bukanga and Buwaya sub-counties received training in seed production from the Cereals Programme at Namulonge AARI. Longe 1 seed, provided by the Cereals Programme, was planted by the trainers in their home parish and seed was produced from these plots using pollination bags to prevent any cross-pollination on at least some plants. A video was produced showing the various stages of seed production and this was shown a number of times in each sub-county through hiring of commercial video cinema outfits. The VBTs should have completed training of other farmers in their parish. This final evaluation is to assess the training of the VBTs.

1. Aim of this evaluation
The main aim was to evaluate how successful the training of Village-Based Trainers (VBTs) has been. This will allow (a) the trainers to provide feedback on the training and (b) the project to assess how useful the training has been in terms of what trainers have learnt.

A related aim was to assess perceptions of different maize types by farmers and researchers.

2. Approach
The evaluation team visited Bukanga and Buwaya sub-counties on March 1st and 2nd 2000. In each sub-county an evaluation was carried by asking the VBTs as a group the following questions:
(1) What activities were carried out; who by, when and why was it done?
(2) What were the strengths, weaknesses, opportunities and threats?
(3) How are different maize types characterised?
(4) What is the way forward?

In order to better understand how well farmers are able to recognise different maize types, farmers were asked to bring samples of maize on the cob. The owners then informed the reporter of the type of maize they understood each cob to be and these were then labelled A, B, C etc. Other farmers and research technicians were then asked what they thought each cob was.

Evaluation team
Grace Acola
Jimmy Akono
Richard Gibson
Solomon Kaboyo
James Kayongo
Richard Lamboll

Findings

1. Trainers evaluation

The tables below are a direct translation of the feedback from trainers which was originally recorded on manilla sheets in the sub-county meetings. The original recordings in Lusoga are shown in Annex 5, Appendix 1.

Table 1: BUKANGA SUB-COUNTY IGANGA DISTRICT: EVALUATION OF VILLAGE-BASED TRAINERS MAIZE OUTPUT

WHAT WAS DONE	WHO	WHEN	WHY WAS IT DONE
Four contact farmers were selected	NAARI Team	1998	-Train how to produce high quality pure maize seeds
Training of farmers in village	4 contact farmers	1999	-To train other farmers on how to produce good maize seeds
Land preparation and planting	4 contact farmers	Oct 99	-Demonstrate how multiply the pure maize seeds
Sold Multiplied seeds of maize	4 contact farmers	1st season 99 2nd season 98 2nd season 99	-Sold at 700= /kg -Get capital -Other farmers to get pure maize seeds
Visited other farmers	4 contact farmers	Mid Nov.99	-Train more farmers how to produce pure maize seeds -Develop farming technics
13 farmers selected for training at NAARI for 2 days	LC3 C/man & Grace Bakaira	Oct 99	-Train how to produce good maize seeds -Develop farming techniques and be the example to others -See for themselves what is done at NAARI -Be trained and become trainers of other farmers -Link up with researchers -Sale of seeds at a high price

Table 2: Strengths and weaknesses of these activities

STRENGTHS	WEAKNESSES
-Always have good seeds at the beginning of the season hence timely planting	-Spend a lot on paper bags
- Self certainty about seeds purity planted	- Never learnt about how maize seeds are properly
- Costs of seeds are low compared to ones dressed in farm shops	- Never learnt about good maize storage
-Reduced transport costs since don't have to travel to town to buy seed	- Never learnt how to preserve the maize seeds
	- Never learnt about how to keep records
- Farmers have a enough pure maize seeds	-The training was too short
- Yield increase	- Never learnt about how apply fertilisers
- Income from pure seeds is reasonable compared to local seeds	-T heft of purely produced maize seeds
- The posho quality is good	
- Fight against famine	
- Early maturity maize	
- Longe maize is resistant to drought	

Table 3: Opportunities and threats to seed production as mentioned by the farmers in Bukanga subcounty

OPPORTUNITIES	THREATS
- Farmers shall continue with good maize seeds	- Lack of knowledge of how to plant
- Market for the pure maize seeds	- Lack of transport to visit other training farmers
	- Difficult to get the pollination bags
- Hope to be experts in maize seeds production	- Failure to know the pests control mechanism in maize plants - Termites
- Video will encourage the training	
- The relationship between farmers and researchers shall continue	- Lack of knowledge on soil conservation methods
- Bukanga sub-county will be the example in Iganga district	- Lack of knowledge on good seed storage methods
- Starvation will be over	- Unpredictable weather may affect growth of maize
- Hoping to get merit letters proving that they are VBT's	- Lack of knowledge on costings involved in seed production to determine profits - Failure to get more training - Still needs link between farmers and NAARI to continue since new technologies will develop -If video does not continue it may be difficult to train other farmers

Table 4: Characteristics Of Different Maize Varieties

CHARACTERS	**LONGEI NOT POLLINATED O,I,E,K,R**	**KATULIKA B_1**	**LOCAL X,G,J_1, F**	**LONGE1 POLLINATED E, J, D**
Length of Grain	Long	short	Big and short	
Colour		yellow	Red cob	
Cob length	Short			short
Silk				Started down
Appearance	Rotten at the end			
Grain colour			J_1 spotted	

Table 5: THE WAY FORWARD

- Continue training other farmers

- Shall open up a farm supply shop

- Continue producing good pure maize seeds

- Farmers meetings to review and discuss the next strategy.
- Continue to inform the researchers the extent we have reached

Table 1: BUWAYA SUB COUNTY IGANGA DISTRICT: EVALUATION OF VILLAGE-BASED TRAINERS MAIZE OUT PUT

WHAT WAS DONE	WHO	WHEN	WHY WAS IT DONE
Farming groups of 10 people each were formed	Mrs Mwidu coordinator P.D.R.	1995	- Develop in agriculture - Have knowledge about saving money in banks - Recieved 3.65 millions as capital - To get agricultural extensionists and train them on different production practices
Visited NAARI	Farmers	Oct. 1999	- Acqiure skills of producing good maize seeds. - Obtained maize seeds - Learn about maize production so that own pure seeds can be produced
Trained and returned to own parishes	farmers	Oct 99	- Practice the skills we acquired at NAARI - Train other village based farmers about pure maize seeds production. - Monitor also other farmers who being trained.
Showed Video	Mr. E. Okoth	Dec. 99- Jan.00	- Have a easy training of other farmers.
Hortcultural group were formed	16 mothers union	Since 1995	- Grow vegetables - Produce enough food eg sweet potato - To be visited and get advise from P.D.R. coordinator. - Set the demos plots and implement what has been learnt - Mr. Ezra our extensionist gave us maize and cassava planting material on credit; practice on demos plots.
Maize seed survey was conducted	NAARI Team	1999	- Have interviews about maize seed production - Gov't want to promote the system of maize seed production to individual home level
Trained about the demonstration plot	Farmers	Early 1999	- Learn and train others
Planted maize seed obtained fron NAARI	Farmers	Sept 1999	- To produce pure maize seed using pollination method
Received the evaluation team from NAARI	Farmers	29 Feb 2000-06-11	- Evaluate the maize seed produced -. Interviewed about seed production knowledge

2. Perceptions of maize types

The detailed results of the perceptions of maize types are shown in Appendix 2 and 3. Tables 3 and 4 in this section summarise this information.

Table 3: Bukanga-Farmer perceptions of maize types

		LONGE		LOCAL		POPCORN		ALL	
	OWNER								
NON-	AGREE BROADLY	6	40%	2	100%	1	100%	9	50%
TRAINED	of which specifically	5	33%	2	100%	1	100%	8	44%
FARMER	DISAGREE	9	60%	0	0%	0	0%	9	50%
n=1	DON'T KNOW	0	0%	0	0%	0	0%	0	0%
	NO. OF RESPONSES	15		2		1		18	
TRAINED	AGREE BROADLY	129	79%	30	83%	19	100%	178	81%
FARMERS	of which specifically	74	45%	30	83%	19	100%	123	56%
n=11	DISAGREE	35	21%	6	17%	0	0%	41	19%
	DON'T KNOW	0	0%	0	0%	0	0%	0	0%
	NO. OF RESPONSES	164		36		19		219	
ALL	AGREE BROADLY	8	100%	3	100%	1	100%	12	100%
FARMERS	of which specifically	8	5%	3	100%	1	100%	12	100%
AS A	DISAGREE	0	0%	0	0%	0	0%	0	0%
GROUP	DON'T KNOW	0	0%	0	0%	0	0%	0	0%
n=12	NO. OF RESPONSES	8		3		1		12	
NAMU.	AGREE BROADLY	42	95%	10	100%	6	100%	58	97%
RESEARCH	of which specifically	25	57%	10	100%	6	100%	41	68%
TECHS.	DISAGREE	2	5%	0	0%	0	0%	2	3%
n=2	DON'T KNOW	0	0%	0	0%	0	0%	0	0%
	NO. OF RESPONSES	44		10		6		60	

Table 4: Buwaya-Farmer perceptions of maize types

0 OWNER		Long e		Local		Popcorn		All	
NON-TRAINED FARMERS n=13	AGREE BROADLY	48	42%	88	57%	26	100%	162	55%
	of which specifically	10	9%	88	57%	26	100%	124	42%
	DISAGREE	57	50%	54	35%	0	0%	111	38%
	DON'T KNOW	8	7%	12	8%	0	0%	20	7%
		113		154		26		293	
TRAINED FARMERS n==10	AGREE BROADLY	45	50%	62	52%	20	100%	127	55%
	of which specifically	10	11%	56	47%	20	100%	86	37%
	DISAGREE	44	49%	48	40%	0	0%	92	40%
	DON'T KNOW	1	1%	10	8%	0	0%	11	5%
		90		120		20		230	
ALL FARMERS AS A GROUP n=23+	AGREE BROADLY	8	89%	8	80%	2	100%	18	86%
	of which specifically	7	78%	8	80%	2	100%	17	81%
	DISAGREE	1	11%	2	20%	0	0%	3	14%
	DON'T KNOW	0	0%	0	0%	0	0%	0	0%
		9		10		2		21	
NAMULONGE. RESEARCH TECHS. n=2	AGREE BROADLY	17	94%	15	63%	4	100%	36	78%
	of which specifically	12	67%	15	63%	4	100%	31	67%
	DISAGREE	1	6%	9	38%	0	0%	10	22%
	DON'T KNOW	0	0%	0	0%	0	0%	0	0%
		18		24		4		46	

CHARACTERISTICS OF DIFFERENT MAIZE VARIETIES

EBYENDHAWULO EBILIWO HAGATI YEBIKA BYADHUMA

EBYENDHAWULO CHARACTERS	**LONGEI NOT POLLINATED O,I,E,K,R**	**KATULIKA B_1**	**LOCAL OWABULIDHO X,G,J_1, F**	**LONGE1 (MUVAAZE) POLLINATED E, J, D**
Length of Grain	Long	short	Big and short	
Colour		yellow	Red cob	
Cob length	Short			short
Silk				Started down
Appearance	Rotten at the end			
Grain colour			J_1 spotted	

BIKI BYEMUNAKOLA MUMAISO

- Tudha gendha mumaiso no kuzaaza ensigo ya dhuma nga tukozesa : Isolation in time, packets, isolation in gardens and growing of same variety

- Tudha gendha mumaiso no kusomesa abalimi abandhi

- Basaba enkolagana yeyongere mumaiso hagati wa balimi ne NAARI

- Tudha wa abalimi abandhi ensigo basobole okuvaayo

- Twendha abe NAARI bongere okutulambulaku mu bye tukola.

Table 1: BUWAYA SUB COUNTY IGANGA DISTRICT: Activities

EKYAKOLEBWA	ANI	IDHI	LWAKI KYAKOLEBWA
Twekolamu ebibina byebyo bulimi ang bya	Mrs Mwidu	1995	-Tusobole okwekulakulanya mu byobulimi no bulunzi - Okuyiga okweterekera sente mu banka zisobole bantu kumi okutuyamba - Batuwa million 3.65 nga za ntandikwa. -Tusobole okufuna absomesa be byobulimi, era twafuna E. Okoth.
Twagenda e Namulonge	Abalimi ne Ezra	Oct 99	- Kwega ku bya dhuma tusobole okwekolera ensigo tuleme kufirisibwa. - Batuwa ensigo ya dhuma. - Batusomesa okuvaaza dhuma - Okwekolera ensigo
Twasoma e namulonge era netukomawo	Abalimi ne Ezra	Oct 99	- Twakola bye twasoma - Twasomesa abalimi abandhi e bigemagana ne nsigo ya dhuma. - Twakyalira abalimi be twasomesa.
Film yalagibwa	Mr. Ezra	Dec 99-Jan 00	- Kwongera ku manyi gakusomesa tuleme okalubirisibwa.
Hortculture group	16 members of mothers union.	Since 1995	- Tusobole okulima enva - Okulima emere emala nga emboli - Twalambulwa P.D.R. coordinator era netuwebwa amagezi ge byobulimi - Twawebwa obuyambi nga buyita mu P.D.R. (Planning Dev't and Rehabilitation). - Twakola demos netuyiga era ne tudayo okukola ekyo kyetuyize.
Survey yakolebwa ku dhuma	Abe NAARI	1999	- Batubuza ku bya dhuma - Batukoba nti Gov't eyagala kutwala nsigo mu balimi bene baleme okuzinonya mu maduuka.
Okusoma ku Demos	Mr. Ezra	Early 1999	- Okwega naife tusomese abandhi.
Twasimba ensigo ezaava e NAARI	Abalimi	Sept 1999	- Twavaaza dhuma.
Twakyaaza Team eva e NAARI	Abalimi	29th Feb 00	- Twalambulwa abona kunsigo ge twavaaza abuuza abalimi abakola ensigo ebintu ebigemegana ku ebyo bye bayega e NAARI wamu nensigo gye balimye

Table 2:

KIKI EKYALI EKYAMANYI (EKIRUNGI)	KIKI EKYALI EKINAFU (EKIBI)
- Enkola eno efunisa abantu omulimu wamu ne sente	- Eriyo abantu abatafaayo nyo kukyetukola
- Okwekolera ensigo saves time	- Abantu abandhi bayinza okutuyingirira munkola
eno nebonoona ensigo yaife	
- Okwekakasa nti ensigo ntuufu era nungi	- Abantu abandhi bakoba bubi bwekituuka
kukutunda ekivude mu nima enungi	
- Ensigo eno etuuka mangu okusinga kuwabulidho era telumya ndala	- Abantu abandhi tebenda kujumbira ekigemagana
ne kyetagisa sente	
- Tuyidhi obukenkufu ku bigemagana ne dhuma	- Abantu abandhi befula abalina amagezi nga ate
byebakola tebiboneka.	
- Kituyambye nti tetusasanya nyo sente mu kugula ensigo.	- Tukyalimu obutamanya
- Tuyidhi enima enungi	- Ensigo okutali bulezi abantu tebagikakasa.
- Okwefananyiriza abakenkufu mukaseera akatono enyo	- Abantu abandhi tebenda kulondha nsigo ntuufu
eyo kulima	
- Enkola etuyanbye nereeta abakyala okwegataku bikolebwa	- Abantu abandhi tebatekateeka nsigo mu bwangu
ate nga enkola etwala ekiseera	
- Kiyanbya okusomesa abantu bangi beyongere okufuna emere	- Kizibu abantu okuva kunsigo enkaire.
- Enkola eno etuyanbye okwaza e nsigo	
- Enkola eno eleeta abantu bangi ekyomuwendo mukitundu.	
- Kituyamba okusoma ebindhi bingi	
- Enkola eno edhatuyamba okufuna akatale	

Table 3:

MULIMU ESSUUBI	KIKI EKIYINZA OBAMALAMU AMANYI
- Tusuubira nti bwetunaba nga tukoze bulungi banaife baja kweyongera okutuwa obuyambi.	- Embeera etateberezebwa
- Omulimu guno guja kusitula embeera no kwekulakulanya	- Akatale kayinza okubula nga ensigo eweze
- Tulina esuubi lyo kuzaaza ensigo mu bungi	- Ebipapula obigula bizibu
- Okwekolera ensigo eja kufuuka project/ Business	- Obuwuka ne ndhwaire
- Enkola eno eja kuleeta enkolagana na bandhi mu bibina ebindhi.	- Enseete
- Enkola eno eja kulongosa akatale.	
- Okuba namagezi agekikugu agayamba yade nga wazira baluwa	
- Endhala tudha dhifula lugero	
- Enkola eno eja kugata abantu abandhi nabo baveeyo	
- Kidha tuyamba okolagana ne kitongole kyebyo bulimi tuyige nebindhi.	
- Tudha gaziya enkola eno etukeko nawandhi.	

Table 4: Characteristics Of Different Maize Varieties
EBYENDHAWULO EBILIWO HAGATI YEBIKA BYADHUMA

EBYENDHAWULO CHARATERS	**OWABULIDHO LOCAL X,G,N,S,H,Y,Z,M,B**	**LONGE1 (MUVAAZE) POLLINATED Q,E,K**	**KATULIKA LOCAL O,P**	**LONGE1 (TIMUVAAZE) NOT POLLINATED W,A,T,F,C,R,A,D,U,J,I, V**
Grain colour	Spotted	White	Yellow	White
Maize cob colour	Red and white	White	White	White
Grain line	Not in straight line	Straight	Down lines are not straight	Straight with mixed colour
Grain appearance	Not sharp	Straight	Small and sharp at the end	Small
Cob filling	Compacted	Too compacted together and did not reach top	Too compacted up, small, big grains down	Reached top
Size of cob	Big	Not so big	Small	Not so big

BIKI BYEMUNAKOLA MUMAISO

- Tudha gendha mumaiso no kuzaaza ensigo ya dhuma
- Tudha gendha mumaiso no kusomesa abalimi abandhi
- Kidhasigala nga project.
- Tudhayongera okufuna ebika bye bilime ebindhi
- Tukayendhamu omusomo omundhi ogwokubangulwa mu mulimo gwo kukola ensigo.
- Tudhakiriza ebibina ebindhi mu nkola eno era twongere okusomesa
- Okufunayo abalimisa abandhi mukitundu okulambula kyetukola.
- Basaba enkolagana yeyongere mumaiso hagati wa balimi ne NAARI
- Okwedhukanya tuleme okwerabira.
- Tudha wa abalimi abandhi ensigo basobole okuvaayo
- Twendha abe NAARI bongere okutulambulaku mu bye tukola.
- Tusaba omukisa ogwo kwongera okudhako e NAARI.

Annex 5: Appendix 2
BUKANGA SUB-COUNTY FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA

FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA

	BUKANGA		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
			A	B	D	E	J	L	N	S	C	F	K	M	O	P	Q	R	T	U	V	W	E1	G1	H	Y	D1	I1	I	G	X	F1	H1	J1	A1	B1	C1
	FARMER		**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**H**	**H**	**H**	**H**	**P**	**C**	**C**	**C**	**C**	**C**	**K**	**K**	**K**
N?	Balyeku	M	L1	L1	L1	C	C	N	N	N	C	L2	L2	C	C	C	N	L	C	N	C	C	N	N	H	N	N	N	H	C	C	N	N	N	K	N	N
		1																																			
T	Mugoya	F	L1	L1	L1	L1	H	N	N	N	L1	L1	N	C	L1	N	N	N	N	N	N	N	N	N	H	N	N	N	H	C	C	C	N	N	K	K	K
T	Kagweri	F	L1	L1	L1	L1	L1	L2	L2	L1	L2	L2	L1	N	L2	L2	N	L2	L2	N	L2	L2	L	L	H	H	H	L	L2	C	C	C	C	C	K	K	K
T	Aida	F	L	C	H	L	L	N	L	L	L	L	L	N	H	C	L	N	C	N	N	N	N	N	H	N	N	N	N	L	L	C	C	N	N	N	N
T	Bakaira	F	L1	L2	L1	L1	L1	L2	L2	L2	L2L1	L2	L2	L2	L2	N	N	L2	L2	L2	L2	L2	N	N	H	L2	N	N	P	C	C	C	C	C2	K	N	N
T	Nakawooma	F	L	L1	L	L	N	L	L	L	N	L	N	L	L	C	L	L	N	N	N	N	N	N	H	H	N	N	H	C	C	N	N	N	K	K	N
T	Mukasa	M	L1	L1	L1	L1	N	N	N	H	L2	L2	N	K2	L2	H	L2	N	N	N	L2	H	N	H	N	N	L2	N	N	C	C	N	C	H	N	K	N
T	Wabigha	M	H	N	H	N	N	P	N	L	N	L	L2	L1	L1	N	L2	L	N	N	N	C	N	N	N	N	N	N	C	H	C	N	N	N	N	K	N
T	Salumanya	M	L1	C	L1	C	L1	N	L1	L1	K	L	L2	N	L	L	N	N	N	L	L	L	N	N	C	L	N	N	N	C	C	N	N	N	K	N	N
T	Isabirye	M	L1	N	H	L1	L1	L2	H	N	L2	C	N	N	C	N	L	N	N	N	N	C	N	N	H	H	N	N	H	C	C	N	N	N	K	K	N
T	Kasoone	M	C	C	C	C	H	L	L1	L1	L2	L2	L2	C	L2	L2	L2	L2	P	H	L2	H	L2	H	L	H	H	L	H	C	C	C	C	L	K	K	K
T	Banuli	M	N	L2	L1	L2	L2	L1	L1	L1	N	L1	L1	L2	L2	L1	L1	L2	L1	L2	L2	L1			H	H			C	L2	C				K	N	K
		11																																			
A	ALL		N	N	L1	L1	L1	N	N	N	N	L2	L2	N	L2	N	N	L2	N	N	N	N	L2	N	N	N	N	N	L2	C	C	N	N	C	N	K	N
R	James	M	L1	L1	L1	L1	L	L1	L1	L2	L2	L2	C3	L2	L2	L1	L1	L1	L1	C3	L2	L2	L	L	C3	L2	C3	K1	C	C	C	C	C	C	K	K	K
R	Jimmy	M	L1	L1	L1	L1	L	L	L2	L2	L2	L2	L	L2	L2	L2	L2	L2	L2	L2	L2	L2	L	L	H	H	H	L	P	C	C	C	C	C3	K	K	K
		2																																			

KEY TO MAIZE SEED TYPES:

L=LONGE; L1=LONGE PAPER BAG POLLINATED;L2=LONGE OPEN POLLINATED;L3=LONGE MIXED

C= LOCAL; C1 = LOCAL RED HUSK; C2 = LOCAL WHITE HUSK; C3 = LOCAL MIXED. H=HYBRID; H1 = HYBRID UGANDA; H2=HYBRID KENYA; H3=HYBRID MIXED.

P=LP; N=NAMULONGE; K=KATULIKA/POPCORN/SUPINI; K1=POPCORN WHITE SEEDED; D=DON'T KNOW; N=NO RESPONSE.

FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA9SORTED BY MAIZE TYPE)

BUKANGA

			A	B	D	E	J	L	N	S	C	F	K	M	O	P	Q	R	T	U	V	W	E1	G1	H	Y	D1	I1	I	G	X	F1	H1	J1	A1	B1	C1
	FARMER		**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**H**	**H**	**H**	**H**	**P**	**C**	**C**	**C**	**C**	**C**	**K**	**K**	**K**
N?	Balyeku	M	L1	L1	L1	C	C	N	N	N	C	L2	L2	C	C	C	N	L	C	N	C	C	N	N	H	N	N	N	H	C	C	N	N	N	K	N	N
		1																																			
T	Mukasa	M	C	C	C	C	H	L	H	H	K	C	L	C	C	C	L	L	C	H	L	C	?	?	C	H	?	?	C	C	C	?	?	?	N	K	K
T	Wabigha	M	H	C	H	C	H	L	L	L	L	L	L1	C	H	C	L	L	L1	L	L2	C	L	H	H	H	H	L	C	C	C	C	C	C	K	K	K
T	Salumanya	M	L	C	H	L	L	L1	L	L	L1	L	L1	K2	L	H	L	L2	L2	L2	L2	H	L2	H	H	H	H	L	H	C	C	C	C	C2	K	K	K
T	Mugoya	F	L	L1	H	L	L1	L2	L1	L	L2	L	L2	L	L	L	L1	L2	L2	L2	L2	H	N	L	H	H	L2	N	H	C	C	C	C	H	K	K	K
T	Kagweri	F	L1	L1	L	L1	L1	L2	L1	L1	L2	L	L2	L1	L1	L1	L2	L2	N	N	L2	L	N	N	H	H	N	N	H	C	C	C	C	L	K	K	N
T	Aida	F	L1	L1	L1	L1	L1	L2	L1	L1	L2	L1	L2	L2	L1	L2	L2	L2	N	N	L2	L1	N	N	H	L	N	N	H	C	C	C	C	N	K	K	N
T	Banuli	M	L1	L1	L1	L1	L1	N	L2	L1	L2	L1	L2	L2	L2	L2	L2	N	N	N	N	L2	N	N	H	L2	N	N	L2	C	C	N	N	N	K	K	N
T	Bakaira	F	L1	L2	L1	L1	L2	N	L2	L1	L2L1	L2	N	N	L2	N	N	N	N	N	N	L2	N	N	H	N	N	N	N	C	C	N	N	N	K	N	N
T	Isabirye	M	L1	L2	L1	L1	N	N	N	L2	N	L2	N	N	L2	N	N	N	N	N	N	N	N	N	L	N	N	N	N	H	C	N	N	N	K	N	N
T	Nakawooma	F	L1	N	L1	L2	N	N	N	N	N	L2	N	N	L2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	L	C	N	N	N	N	N	N
T	Kasoone	M	N	N	L1	N	N	P	N	N	N	L2	N	N	L2	N	N	N	P	N	N	N	N	N	N	N	N	N	P	L2	L	N	N	N	N	N	N
		11																																			
A	ALL		N	N	L1	L1	L1	N	N	N	N	L2	L2	N	L2	N	N	L2	N	N	N	N	L2	N	N	N	N	N	L2	C	C	N	N	C	N	K	N
R	James		L1	L1	L1	L1	L	L	L1	L2	L2	L2	C3	L2	L2	L1	L1	L1	L1	C3	L2	L2	L	L	C3	L2	C3	K1	C	C	C	C	C	C	K	K	K
R	Jimmy		L1	L1	L1	L1	L	L1	L2	L2	L2	L2	L	L2	L2	L2	L2	L2	L2	L2	L2	L2	L	L	H	H	H	L	P	C	C	C	C	C3	K	K	K

BUKANGA –FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA9SORTED BY MAIZE TYPE)

		A	B	D	E	J	L	N	S	C	F	K	M	O	P	Q	R	T	U	V	W	E1	G1	H	Y	D1	I1	I	G	X	F1	H1	J1	A1	B1	C1
	OWNER	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**H**	**H**	**H**	**H**	**P**	**C**	**C**	**C**	**C**	**C**	**K**	**K**	**K**
NON-	AGREE	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	
TRAINED	BROADLY of which specifically	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	
FARMER	DISAGREE	0	0	0	1	1	0	0	0	1	0	0	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	1	1	0	0	0	1	1	1	0	1	
	n=1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
		1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0	1	0	0	0	1	1	1	0	0	0	1	0	
TRAINED	AGREE	8	6	7	8	6	6	7	8	7	10	7	4	9	4	7	6	3	3	6	4	2	1	7	5	2	0	1	8	10	5	5	2	8	7	
FARMERS	BROADLY of which specifically	6	4	6	5	4	1	3	4	5	4	4	2	5	2	3	4	2	2	5	2	1	0	7	5	2	0	1	8	10	5	5	2	8	7	
	DISAGREE	2	3	4	2	2	1	1	1	1	1	0	3	2	3	0	0	2	1	0	4	0	2	2	2	1	2	7	3	1	0	0	2	0	0	
	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	1	2	0	1	3	4	3	2	3	0	4	4	0	4	4	5	6	7	5	3	9	8	2	4	8	9	3	0	0	6	6	7	3	4	
	n=11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	1
		10	9	11	10	8	7	8	9	8	11	7	7	11	7	7	6	5	4	6	8	2	3	9	7	3	2	8	11	11	5	5	4	8	7	
ALL	AGREE	0	0	1	1	1	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	1	
FARMERS	BROADLY of which specifically			1	1	1	0	0	0		1	1	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	1	
AS A	DISAGREE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
GROUP	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	1	1	0	0	0	1	1	1	1	0	0	1	0	1	1	0	1	1	1	1	0	1	1	1	1	1	0	0	0	1	1	0	1	0	
	n=12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
		0	0	1	1	1	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	1	0	1	
NAMU.	AGREE	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	1	2	2	2	2	1	1	1	0	1	2	2	2	2	2	2	2	
RESEARCH	BROADLY of which specifically	1	1	2	2	0	1	1	0	2	2	0	2	2	1	1	1	1	1	2	2	0	0	1	1	1	0	1	2	2	2	2	2	2	2	
TECHS.	DISAGREE	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1	2	1	0	0	0	0	0	0	0	
	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	n=2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	

BUKANGA- FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA9SORTED BY MAIZE TYPE)

	SAMPLE	A	B	D	E	J	L	N	S	C	F	K	M	O	P	Q	R	T	U	V	W	E1	G1	H	Y	D1	I1	I	G	X	F1	H1	J1	A1	B1	C1
O	OWNER	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L1**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**L2**	**H**	**H**	**H**	**H**	**P**	**C**	**C**	**C**	**C**	**C**	**K**	**K**	**K**
NON-	AGREE	100	100	100	0	0	0	0	0	0	100	100	0	0	0	0	100	0	0	0	0	0	0	100	0	0	0	0	100	100	0	0	0	100	0	
TRAINED	BROADLY of which specifically	100	100	100	0	0	0	0	0	0	100	100	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	100	100	0	0	0	100	0	
FARMER	DISAGREE	0	0	0	100	100	0	0	0	100	0	0	100	100	100	0	0	100	0	100	100	0	0	0	0	0	0	100	0	0	0	0	0	0	0	
	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	0	0	0	0	0	100	100	100	0	0	0	0	0	0	100	0	0	100	0	0	100	100	0	100	100	100	0	0	0	100	100	100	0	100	10
	n=1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10
TRAINED	AGREE	73	55	64	73	55	55	64	73	64	91	64	36	82	36	64	55	27	27	55	36	18	9	64	45	18	0	9	73	91	45	45	18	73	64	3
FARMERS	BROADLY of which specifically	55	36	55	45	36	9	27	36	45	36	36	18	45	18	27	36	18	18	45	18	9	0	64	45	18	0	9	73	91	45	45	18	73	64	3
	DISAGREE	18	27	36	18	18	9	9	9	9	9	0	27	18	27	0	0	18	9	0	36	0	18	18	18	9	18	64	27	9	0	0	18	0	0	
	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	9	18	0	9	27	36	27	18	27	0	36	36	0	36	36	45	55	64	45	27	82	73	18	36	73	82	27	0	0	55	55	64	27	36	6
	n=11	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10
ALL	AGREE	0	0	100	100	100	0	0	0	0	100	100	0	100	0	0	100	0	0	0	0	100	0	0	0	0	0	0	100	100	0	0	100	0	100	
FARMERS	BROADLY of which specifically	0	0	100	100	100	0	0	0	0	100	100	0	100	0	0	100	0	0	0	0	100	0	0	0	0	0	0	100	100	0	0	100	0	100	
AS A	DISAGREE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	
GROUP	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	100	100	0	0	0	100	100	100	100	0	0	100	0	100	100	0	100	100	100	100	0	100	100	100	100	100	0	0	0	100	100	0	100	0	10
	n=12	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10
NAMU.	AGREE	100	100	100	100	100	100	100	100	100	100	50	100	100	100	100	100	100	50	100	100	100	100	50	50	50	0	50	100	100	100	100	100	100	100	10
RESEARCH	BROADLY of which specifically	50	50	100	100	0	50	50	0	100	100	0	100	100	50	50	50	50	50	100	100	0	0	50	50	50	0	50	100	100	100	100	100	100	100	10
TECHS.	DISAGREE	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	50	0	0	0	0	50	50	50	100	50	0	0	0	0	0	0	0	
	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NO RESPONSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	n=2	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10

FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA

	Buwaya	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	FARMER	A	B	K	Q	R	I	J	U	V	C	D	E	F	G	H	L	M	N	S	T	W	X	Y	Z	1	O	P
		L	L	L1	L1	L1	L2	L2	L2	L2	P	P	P	P	C	C	C	C	C	C	C	C	C	C	C	C	K	K
N	Mugoya (N)	H	C	H	L	L	L	C	H	L	L	H	C	C	C	N	L	H	C	L	L	C	C	C	C	L	K	K
N	Kanuwa(N)	H	H	L	N	H	P	L	C	L	P	P	H	L	H2	H2	L	L	H2	H2	H	P	C	C	H2	H	K	K
N	Catherine (N)	L	C	L	C	L	L	C	C	L	C	L	H	H	C	C	C	C	C	H	L	C	C1	C	C	L	K	K
N	Mwidu(N)	L	C	L	H	H	C	C	L	H	C3	L	H	L	C	C	L	C	C	C	H	C	C	C	C	L	K	K
N	Wabegha(N)	L	C	L	P	L	L	L	L	P	L	L	L	L	C	C	C	C	C	C	C	C	C	C	C	N	K	K
N	Malyamu(N)	H2	D	N	D	L	H1	D	D	D	D	L	D	D	H2	D	D	D	D	C	L	D	D	D	L	D	K	K
N	Mpaibira(N)	H	C	H	C	H	C	P	C	C	C	H	C	C	H	C	L	C	L	L	H	L	D	C	C	P	K	K
N	Edinasi (N)	L	L	N	L	L	N	L	L	L	C	L	L	C	C	L	L	C	C	C	L	L	C	C	C	L	K	K
N	Bangi(N)	C	C	D	L	L	D	D	C	H	C	C	L	L	C	H	C	C	C	H	C	C	C	D	C	C	K	K
N	Isabirye(N)	L	H	L	D	L	C	C	C	C	L	L	C	D	C	C	D	C	C	C	C	L	C	C1	C1	L	K	K
N	Mudondo(N)	H	L	L	L	L	L	L	L	C	P	P	P	P	C1	D	L	C1	C1	C1	L	C	C	H2	H2	D	K	K
N	Mbawe(N)	L	H	L	H	H	H	H	L	H	L	L	H	C	C	C	H	C	C	C	H	C	C	C	C	L	K	K
N	Nawumba(N)	H	L	L	P	P	P	P	L	L	P	P	P	P	L	L	L	L	C	C	L	D	C	C	C	C	K	K
		13																										
T	Byansi(T)	L	C	C	H	P	P	C	L	P	C	L	P	H	C	C	D	L	L	C	H	P	C	C	D	L	K	K
T	Makavu (T)	H	C	L	L	L	P	L	L	H	D	L	H	C	C	D	C	C	H	H	L	C	C	H	H	L	K	K
T	Mugabi (T)	L1	C	L	L	L	L	C	L	H	H	L	H	H	C1	C1	C	C	C	C	L	C	C	C	C	H	K	K
T	Kubyanukula (T)	L	C	L	L1	L1	L	L	L1	L	L	L	C	C	C	C	C	C	C	C1	L1	C	C	D	D	D	K	K
T	Kambuzi(T)	L	P	P	C	L	C	L3	P	P	P	L3	L	H	H	C	L	H	L3	H	L	P	C	H	H	P	K	K
T	Rev. Nyende (T)	L	C	L	P	P	P	L3	P	L	C	L	L	D	H	C	C	C	C	L	L	L	C	C	C	C	K	K
T	Musenze(T)	P	H	P	L1	L2	C	P	C	C	H	L	P	P	C	L	P	C	C	C	L	L	C	C	C	C	K	K
T	Koolya (T)	L	C	L	L	L	L	L	L	L	C	P	P	L	C	C	L	L	L	L	P	P	C	C	C	L	K	K
T	Annet(T)	H	D	L1	C2	L	L	D	L	L	C2	L	D	D	D	C2	D	C2	D	C	C	H	C	L	L	D	K	K
T	Haumba (T)	H	P	L	C	P	P	L	P	P	P	L	D	L	C	C	P	H	C	C	L	L	C	C	H	L	K	K
		10																										

A	All farmers	L2	C	L1	L1	L2	L2	L2	L2	L2	L2	L2	L1	L2	C	C	N	C	C	C	L2	L2	C	C	C	N	K	K
R	Solomon(R)	L	L2	L1	L1	L2	L2	L2	L2	L2	L2	L2	L1	L2	C	C	L2	C	C	C	L1	L2	C	C	C	L2	K	K
R	James(R)	L3	C	L1	L1	L1	L	L	L	L	L	L	L1	L	C	C	L	L3	C	C	L1	L1	C	C	L	C	K	K

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FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA (SORTED BY MAIZE TYPE)

Buwaya

FARMER	A	B	K	Q	R	I	J	U	V	C	D	E	F	G	H	L	M	N	S	T	W	X	Y	Z	1	O	P
	L	**L**	**L1**	**L1**	**L1**	**L2**	**L2**	**L2**	**L2**	**P**	**P**	**P**	**P**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**K**	**K**
N	C	C	D	C	H	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	K	K
N	H	C	H	C	H	C	C	C	C	C	H	C	C	C	C	C	C	C	C	C	C	C	C	C	C	K	K
N	H	C	H	D	H	C	C	C	C	C	H	C	C	C	C	C	C	C	C	C	C	C	C	C	D	K	K
N	H	C	L	D	H	D	C	C	D	C	L	D	C	C	C	D	C	C	C	H	C	C	C	C	D	K	K
N	H	C	L	H	L	H	D	C	H	C3	L	H	D	C	C	D	C	C	C	H	C	C	C	C	H	K	K
N	H	C	L	H	L	H1	D	D	H	D	L	H	D	C	C	H	C	C	C	H	C	C	C	C	L	K	K
N	H2	D	L	L	L	L	H	H	H	L	L	H	H	C	D	L	C	C	C	H	C	C	C	C	L	K	K
N	L	H	L	L	L	L	L	L	L	L	L	H	L	C	D	L	C	C	C1	L	D	C	C	C	L	K	K
N	L	H	L	L	L	L	L	L	L	L	L	L	L	C1	H	L	C1	C	H	L	D	C	C	C	L	K	K
N	L	H	L	L	L	L	L	L	L	L	L	L	L	H	H2	L	D	C1	H	L	L	C	C1	C1	L	K	K
N	L	L	L	N	L	N	L	L	L	P	P	L	L	H2	L	L	H	D	H2	L	L	C1	D	H2	L	K	K
N	L	L	N	P	L	P	P	L	L	P	P	P	P	H2	L	L	L	H2	L	L	L	D	D	H2	N	K	K
N	L	L	N	P	P	P	P	L	P	P	P	P	P	L	N	L	L	L	L	L	P	D	H2	L	P	K	K

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T	H	C	C	C	L	C	C	C	C	C	L	C	C	C	C	C	C	C	C	C	C	C	C	C	C	K	K
T	H	C	L	C	L	C	C	L	H	C	L	D	C	C	C	C	C	C	C	H	C	C	C	C	C	K	K
T	H	C	L	C2	L	L	D	L	H	C	L	D	D	C	C	C	C	C	C	L	C	C	C	C	D	K	K
T	L	C	L	H	L	L	L	L	L	C2	L	H	D	C	C	C	C	C	C	L	H	C	C	C	D	K	K
T	L	C	L	L	L	L	L	L	L	D	L	H	H	C	C	D	C	C	C	L	L	C	C	D	H	K	K
T	L	C	L	L	L1	L	L	L	L	H	L	L	H	C	C	D	C2	D	C1	L	L	C	C	D	L	K	K
T	L	D	L	L	L2	P	L	L1	L	H	L	L	H	C1	C1	L	H	H	H	L	L	C	D	H	L	K	K
T	L	H	L1	L1	P	P	L3	P	P	L	L	P	L	D	C2	L	H	L	H	L	P	C	H	H	L	K	K
T	L1	P	P	L1	P	P	L3	P	P	P	L3	P	L	H	D	P	L	L	L	L1	P	C	H	H	L	K	K

	T	P	P	P	P	P	P	P	P	P	P	P	P	P	H	L	P	L	L3	L	P	P	C	L	L	P	K	K	
10																														
	A	L2	C	L1	L1	L2	L2	L2	L2	L2	L2	L2	L1	L2	C	C	N	C	C	C	L2	L2	C	C	C	N	K	K		
	R	L	C	L1	L1	L1	L	L	L	L	L	L	L1	L	C	C	L	C	C	C	L1	L1	C	C	C	C	K	K		
	R	L3	L2	L1	L1	L2	L2	L2	L2	L2	L2	L2	L1	L2	C	C	L2	L3	C	C	L1	L2	C	C	L	L2	K	K		
2																														

FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA9SORTED BY MAIZE TYPE)

Buwaya

			A	B	K	Q	R	I	J	U	V	C	D	E	F	G	H	L	M	N	S	T	W	X	Y	Z		1	O	P	
	0	OWNER	**L**	**L**	**L1**	**L1**	**L1**	**L2**	**L2**	**L2**	**L2**	**P**	**P**	**P**	**P**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**K**	**K**	
NON-		AGREE BROADLY		6	3	8	4	8	4	4	6	5	3	3	2	2	9	6	3	9	10	8	3	7	11	10	10	2	13	13	
TRAINED		of which specifically		6	3	0	1	0	0	0	0	0	3	3	2	2	9	6	3	9	10	8	3	7	11	10	10	2	13	13	
FARMERS		DISAGREE		7	10	2	6	5	7	7	6	7	10	10	11	11	4	4	8	3	2	5	10	4	0	1	3	10	0	0	
		DON'T KNOW		0	0	1	2	0	1	2	1	1	0	0	0	0	0	2	2	1	1	0	0	2	2	2	0	0	0	0	
		NO RESPONSE		0	0	2	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	
			13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
TRAINED		AGREE BROADLY		6	0	7	5	7	4	6	6	4	2	1	1	0	7	8	4	6	5	6	1	3	10	6	4	2	10	10	
FARMERS		of which specifically		6	0	1	2	1	0	0	0	0	2	1	1	0	7	8	4	6	5	0	1	3	10	6	4	2	10	10	
		DISAGREE		4	10	3	5	3	6	3	4	6	8	9	9	10	2	1	4	4	4	4	9	7	0	3	4	6	0	0	
		DON'T KNOW		0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	2	0	1	0	0	0	0	1	2	2	0	0	
		NO RESPONSE		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
ALL		AGREE BROADLY		1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	0	1	1	1	0	0	1	1	1	0	1	1	
FARMERS		of which specifically		1	0	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1	1	0	0	1	1	1	0	1	1	
AS A		DISAGREE		0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	
GROUP		DON'T KNOW		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NO RESPONSE		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	
		23+		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

NAMULONGE.	AGREE BROADLY		2	1	2	2	2	2	2	2	2	0	0	0	0	2	2	0	1	2	2	0	0	2	2	1	1	2	2
RESEARCH	of which specifically		2	1	2	2	1	1	1	1	1	0	0	0	0	2	2	0	1	2	2	0	0	2	2	1	1	2	2
TECHS.	DISAGREE		0	1	0	0	0	0	0	0	0	2	2	2	2	0	0	2	1	0	0	2	2	0	0	1	1	0	0
	DON'T KNOW		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NO RESPONSE		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

FARMER PERCEPTIONS OF MAIZE TYPES IN IGANGA9SORTED BY MAIZE TYPE)

Buwaya

	SAMPLE	A	B	K	Q	R	I	J	U	V	C	D	E	F	G	H	L	M	N	S	T	W	X	Y	Z	1	O	P	% agree with
O	OWNER	**L**	**L**	**L1**	**L1**	**L1**	**L2**	**L2**	**L2**	**L2**	**P**	**P**	**P**	**P**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**K**	**K**	owner
NON-	AGREE BROADLY	46	23	62	31	62	31	31	46	38	23	23	15	15	69	46	23	69	77	62	23	54	85	77	77	15	100	100	45344
TRAINED	of which specifically	46	23	0	8	0	0	0	0	0	23	23	15	15	69	46	23	69	77	62	23	54	85	77	77	15	100	100	
FARMER	DISAGREE	54	77	15	46	38	54	54	46	54	77	77	85	85	31	31	62	23	15	38	77	31	0	8	23	77	0	0	
	DON'T KNOW	0	0	8	15	0	8	15	8	8	0	0	0	0	0	15	15	8	8	0	0	15	15	15	0	0	0	0	
	NO RESPONSE	0	0	15	8	0	8	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	8	0	0	
	N=13	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
TRAINED	AGREE BROADLY	60	0	70	50	70	40	60	60	40	20	10	10	0	70	80	40	60	50	60	10	30	100	60	40	20	100	100	45300
FARMERS	of which specifically	60	0	10	20	10	0	0	0	0	20	10	10	0	70	80	40	60	50	0	10	30	100	60	40	20	100	100	
	DISAGREE	40	100	30	50	30	60	30	40	60	80	90	90	100	20	10	40	40	40	40	90	70	0	30	40	60	0	0	
	DON'T KNOW	0	0	0	0	0	0	10	0	0	0	0	0	0	10	10	20	0	10	0	0	0	0	10	20	20	0	0	
	NO RESPONSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	N=10	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

ALL	AGREE BROADLY	100	0	100	100	100	100	100	100	100	0	0	0	0	100	100	0	100	100	100	0	0	100	100	100	0	100	100	6		
FARMERS	of which specifically	100	0	100	100	0	100	100	100	100	0	0	0	0	100	100	0	100	100	100	0	0	100	100	100	0	100	100	3		
AS A	DISAGREE	0	100	0	0	0	0	0	0	0	100	100	100	100	0	0	0	0	0	0	100	100	0	0	0	0	0	0	5		
GROUP	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9		
	NO RESPONSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0			
	N=23+	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
NAMU.	AGREE BROADLY	100	50	100	100	100	100	100	100	100	0	0	0	0	100	100	0	50	100	100	0	0	100	100	50	50	100	100	6		
RESEARCH	of which specifically	100	50	100	100	50	50	50	50	50	0	0	0	0	100	100	0	50	100	100	0	0	100	100	50	50	100	100	3		
TECHS.	DISAGREE	0	50	0	0	0	0	0	0	0	100	100	100	100	0	0	100	50	0	0	100	100	0	0	50	50	0	0	5		
	DON'T KNOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4		
	NO RESPONSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	N=2	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100			

KEY TO MAIZE SEED TYPES:

L=LONGE; L1=LONGE PAPER BAG POLLINATED;L2=LONGE OPEN POLLINATED;L3=LONGE MIXED

C= LOCAL; C1 = LOCAL RED HUSK; C2 = LOCAL WHITE HUSK; C3 = LOCAL MIXED. H=HYBRID; H1 = HYBRID UGANDA; H2=HYBRID KENYA; H3=HYBRID MIXED.

P=LP; N=NAMULONGE; K=KATULIKA/POPCORN/SUPINI; K1=POPCORN WHITE SEEDED; D=DON'T KNOW; N=NOT SELECTED/ NO RESPONSE.

Annex 6 Management Strategies For MSVD:Farmer-Based Seed Production In Iganga District - Final Evaluation: TRAINEES

Draft prepared by Richard Lamboll

Introduction:
Two Village Based Trainers (VBTs) from each of the parishes of Bukanga and Buwaya sub-counties received training in seed production from the Cereals Programme at Namulonge AARI. Longe 1 seed, provided by the Cereals Programme, was planted by the trainers in their home parish and seed was produced from these plots using pollination bags to prevent any cross-pollination on at least some plants. A video was produced showing the various stages of seed production and this was shown a number of times in each sub-county through hiring of commercial video cinema outfits. The VBTs should have completed training of other farmers in their parish. This final evaluation is to assess this training.

1. Aim of this evaluation
The main aim was to evaluate how successful the training of farmers by Village-based Trainers (VBTs) has been. This will allow (a) the trainees to provide feedback on the training and (b) the project to assess how useful the training has been in terms of what trainees have learnt.

2. Approach
The evaluation is to be carried out through a formal survey of a sample of randomly selected trainees using a questionnaire.

The sample
It was planned that training would took place in each parish in each of the two sub-counties. Two VBTs were to be selected from an existing community group, one woman and one man. Lists of trainees were provided by VBTs in Bukanga and Buwaya, which shows the number of trainees to vary in each parish. In each parish/ group a random sample of 5 trainees were interviewed. This provided a total sample of 60 trainees (see Table 1).
The sample was selected by choosing a random number and then selecting every nth farmer on a list. The questionnaire used is shown in Appendix 1.

Further information was also collected about each group from the group leaders (see checklist in Appendix 2)

The survey was carried out by Teddy Kauma, Solomon Kaboyo and James Kayongo of NARI.

Table 1: Names of parishes, groups and VBTs in Bukanga and Buwaya sub-counties

SUB-COUNTY/ Parish	Name of group	VBT 1	VBT 2	No. of trainees	Sample
BUKANGA					
1. Budondo	Akibono Okubi Group	Mohammed Isabirye	Nabirye Maale	26	5
	Kyozira	Samson Musota			
2. Busalamu	Kyebata tobona	Kasone Musa	Mrs Betty Namugerera(F)	21	5
3. Buwologama	Gemafa	Mukasa Stephen	Scovia Mutasa (F)	32 (5)	5
4. Kiroba	Tukolere Walala	Budoli Banuli	Zaituna Mugoya (F)	31(2)	5
5. Nabubya	Dhikusoka's group	Salumanya David	Mrs Kakaire Mary (F)	20	5
6. Namukubembe	Bakusekamajja	Grace Bakaira (F)	Florence Kagweri(F)	63 (4)	5
BUWAYA					
1. Buwaiswa	Buwaya Mothers Union	Rev Ezekiel Nyende	Mrs Alice Kolya (F)	17	5
2. I sikiro	a)Isikiro Horticultural group	Ezra Okoth, James Makubi	Eria Musenze	16	5
	b)sikiro Horticultural group	Mr Kefa Kubyanukula	Mr James Mugabi	21	5
3. Kyete	Kyebata tobona	Mrs Anet Isabirya (F)	Mariam Nabirye (F)	22	5
4. Mugi	Wamulonge Horti. group	James Makavu	David Kambuzi	30	5
5. Wairama	Bakusekamajja	Nathan Sheke	Haumba Rogers	35	5

( ) Number of centres

3. Findings

3.1 Groups

Table 2 presents a summary of some of the main features of the groups involved in training. More detailed information is provided in Annex X. The same group may be referred to by more than one name and the same name may be used for more than one group eg Bakusekamajja was the name of two groups in Bukanga and one group in Buwaya. At times, this can present difficulties for monitoring by external agents!

Although the oldest group dates back to 1960 (Buwaya Mothers Union) dates back to 1960, most groups have formed over the last six years. The most recent of the original groups was only formed in 1999 in response to the opportunity to be involved in maize seed production. Even more recent than that is the Buswikira Young Farmers group, which was only formed in January 2000.

The groups were formed for diverse reasons. These include: vegetable production (3 groups), savings groups (2) and to get aid (2). All but one group has both female and male members. Total membership of all the groups is 521 women and 140 men. However, this includes one the Bakusekamajja groups in Bukanga which reports a membership across the sub-county of 421 women and 32 men. The other groups have a membership ranging between 11 and 28 people.

Criteria for membership are based on a number of factors. These include: a persons character (eg stability, good conduct, self-initiative, hard working), interests (eg farming, interest/ commitment to the group) and in some cases ability to pay membership fees.

The aims of the groups vary, but a number are common. The most common aim is increasing income, followed by food security, developing farming and general welfare and development. The activities to achieve these aims mainly revolve around farming. Maize seed production was reported as an activity of most of the groups. Other activities given were: production of cassava and beans; vegetables; bananas; livestock; making handicrafts; making stoves and singing.

In almost all cases the groups became involved in seed production through being contacted by co-ordinators in the sub-counties. These were Grace Bakaira and the LC3 in Bukanga and Ezra Okoth (FOSEM) in Buwaya.

GROUP INFORMATION - BUKANGA AND BUWAYA SUB-COUNTIES

SUB-COUNTY/ parish	Name of group	Year formed	Members: F	M	Criteria for membership	Aims
BUKANGA						
Budondo	Akibona Obubi	1993	12	5	Interest in group; Initiative	Increase income; Learn modern farming
Busalamu	Bakusekamajja II	1997	8	15	Stability (esp for women); Committed people; Hard working; Personality.	To become outstanding in the sub-county; Do away with poverty, ignorance and famine.
Buwologama	GEMAFA	1999	8	6	Self initiative; Hardworking	Develop farming; Increase income
Kiroba	Tukolele Walala	July 1999	4	11	Interest in seed production; Commitment to the group.	To do away with famine; Increase income; Being able to produce Longe1 seed.
Nabubya	Nabubya United Farmers Association	1996	6	15	Membership fee of 1000 Ush; Willingness to learn and commitment.	Have enough food; Maintain good seed; Improve farming to get higher income; Togetherness to share info.
Namukubembe	Bakusekamajja I	1986	421	32	Active people with interest in the group	To develop and increase household incomes. To be united.
BUWAYA						
Buwaiiswa	Buwaya Mothers Union	1960	20 (10)	-	Wedded member of the church and with good conduct.	Learn about housekeeping, increase income, enough food for family, improve welfare.
Isikiro	Isikiro Horticultural group	1995	5	6	Interested/ need farming; good conduct; co-operative.	Bring togetherness to members/ village; raise income; increase food supply and general welfare of the members.
Isikiro/ Buwaiswa	Bidhampola (Hort)	1996	8	14	Good conduct, committed and hard working. Membership Ush 10,000; entrance fee Ush 5,000.	Raising living standards through farming and other business. have enough and variety of food, pay school fees & other needs.
Kyete/ Nangambo	Kyebajja Kobona	1998	17	11	Membership fee (Ush 2,000). Personality-good conduct. Interest in farming.	To come out of poverty, have enough food and also to known by other people and groups.
Mugi	Klamulongo Horticultural group	1995	4	7	Originally no criteria. Now, Ush 1,500 membership fee and interest in farming.	Improving their welfare through better farming.
Mugi (became involved through Klamulongo HG	Buswikira Young Farmers or Tugzeku	Jan 2000	8	13	Someone who likes to work. Conduct.	To work towards development
Wairama	Bakusekamajja	1997	10	5	Anyone can join, but must be willing to work together and hard working.	To learn about new things (esp. farming). To develop the area in terms of family incomes

3.2 Individual trainees

Characteristics of trainees

Background information was collected about the trainees primarily to provide some indication of the extent to which different members of the communities were represented.

Overall, just over half of the trainees were female (53%), but significantly more women were trained in Bukanga than Buwaya (Table 1). Only two female trainees were reported as heads of households, which almost certainly considerably under-represents the wider population. The trainees were relatively young, with a mean age of thirty four and 72% being under the age of forty. Female trainees were generally older than male. There was particularly low representation from farmers of fifty years and over.

Table 1: Gender, mean age and age frequency distribution of trainees (Percentage of total respondents)

		No. of respondents	Mean age	<30	30<40	40<50	>=50
Bukanga	Female	18	34	10	8	10	2
	Male	12	31	10	8	2	0
Buwaya	Female	14	38	5	8	5	5
	Male	16	34	7	15	3	2
Total	Female	32	36	15	17	15	7
	Male	28	32	17	23	5	2
	Total	**60**	**34**	**32**	**40**	**20**	**8**

Table 2 shows the formal education experience of trainees ranged from none (12%) to beyond secondary year 4 level (5%). Overall, 75% of respondents had completed primary school education (P7). The results reflect the broader situation in Uganda with educational attainment for females significantly lower than for males.

Table 2: Gender and education of trainees (Percentage of total respondents)

		No. of respondents	None	P1-P6	P7	S1-S4	Beyond S4
Bukanga	Female	18	3	3	10	13	0
	Male	12	0	0	10	8	2
Buwaya	Female	14	7	8	7	2	0
	Male	16	2	1	7	13	3
Total	Female	32	10	12	17	15	0
	Male	28	2	2	17	22	5
	Total	**60**	**12**	**13**	**33**	**37**	**5**

Iganga is a densely populated district and land is a scarce resource. In this sample, the mean area of land per household is 3 hectares, but in Bukanga it is 1.8 hectares, compared to 4.3 hectares in Buwaya. In both sub-counties at least 50% of respondents had less than 2 hectares/ household, but whereas no farmers reported having more than 5 hectares in Bukanga, 13% did so in Buwaya. One farmer reported 54 hectares in that sub-county. The mean area of land occupied by maize per season is reported at 0.5 ha in 1999a and 0.43 ha in 1999b. Assuming these figures are fairly representative of the

wider population, a much higher proportion of land is planted with maize in Bukanga than Buwaya.

Table 3: Mean and frequency distribution of household land ownership (hectares) and area of maize grown in the 1999a and 1999b seasons (hectares)

	N=	<0.5	0.5<1	1<2	2<3	3<4	4<5	>5	Mean	Maize 1999a	Maize 1999b
Bukanga	30	20	10	23	27	10	10	0	1.8	0.54	0.39
Buwaya	30	17	10	23	17	10	10	13	4.3	0.47	0.47
Total	**60**	**18**	**10**	**23**	**22**	**10**	**10**	**7**	**3.0**	**0.5**	**0.43**

Participation and access to training

Overall, 58% of trainees saw the training video, with little difference between the two sub-counties and slightly higher viewing by women. The video was scheduled to be shown in every parish, the reasons for not being seen by 40% of the trainees are not clear. Training sessions varied from zero to three. The mean number of training sessions attended per respondent was higher in Bukanga (1.9) than Buwaya (1.3).

Table 4: Participation/ Access to training

		Video view (% of respondents)	Training sessions (mean no. per respondent)	Number of training sessions attended (% of respondents)			
				0	1	2	3
Bukanga	30	60	1.9	0	20	67	13
Buwaya	30	57	1.3	23	37	30	10
Female	32	63	1.4	10	47	43	7
Male	28	54	1.8	14	11	57	18
Total	**60**	**58**	**1.6**	**12**	**28**	**48**	**12**

Trainees expectations

Trainees were asked what they had expected from the training. Interestingly, 60% of trainees were expecting what the project had aimed to deliver. However, other expectations included training in maize production (28%) and general farming (18%).

Table 5: Expectations of training (Percentage of respondents)

	Respondents	Maize seed production	New maize farming skills	New general farming skills	Receiving maize seed	Other	None/ no response
Bukanga	30	63	20	20	7	7	0
Buwaya	30	57	37	17	0	0	13
Total	**60**	**60**	**28**	**3**	**0**	**3**	**7**

Note: Some trainees gave more than one response and therefore percentage total exceeds 100

Trainees understanding

Trainees were asked to explain any method which they know to produce maize seed. Enumerators (technicians from National Cereals Programme, NAARI) evaluated whether each method was not known (or mentioned), partially understood or fully understood.

The results are shown in Table 6. The most complicated method (use of pollination bag) seems to be the most understood and the more straightforward methods least understood. There are at least two likely explanations for these results. Firstly, if a respondent mention a method it may be due to it not being known of that the method has been rejected as inappropriate. In Bukanga, for example, where land is particularly scarce, 60% of respondents either were not aware or rejected isolation in space compared to only 30% in Buwaya. The same may be true of isolation in time and all farmers growing one type of maize. For many farmers these don't appear to be viable options (Table 6). Secondly, the pollination bag method was introduced into Bukanga in the 1999a season and the leading co-ordinator is enthusiastic about this method. This may explain the high level of understanding in this sub-county compared to Buwaya and also compared to other methods.

Table 6: Trainees' understanding of seed production methods

		Isolated in space			Isolated in time			All growing one type			Use of pollination bags		
		None	Partial	Full	None	Partial	Full	None	Partial	Full	None	Partial	Full
Bukanga	30	60	27	13	50	20	30	67	17	17	3	23	73
Buwaya	30	30	43	33	57	7	37	73	7	20	13	47	40
Total	**60**	**52**	**25**	**23**	**53**	**13**	**33**	**70**	**12**	**18**	**8**	**35**	**57**

Trainees - future plans

Overall, 87% of respondents anticipate that they will carry out seed production (Table 7). There is clearly a divergence between the two sub-counties in the choice of method. In Bukanga the pollination bag method emerges as the favoured approach. In Buwaya, the pollination bag method is again favoured, but isolation in time and space are also chosen by a significant number of farmers.

The VBT has been or is expected to be the source of seed for most farmers planning to produce seed (Table 8). Many farmers (42% overall) hope to receive seed which is free or on loan, with 32% expecting to pay(Table 9).

Table 7: Choice of seed production method (Percentage of respondents)

	Respondents	Space	Time	Everybody growing	Pollination bag	Unsure	None
Bukanga	30	0	7	0	80	3	10
Buwaya	30	20	17	0	40	7	17
Total	**60**	**10**	**12**	**0**	**60**	**5**	**13**

Table 8: Planned source of seed to produce seed (Percentage of respondents)

	Respondents	% Producing	VBT	Dealer	Own	Friend/ family	None
Bukanga	30	90	67	10	10	3	10
Buwaya	30	83	67	3	10	3	17
Total	**60**	**87**	**67**	**7**	**10**	**3**	**13**

Table 9: How Longe seed has been/ is to be procured

	Respondents	Producing	Buy	Loan/Free	Own	Not known
Bukanga	30	90	37	40	10	3
Buwaya	30	83	27	43	10	3
Total	**60**	**87**	**32**	**42**	**10**	**3**

Concluding comments

1. Trainees appeared to represent a wide range of farmers according to gender, age, land ownership and education. However, it is beyond this study to compare directly with the wider population in these two sub-counties and Iganga district.

2. One-off training of VBTs has resulted in a significant number of farmers being able to demonstrate an understanding of seed production methods. However, in many instances there is a lack or only partial understanding.

3. The trainees indicated a number of other training needs, some relating to seed and others to general maize production (Appendix 3). Who should respond to this training need?

4. Future interventions of this kind may benefit from exploring the potential for further participatory monitoring of activities and outcomes.

Annex 6: Appendix 1

VILLAGE BASED MAIZE SEED PRODUCTION: SURVEY OF FARMERS TRAINED BY VILLAGE BASED TRAINERS

Name: .....Village:.....Parish:.....

Age: ..... Gender.....Highest level of education achieved.....

Relationship to head of household.....Land owned by household (acres).....

Total area of maize planted in 1999a(acres)..... and 1999b(acres).....

1. Did you see the maize seed production training video? YES/ NO

2. (a) Have you received any training in maize seed production? YES/ NO
If YES (b) Complete the following table

Session	Village where it took place	Name of trainer(s)	Demo plot/ other field/ other	When?	How many other people?

3. What were your expectations of the training? .....

4. Is there anything that you will do different in the way you produce maize as a result of the training?
(i).....
(ii).....
(iii).....

5. What were the 3 most important things missing from the training with respect to maize seed production?
(i).....
(ii).....
(iii).....

6. Which methods did you learn for producing Longe1 seed in the field?
(Based on farmers knowledge of what? when? how and why?, put a tick (✓) in the appropriate column)

	Not known	Partial under - standing	Full under - standing
Isolation in space			
Isolation in time			
Everybody growing the same type of maize			
Using pollination bags			

7. Have you passed on any information you received in training to anyone else?
YES/NO

8.. (a)Are you planning to produce Longe1 seed this season (2000a)?YES/NO
If YES, (put a circle around the appropriate answer)

Source of seed ?	VBT / Seed dealer / Own seed / Other
How was it procured?	Bought / Exchange / Gift / Own seed / Other
Which method for producing seed?	

(b) If NO, explain why?.....

Annex 6: Appendix 2
FARMER GROUP QUESTIONNAIRE

(TO BE ASKED TO GROUP LEADERS)

1.Name of group.....English translation.....

2. Names of group leaders.....

3. Home base/ Address of group .....

4. Year in which group started:.....

5. Why and how was the group formed?
.....
.....

6. Total number of group members: Women:.....Men:.....
(Please list the names of group members on the back of this sheet)

7. From which villages do group members come?
.....
.....

8. What are the criteria for group membership?
.....
.....

9. What are the aims of this group?
.....
.....

10. What are the current activities of this group?
.....
.....

11. How frequently does the group meet?.....

12. How did this group become involved in maize seed production activities?

.....

Annex 6: Appendix 3
Trainees response to 'What was missing from the training?'

TRAINEES	BUKANGA	BUWAYA
FEMALE	Best season for growing maize	Didn't show different cobs of opv and protected cobs
	Better maize production methods	Didn't show what a pollinated cob looks like
	Chemicals that can be used to spray	Handling
	Control diseases	How and when to plant maize seeds
	Control of pests	How to apply fertilisers
	Drying, storage and marketing	How to apply fertilisers
	Expected to provide us with maize seeds	How to secure fertiliser & application
	How and when to harvest maize cobs	How to spray chemicals to control pests
	How to add fertility to soils	How to store well the maize
	How to apply fertilizer	Market the output
	How to gap fill	Method of planting maize seed
	How to get fertilizers	No intercrop shown
	How to get packets for pollination	Planting
	How to identify diseased plants	Training about pollination method during changing of pollen from tassel to silk
	How to plant maize	Securing a market
	How to plant maize seeds	Seed preservation
	How to plant using proper spacing	Seeds per hill
	How to prepare seedbeds	Shelling with hand(we just beat in sack?)
	How to select seeds from cob	Soil conservation
	How to store seeds	Spacing
	Info on soil pests that attack maize	Spacing/seeds per hole
	Info on spraying	Termite control
	Info to control diseases	Termite control
	Info to control termites	
	Inorganic fertilisers	
	Market	
	Pest control	
	Planting maize	
	Proper storage facilities	
	Reason why plants are rouged	
	Shelling maize cobs	
	Spacing maize	
	Storage of maize	
	Storage of maize	
	Storage pests control	
	Training, but these stopped	

MALE	Harvesting	Application of fertiliser
	How to make proper furrows	Conserving the land
	How to harvest	Control of pests and diseases
	How to maintain	Control of pests(stem borer, termites)
	How to plant	Control termites
	How to plant	Differences in varieties
	How to store maize	How maize is planted
	How to plant	How to find market
	If fert available I can use it	How to make compost manure
	No maize plants physically present (dry season)	How to procure Longe1 seed
	Pollination bags not enough	How to secure inputs
	Pests of maize	Maize planting
	Planting of maize	Maize pest control
	Planting, especially spacing	Maize stover utilisation
	Pollinating local variety	Market opportunities
	Proper spacing	Marketing
	Spacing	Marketing information
	Spacing for planting maize seeds	Pollen timing for changing from tassel to silk
	Spraying of maize	Proper spacing
	Storage	Seed processing
	Storing/marketing/fertilizer	Soil conservation
		Storage facilities
		Storage of maize cobs
		Storage, especially for seeds
		Weeding

Annex 6: Appendix 5

Trainees response to the question 'What will you different in the way you produce maize after the training?'

Trainees	BUKANGA	BUWAYA
Female	Better seed	2 seeds/hill
	Contour farming	2/3 seeds/hill thinned to 2
	Contour/	Get improved seed
	Drop local variety	Good plants are the ones pollinated
	Expand acreage to get school fees	Good seed bed preparation
	Fallow farming?	Hire relatively large area
	Fertilizer	Hope to start planting Longe1
	Good seed bed prep.	Isolate fields from local maize
	Hope to get chemicals to control stemborers	Learn more skills
	Hope to secure market for my seeds	Look vigorous plants only?
	How to select good cobs for seed	Maintain and grow maize
	Olubiri to control termites	Monocropping of maize
	Pick high yielding, early maturing seed and get some cash	Plant in rows
	Pick-up on Longe1	Proper spacing(2x2.5ft)
	Plant rows	Proper tillage
	Pollinate maize	Recommended spacing
	Producing own seed	Rogue my field
	Proper field maintenance	Select good plant for pollination
	Proper spacing (2.5x1.5ft)	Spacing(2.5x2ft)
	Proper spacing(3ftx2ft)	Use hired labour if she gets money
	Proper spacing(2ftx1ft)	
	Proper tillage	
	Proper tillage to get good seed bed	
	Put more effort	
	Row planting	
	Save my own seed using paper bags	
	Save my own seeds of longe1	
	Seed maintenance	
	Sensitise fellow farmers to grow similar variety around us	
	Sensitise fellow farmers to pick longe1	
	Soak maize?	
	Spacing	
	Spacing (2*1ft)	
	Spacing(2ft81ft)	
	Start saving own seed	
	Start staggering my crop	
	Teach others	
	Tillage practice	
	Time to 2 plants?	
	Timely weeding	
	Use longe1	
	Would have put fert, but expensive	

Male	Add green manure	Buy good seeds from Sukura shop, Iganga
	Construction of furrows for water	Compost manure
	Contour bunds to control erosion	Dap fertiliser
	Finely prepare the seed bed	Expand field
	Follow recommended plant method	Green manure
	Grow maize where other people are growing other crops	Increase size of field
	Grow more maize	Mulching using maize stovers & elephant grass
	Growing improved maize seeds	Mulching using stover
	Increase size of plot	Pesticide
	Maintain pure Longe seed	Plant better varieties e.g. Longe, hybrid
	Maintain seed	Planting improved seed
	Multiply and maintain seed that he has	Proper weeding
	New seed	Prune/ reduce no. Of trees in garden
	Plant at right spacing 2ft*1ft	Recommended spacing
	Proper spacing	Recommended spacing
	Recommended spacing instead of wide spacing	Recommended spacing
	Row planting	Recommended spacing 2.5x2ft
	Start producing longe1	Recommended spacing(2.5x2ft)
	Stop buying Longe & produce own seed	Revise intercrop system
	Teach others	Soil conservation (furrows)
	Timely pollination	Spacing(2.5x2ft)
	Use fertiliser (dap)-already applied	Spraying to control pests
	Use organic manure, but has no good knowledge	Stagger planting to avoid contamination
	Use plant remains for fertiliser instead of burning	Take on small plot rather than big plot poorly managed
		Take up improved variety
		Thinning(2 plants/hill)

Annex 7:
SEED TYPES BROUGHT BY FARMERS DURING THE GROUP EVALUATION OF THE SEED WORKS IN BUKANGA

Letter assigned to each cob	Maize type	Name of farmer who brought the cob
A B X Y D1 E1 F1	Longe 1 (PP) Longe 1(PP) Local Hybrid Hybrid Lon ge 1 (OP) Local	Florence Kagweri (T)
C D	Longe 1 (OP) Lon ge 1 (PP)	Steven Mukasa (T)
E F G H I A1 B1 C1	Longe 1 (PP) Lon ge 1 (OP) Local Hybrid LP Katulika Katulika Katulika	Grace Bakaira (T)
J K	Longe 1 (PP) Longe 1 (OP)	Isabirye Mohammad (T)
L M	Longe 1 (PP) Longe 1 (OP)	Banuli Budoli (T)
N O	Longe 1 (PP) Longe 1 (OP)	Zaituni Mugoya (T)
P Q	Longe 1 (OP) Longe 1 (OP)	Kasone . B.M (T)
R S	Longe 1 (OP) Longe 1 (PP)	Nakawuma Jeska (T)
T U	Longe 1 (OP) Longe 1 (OP)	Salumanya David (T)
V W	Longe 1 (OP) Longe 1 (OP)	Aida Kakaire (T)
G1 H1 I1 J1	Longe 1 (OP) Local Hybrid Local	Magistrate (NT)

OP = Open pollinated; PP = Paper pollinated;T = Trained; NT = Not trained

SEED TYPES BROUGHT BY FARMERS DURING THE GROUP EVALUATION OF THE SEED WORKS IN BUWAYA

Letter assigned to each cob	Maize type	Name of farmer who brought the cob
A B	Longe Longe	Edinasi Koolya
C D E F G H	LP LP LP LP Local Local	Rehema Mudondo
I J	Longe 1(OP) Longe 1(OP)	Alice Koolya (T)
K L M N	Lone 1 (PP) Local Local Local	Annet Isabirye (T)
O P Q R S T U V	Katulika (Spine) Katulika (Spine) Longe 1 (PP) Longe 1 (PP) Local Local Longe 1 (OP) Longe 1 (OP)	Kefa (T)
W X Y Z 1	Local Local Local Local Local	Eria Musenze (T)

ANNEX 8

TRAINING OF VILLAGE-BASED TRAINERS (VBTS) ON MAIZE SEED PRODUCTION

Namulonge Agricultural and Animal Production Research Institute (NAARI)

25th - 26th October 1999

Edited by

G. Acola
Dr J. Imanyohwa

Dr D Kyetere

National Agricultural Research Organization (NARO)

Natural Resources Institute (NRI), University of Greenwich, UK

Acronyms and abbreviations

MSV	Maize Streak Virus
NAARI	Namulonge Agricultural and Animal Production Research Institute
NARO	National Agricultural Research Organization
NGOs	Non-Governmental Organizations
OPVs	Open pollinated varieties
USP	Uganda Seed Project
VBTs	Village-based trainers

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Foreward

The training of Village-based trainers (VBTs) on maize seed production for 26 farmers from Bukanga and Buwaya subcounties in Iganga district was jointly organized by the National Agricultural Research Institute (NARO) and the Natural Resources Institute (NRI) of UK with funding from the UK's Department for International Development through their Renewable Natural Resources Research Strategy's Crop Protection Programme.

Through village-based interviews with farmers in Iganga, it was observed that seed of released varieties of maize such as Longe 1 often germinated and performed poorly. Farmers had always expressed the need on skills of how to produce and maintain the quality of their maize seeds. It was against this background that this two-day workshop was organized. Two farmers, a female and male were selected by the community members in 13 parishes in each of the two subcounties. These farmers were to act as trainers of other farmers on techniques learnt from their training.

The training workshop covered aspects of cultural practices, types of seed production, recommended methods of quality seed production and their advantages and disadvantages. A greater part of the workshop was spent in the field demonstrating different techniques of seed management and production of materials used for pollination. The training took the form of lectures, demonstrations, video viewing and practical examples in the field. At the end of the workshop the VBTs came up with an action plan of what they hope to achieve when they got back to their respective parishes.

It is envisaged that this training will go a long way in ensuring that the quality of maize seed can be maintained at farm level. Its success will depend on how the VBTs make use of the training received.

Grace Acola
NRI/NAARI

Opening remarks

Dr F.A. Opio
Director of Research
NAARI

Ladies and Gentlemen,

On behalf of NAARI and my own behalf, I wish to welcome you to this Institute. I would like to inform you that in addition to maize, we handle other crops like cassava, Irish potatoes, sweet potatoes, beans and animal production. So when you come here and have the time, take time and visit other commodity programs as well. Maybe other programs may be encouraged to bring you so that you can learn from them like the maize programme has done. We are always visited by farmers, but it is rare to have a workshop of this nature.

Turning to the workshop, farmer seed production is at the heart of everybody. What we have had previously is the seed project producing seed for sale. This takes time to reach the farmers, by the time it gets to the farmers, it is poor quality and very expensive. Farmers have had a problem because they spend a lot of money buying seed which fails to germinate. If we can get the farmers involved in seed production then we can be sure of sustainable seed production in the farming communities.

For this reason, ladies and gentlemen, we wish to thank this group for starting this activity in Iganga. I hope with this training, you will progress very well and become our contact group and also for farmers elsewhere too. If you do well you can be a good example outside the district. I am sure you will not stop on maize but also other crops too. Madam representative of the CBOs, I am requesting you to contact other CBOs and NGOs so that we can reach as many farmers as possible and faster.

Mr Chairman, I wish you and the farmers good deliberations, and I am sure by the time you leave here, you will be specialists in producing good seeds.

With those remarks, I declare this workshop open.

Objectives of the workshop

Dr J. Imanyohwa
Maize Breeder, Cereals Programme

The objectives of the workshop is to train trainers so that when they go back to their community they can train farmers in their farming groups how to produce good quality seed.

The overall objective is to improve seed quality in Bukanga and Buwaya subcounties which will in turn improve on maize yields.

Seed production in general entails transforming the efforts of breeders into adequate quantities of improved seed for farmers. This also involves cultural practices, seed drying and storage. With this done, quality seed can be produced. As you already know, lack of good seed is one of the major constraints in maize production.

There are two types of maize production:
(1) Formal system (a system used by the Uganda Seed Project (USP))
(2) Informal system (this is the category to which you belong and its the one we want to promote.

The informal system is used by farmers with a common objective to produce quality seed. They may have laid down regulations and bye-laws within their group. Our concern is that farmers or a group of farmers can produce quality seed for themselves and sell surplus to their neighbours.

Types of seeds

(1) Breeder seed
(2) Foundation seed
(3) Registered seed
(4) Certified seed

The fourth type is the seed that is marketed by the seed project and is the type that we want you to try to achieve. Quality seed can be produced using one of the methods below:

(1) Isolating seed maize from any other maize
(2) Isolation in time (different planting dates)
(3) All the farmers within the neighbourhood growing the same variety
(4) Using pollination bags (hand pollination)

The last one requires inputs and little seed is obtained. This is the method you have been using in your area.

In each of the types, off-type plants and sick plants are removed by rouging. Seed is obtained from plants that have ears at about the same height, good husk cover and plants of about same height.

Overview of Maize Management

Dr D.T. Kyetere
Head, Cereals Programme

There are two categories of maize varieties grown in Uganda.

1. **Open pollinated varieties (OPVs) such as composite varieties, Longe 1, local varieties etc. Seeds can be used season after season (2-3 seasons).**

2. Hybrid varieties. Seeds of this type are planted once in a season.

Each of the maize seed production mentioned by Justus have advantages and disadvantages.
(Farmers outlined advantages and disadvantages of the pollination method)

Shortcomings of pollination as outlined by the farmers
1. Packets and pollination bags, difficult to get
2. Time taken in pollination is long
3. Too much labour is involved
4. High commitment on the side of the farmer
5. Time consuming
6. Type of packaging material in the rainy season

Positive side of the process
1. High quality seed
2. Assurance of genuine seeds/product
3. Seed variety maintenance is assured
4. Timely availability of seeds
5. No buying contaminated seeds
6. Learn to work in a group, fosters cooperation amongst farmers
7. Uniformity in crop
8. Sales of high quality seeds
9. Poor seed losses are minimized
10. High yield
11. Quality posho
12. Protection from birds

Comments/Questions from farmers

Question: What is the cost of pollination bags?

D. Kyetere

(Response): The cost of a bag is 50 shillings. However, the tassel/ear bags that are good and can withstand rain cost about 450 shillings and is actually bought from Kenya. This cost does not include cost of the ear bags, transport, staples to be used. Therefore to reduce cost on earbags (imported), we are alternatively using polythene sheets from owino market which are relatively cheaper.

Farmer

(Comment): For a kilo of maize, you need 7 bags at pollination to produce approximately 1kg of seed.

K. Kyetere

(Comment): To cut down on the above mentioned problem of pollination, growing maize in isolation is the most ideal since it does not require buying bags, staples. We are happy with the pollination method using bags but we want to change to a method that is sustainable. For sustainability of this seed, the programme will after every three seasons be sending the breeders seed to the farmers. However, under good maintenance, this seed can go for five seasons.

Question: Why is the middle seeds of a cob preferred?

J. Imanyohwa

(Response): Seeds in the middle of the cob are uniform and grow at the same time and have same vigour. The ones at the ends are small and take long to germinate.

Question: Can seeds for planting be graded?

Response: Yes. Uniform middle seeds can be considered for planting, the others from the ends of the cob can be separated for planting separately.

Question: How can we maintain pure seed?

Response: High quality seed size is considered and selection is done by breeders and passes through some basics on selection. Then this can be passed to farmers for multiplication.

Question: Can we choose pure seed ourselves?

Response: There are different maize types like Katumani for dry areas, hybrids 614, 612 for highlands and Longe 1 which performs almost everywhere. The idea for different types is for farmers to choose the variety they prefer. Scientists may need many varieties for their research activities.

Comment: Iganga farmers can go for Longe 1 and the two other Uganda hybrids.

Techniques demonstrated to farmers

(a) How to make shoot/ear bags using locally available material e.g. polythene obtained from Owino. A piece was cut and given to each participant to make a bag using a candle flame for sealing it.

(b) How to select a plant for pollination. Plants that are free of diseases should be avoided. Plant height (medium) should be considered. Plants infected with MSV be rouged out.

(c) Stage of plant development to put the ear bags, that is when the silks are peeping.

(d) When to fix the pollination bags to trap the pollen and when to move the bag onto the silks.

(e) Planting in Isolation in time.

(f) How to manage the harvested corns after harvesting.

(g) How to select and at what point to select good seeds for planting.

Action plan developed by the Village-based trainers (BVTs) at a training workshop on seed management

Bukanga subcounty

Activities

1. Initiation of demonstration plots at parishes and subcounty
2. Training and experiments
3. Sensitization and formation of new groups
4. Seed processing, preservation, storage etc.
5. Exchange visits among farmers to share experiences and knowledge
6. Information/data collection
7. Record keeping
8. Follow-up visits

Venue: Village, parish and subcounty

When and for how long:

Activity	**Duration**
⇒ Demonstration plots	2 weeks
⇒ Training and experiments	1 week
⇒ Sensitization of new groups	1 week
⇒ Exchange visits	2 weeks
⇒ Data/information collection	Weekly
⇒ Record keeping	Routine
⇒ Follow-up	Routine

Who

Trainers together with other farmers

The group selected hand pollination as the method to maintain seed purity. This is because it enables timely planting and does not create conflict with the community. This method will be achieved through using packets made locally from cement bags.

Buwaya subcounty

Activities

1. Demonstration plots (already planted)
2. **Used demonstration plots for training farmers on agronomy, pollination and harvesting**
3. Harvesting of seeds
4. Processing, preservation and storage
5. Identification of other groups
6. Sensitization, planning with new groups/neighbours and communities
7. Gathering data on yield and qualities of seed produced
8. Division of labour i.e. activities of different types to be done by different people.

Of the methods learnt the group selected planting in isolation in time.

Reasons

⇒ Less expensive
⇒ Lack of enough land
⇒ High population of the neighbourhood
⇒ It saves time
⇒ It encourages time consciousness
⇒ Encourages other communities in the neighbourhood to learn new technologies

This will be achieved through mobilization and sensitization of the community of the need in reference to the demonstration plots.

Maize programme

⇒ Packets will be purchased and given to farmers on a refund basis
⇒ Video tapes to be given to each parish in the two subcounties

List of participants: Training of village-based trainers workshop

Name of participant	Address
BUKANGA SUBCOUNTY	
Mukasa Stephen	Farmer, PO Box 1, Iganga, Buwologoma Parish
Muteesa Scovia	Farmer, Buwologoma Parish
Isabirye Mwamadi	Farmer, Budondo Parish
Namirye Male	Farmer, Budondo Parish
Nakawoma Namugereka	Farmer, Busalamu Parish
Benerya Musa Kasoome	Trainer of trainers, PO Box 1404, Iganga, Busalamu Parish
Aida Kakaire	Farmer, Namubya Parish
Salumanya David	Farmer, Kiroba Parish
Banuli Budoli	Farmer, Kiroba Parish
Kagweri Florence	Farmer, Namukubembe Parish
Grace Bakaira	Contact farmer in charge of NGOs, Bukanga subcounty, Namukubembe Parish
Sulaiman Wabigha	Chairman LC III, Bukanga

BUWAYA SUBCOUNTY

Haumba Rogers	Village trainer
Kubyanukula C. Augustine	Chairman Isikiro horticulture group, P.O. Box 183, Iganga, Iskiro Parish
Byansi Moses	Committee member, Bidhampola group, Buwaya Parish
Nabangi Mary	Farmer, P.O. Box 183, Iganga
Isabirye Annet	Farmer
Koolya Alice	Secretary horticulture group, Buwaya Church of Uganda
James C Mugabi	Organizer horticulture group, P.O. Box 395, Iganga
Rev. Ezekiel Nyende	Patron Buwaya horticulture group, St. John's, P.O. Box 183, Iganga
Kambuzi David	Farmer, Muggi Parish
Sheke Nathan	Farmer
Musenze Eria	Farmer
Makavu James	Farmer
Ezra Okoth	Extension Coordinator, FOSEM project (Iganga Office), P.O. Box 395, Iganga or FOSEM project (Kampala office), P.O. Box 2215, Kampala Tel: 041-254245

NAMULONGE AGRICULTURAL AND ANIMAL PRODUCTION RESEARCH INSTITUTE (NAARI), P.O. BOX 7084, KAMPALA
E-MAIL: naari@naro.bushnet.net

Dr F.A. Opio	Director of Research, NAARI
Dr D.T. Kyetere	Head, Cereals Programme
Dr J. Imanyohwa	Breeder, Cereals Programme
Dr G. Birgirwa	Pathologist, Cereals Programme
G. Acola	Socio-economist, Cassava Programme
Ssali Andrew	Technician, Cereals Programme
J.S. Okanya	Technician, Cereals Programme
Alupo Jane	Technician, Cereals Programme
Kayongo James	Technician, Cereals Programme
Kaboyo Solomon	Technician, Cereals Programme
Kiggwe Fred	Technician, Cereals Programme
Akono Jimmy	Technician, Cereals Programme
Walusimbi M.	Technician, Cereals Programme
Nakayima A.	Technician, Cereals Programme
Semambo W.	Field Assistant
Balemuka J.	Field Assistant
Bongole K.	Field Assistant

Annex 8; Appendix 1
Workshop Evaluation:
Training of Village-based trainers on Maize Seed Production;
25th-26th October, 1999

G. Acola and J. Kayongo

The workshop was evaluated by 25 of the participants. Regarding the general workshop organization, 64% indicated that it was excellent, 8% indicated that it was good and 12% indicated that it was fairly organized.

Sixty four percent referred to field demonstrations as excellent whereas 12% and 16% referred to it as good and fair respectively.

Twenty percent referred to field demonstrations as excellent and 28% and 40% respectively referred to it bas being good and fair.

Finally, the workshop duration was considered short by 68% of the participants and 24% regarded it as appropriate.

In conclusion, the majority of participants felt that the workshop was well organized (Table 1) and that it achieved its objectives (Appendix 1). Majority were aware that the workshop was training them on pure seed production and how this could be maintained. The farmers were of the view that for future workshops that are to be held, all the crops should be combined so that they also gain knowledge from other crops as well. They mentioned the following as the main benefits from the workshop: knowledge on production, maintenance of good quality seeds using different methods and working together and sharing experiences with other farmers from other villages.

Table 1: Workshop evaluation by participants (n=25)

Comments	Response	% Response
General arrangements		
Excellent	16	64
Good	2	8
Fair	3	12
Poor	1	4
Non-response	3	12
Accommodation		
Excellent	5	20
Good	7	28
Fair	10	40
Poor	0	0
Non-response	3	12
Meals		
Excellent	12	48
Good	7	12
Fair	4	16
Poor	0	0
Non-response	2	8
Field demonstrations		
Excellent	16	64
Good	3	12
Fair	4	16
Poor	0	0
Non-response	2	8
Time factor		
Excellent	8	32
Good	5	20
Fair	6	24
Poor	4	16
Non-response	2	8
Workshop duration		
Short	17	68
Appropriate	6	24
Too long	0	0
Non-response	2	8

Participants general comments regarding the workshop

Comments in relation to the workshop objectives

1. Training farmers how to maintain pure Longe seeds
2. Maize production training workshop
3. Training VBTs on pure seed production for food sustainability
4. Pure seed maintenance, good production and higher yields
5. Skills on maize production and making friends
6. How to rouge infected or unwanted plants
7. Training us so that we train others on how to produce pure seed
8. **Training farmers how to produce good seed, identify diseases and pests, pollination and working together as a group**
9. Good farming
10. Training to improve the agricultural methods in our areas, set demonstrations and introduce new varieties
11. Good workshop with a lot to learn and well looked after

Farmers suggestions for future improvement

1. Scheduling more workshops to train farmers
2. Duration of workshop should be long enough
3. Training in other crops also like cassava, beans, sweetpotatoes
4. Conduct such similar training at village level
5. Working together so that we can be trained on other crops
6. Such training should be continued
7. Carry out such a workshop in other places for more people to learn
8. Continue training other farmers and inform them of the disadvantages of planting other local maize varieties
9. Working together for development

Farmers benefits from the workshop

1. Can differentiate good and bad things in maize production
2. Knowledge of producing maize seeds communally
3. Knowledge of production and storage of improved seeds
4. Got pocket money
5. Learnt how to maintain seed purity and viability
6. Learn how to pollinate maize
7. Learnt how to produce good own seeds, there would be no need of buying seeds again
8. How to pollinate and avoid disease spread and good seeds selection
9. Maintenance of new seeds
10. Knowledge of uplifting villages as cultivation is a key factor
11. Production of pure maize seeds from the available seeds and remain stable
12. Hitech knowledge in seed production in the fields
13. Good relationship

Annex 8; Appendix 2: PROGRAMME

TRAINING OF VILLAGE-BASED TRAINERS ON MAIZE SEED MANAGEMENT

25th-26th OCTOBER 1999

24th October, 1999	Arrival of participants

Day one

25th October, 1999

8.30 am - 9.00 am	Registration of participants
9.00 am - 9.30 am	Welcome by Head of Cereals, Director of Research
9.30 am - 10.00 am	Objectives of workshop, Dr J. Imanyohwa
	10.00 am - 11.00 am Video on principles and practical approaches to maize management
11.00 am - 11.30 am	**Tea break**
11.30 am - 1.30 pm	Field tour by scientists and technicians
1.30 pm - 2.30 pm	**Lunch break**
2.30 pm - 5.00 pm	Review of video and discussions with participants practicalities of inputs (shoot/ear bags etc).

Day two

26th October, 1999

9.00 am - 11.00 am	Farmers practicing pollination
	Action plan
11.00 am - 11.30 am	Workshop evaluation
11.30 am - 12.00 pm	Departure

ANNEX 9

Quality of Farmers' Maize Seed

DRAFT REPORT BY

Dr. Justus Imanywoha and James Kayongo

PERFORMANCE OF COMMUNITY BASED SEED WITH REGARD TO GENETIC PURITY

Introduction

In 1999 I was incorporated in a village-based farmer seed production project carried out by NRI/NAARI in Iganga. Farmers had received breeder seed from the program and were multiplying it using hand-pollinated method. We visited the farmers at the time of pollination. The farmers were doing their best given that this is a method used by breeders. We undertook immediate in-the-field training for the farmers. This involved identification of Longe 1 plants (there were many off-types after one season of seed production by the farmers) covering the tassel and the stage at which to cover, the pollination process when to harvest, and what type of plants and ears to take. It was deemed necessary to pool seed from a number of farmers and test it against Longe 1 breeder seed and Longe 1 certified seed.

Objectives

To find out whether farmers can keep genetic integrity of Longe 1 variety.
To find out in what area if any to improve.

Materials and Methods

The materials used were variety Longe 1 breeder seed, Longe 1 certified seed and Longe 1 seed multiplied by farmers. The seed collected from about 10 farmers was bulked to make a pooled seed sample. The trial was planted in Kamenyamiggo at Masaka District Farm Institute. The trial was laid in randomized block design (RBD) of 4 replications. Seeds were planted in a 4 row plot of 5m long with spacing of 75cm between rows and 30cm between plants within the row.

At anthesis, data was taken on plant stand, plants with MSV, plants with cobs, and MSV severity. Severity was taken on 15 plants per plot. Each plant was scored individually and the mean score for the plot was computed by summing up scores of the 15 plants and dividing by 15. The scores were on 1-5 scale where 1 = no or few streaks, 5 = stunted plant with no cobs with very yellow leaves. At harvest the plants had been affected by drought that yield data was of little utility.
Analysis was done using MSTAT-C software package.

Results and Discussion

Performance maize seed produced by Iganga farmers Kamenyamiggo 1999B.

Table 1. Maize seed performance data

	No. of plants	**% plants without MSV**	**No. plants with cobs**	**MSV score**
Iganga Seed	24	9.52	18.3	2.58
Certified Longe	24	7.14	17.5	2.91
Breeder Seed	30	19.72	25.5	2.50
Mean	25.8	12.123	20.4	2.666
LSD	6.9	8.253	4.986	0.683
P.>	0.1605	0.0211	0.0142	0.35
	Ns	**	**	Ns

The data obtained on the above parameters showed little difference among the three. Although there was a tendency for breeder seed to perform better. Significant statistical differences were obtained on number of plants without MSV and number of plants with cobs (table 1). This suggests that the number of plants without MSV boost the number of plants with cobs in the plot. At the time of collecting seed from the farmers for the above trial, fresh breeder seed was distributed to farmers. The generation of the seed they produced was also collected from at least 26 farmers for testing at Namulonge and Kamenyamiggo.
This time the seed was not pooled but rather each farmer's seed was considered a treatment. This was tested along Longe 1 breeder seed, Longe 1 certified seed, Longe 1 top cross and LP 16 (Longe 4) an early maturity variety. The trial was laid in (α-1) lattice design with 3 replications of 2 row plots. Plants were spaced in rows of 75cm

apart and 30cm between plants/hills. Data was however analyzed in MSTAT-C and (α-1) lattice. The trial at Namulonge was affected by drought and the plant stand reduced by the termites. The yield obtained was much reduced by the two factors and are not considered in the discussion. Other data like the flowering data, ear and grain characteristics were much relied on in comparing the farmer seed with the breeder's seed and certified seed. The farmer produced seed should be at the level of foundation seed and registered seed. This means that the performance of such seed should be better than certified seed but inferior to breeder seed. The results obtained at Namulonge and also at Kamenyamiggo (Tables 2&3) show that the farmers seed is actually in between the two. Significant statistical differences were observed in days to anthesis (pollen shed) with seed from Wabigha G. and Kasujja M. There is reason to believe that the seed of these two farmers was either contaminated with local varieties or out crossed. Significant differences were also observed on days to silking. Seed of 5 farmers fell outside the expected range and therefore can be considered as contaminated. The farmers are: Wabigha, G., Kunya, L., Badagawa, F., Mabanda, M. and Muniavu, A. This is also reflected in the anthesis, silking interval (ASI) of seed from above farmers. The ASI is about 4 days whereas most are 1-3 days.
In general the majority of farmers seed fell in the expected range.

Conclusion

The farmers of Namukubembe have proved that farmers can maintain the genetic purity of maize seed. If other aspects of seed quality are observed by seed conditioning, it is possible that they can have their seed certified by certifying unit and sell it to other farmers in the areas other than Iganga.
The method used of hand pollination is expensive and unsustainable. The good news is that farmers in Namukubembe have realised this and they are switching on to isolation in time.

If what we were told by a seed specialist from Kenya who visited the farmers is to go by, then the Namukubembe farmers are doing fine. The last batch of breeder seed they got has been well multiplied and the uniformity of the plants is impressive.

Table 2. Performance of maize seed produced by different farmers of Namukubembe

NAME OF FARMER / Maize type	50% DAYS TO SILK	ANTHESIS DAYS	SCORE 1-5 EAR ASPECT	EAR ROT %	GRAIN TEXTURE SCORE	YIELD KG/HA	ASI DAYS
WABIGHA G	77.0	74.7	3.5	0.00	2.5	467.0	2.3
NATALE M	74.3	71.0	3.7	0.03	2.7	434.0	3.3
KASONE M	74.3	71.6	4.2	0.03	2.2	608.0	2.7
KASUJA M	76.7	75.0	3.3	0.00	2.2	460.0	1.7
WABIGHA N	76.3	73.7	3.7	0.30	2.5	598.0	2.6
KUNYA L	77.3	72.7	3.7	0.00	2.7	639.0	4.6
BADAGAWA F	78.0	74.0	3.8	0.07	2.5	516.0	4.0
KAKUNGULU J	76.5	72.6	3.8	0.07	2.3	553.0	3.9
MAHAGA S	73.3	72.0	3.7	0.03	2.7	609.0	1.3
MABANDA M	77.3	73.3	4.2	0.07	2.5	862.0	4.0
SIRAFI W	73.5	73.6	3.5	0.03	2.5	677.0	0.0
MUNIAVU D	77.0	74.0	3.7	0.00	2.3	487.0	3.0
MATENDE J	70.0	69.0	3.5	0.07	3.2	881.0	2.0
MENYA M	76.0	73.3	3.5	0.00	2.8	769.0	2.7
NGOBI K	75.0	72.7	3.7	0.00	2.5	730.0	2.3
LUKUJJAO J	76.7	73.0	3.5	0.00	2.7	903.0	3.7
KAGWERI F	76.3	73.3	3.8	0.00	2.2	500.0	3.0
NALUGODHA B	75	72.7	3.3	0.00	2.5	687.0	2.3
SABATAKI E	75.3	74.0	3.7	0.07	2.8	571.0	1.3
KADALA H	72.9	71.1	3.5	0.00	2.5	547.0	1.8
BAKAIRA G	74.3	73.0	3.8	0.03	2.3	653.0	1.3
BREEDER SEED	72.9	71.1	3.2	0.03	2.5	305.0	1.8
KIGENYI P	75	72.7	3.5	0.00	2.3	610.0	2.3
NALUMANSI	71.3	68.7	3.5	0.00	2.5	1052.0	2.6
KUNYA	72.3	70.0	3.2	0.00	2.5	970.0	2.3
MUYINGO H	76.3	74.0	3.2	0.00	2.5	831.0	2.3
BYAKIRASO F	74.7	72.0	3.7	0.00	2.5	862.0	2.7
LONGE 1 CERTIFIED	71.7	69.3	4.0	0.00	2.5	1044.0	2.4
LONGE 1 TOPCROSS	76.1	73.3	3.5	0.00	2.2	631.0	2.8
LP16(LONGE 4)	70	67.7	3.8	0.00	2.5	1060.0	0.3
Min	69.7	67.7	3.2	0	2.2	304	0
Max	78	75	4.2	0.07	3.2	1060	4.6
Mean	74.8	72.3	3.6	0.02	2.5	684	
CV	3.12%	2.47%	8.81%	21.43%	9.62%	48.87%	
LSD	3.83	2.919	0.524	0.071	0.66		

Table 3. Performance of maize seed produced by different farmers of Namukubembe - Kamenyamiggo

NAME OF FARMER / Maize Type	NO. PLANTS	% OF F.TYPES	NLB	GLS	EAR ASP.	GR. TEX.	YIELD KG/HA
				SCORES 1-5			
WABIGHA G	26	5	2.8	1.5	3.3	3.3	4476
NATALE M	25	4	2.8	2.0	3.0	3.3	4193
KASONE M	25	3	2.8	1.5	3.3	3.0	4349
KASUJA M	26	5	3.0	2.0	3.5	3.3	4659
WABIGHA N	28	6	3.3	2.0	3.3	3.3	4676
KUNYA L	29	3	3.0	2.0	3.3	3.5	4380
BADAGAWA F	26	2	2.8	2.0	3.0	3.0	4255
KAKUNGULU J	24	5	3.3	2.0	3.3	3.3	4087
MAHAGA S	19	4	2.8	1.5	3.3	3.3	3920
MABANDA M	24	2	3.3	1.5	3.3	3.0	4116
SIRAFI W	26	6	3.3	2.0	3.0	3.0	4255
MUNIAVU D	28	4	3.3	2.0	3.0	3.0	4583
MATENDE J	28	4	3.3	2.0	2.3	2.8	4773
MENYA M	28	3	3.3	1.5	3.0	3.5	4664
NGOBI K	29	5	3.0	2.0	3.3	3.8	4882
LUKUJJAO J	26	2	2.8	2.0	3.5	3.0	4427
KAGWERI F	24	4	2.8	1.5	3.3	3.5	4572
NALUGODHA B	27	3	3.3	1.5	3.5	3.3	4510
SABATAKI E	26	2	3.0	1.5	3.3	3.0	4368
KADALA H	25	5	3.5	2.0	3.3	3.3	4168
BAKAIRA G	26	3	3.2	1.5	3.3	3.0	4372
BREEDER SEED	29	0.1	2.5	2.0	3.3	3.0	5680
KIGENYI P	27	2	3.5	1.5	3.5	3.0	4636
NALUMANSI	28	4	3.0	1.5	3.3	3.0	4463
KUNYA	28	2	3.0	1.5	3.8	3.0	4522
MUYINGO H	27	6	2.8	1.5	3.3	3.3	4013
BYAKIRASO F	26	3	3.0	2.0	3.3	3.3	4363
LONGE 1 CERTIFIED	30	5	3.3	2.0	3.5	3.0	4224
LONG 1 TOPCROSS	27	4	3.3	1.5	3.5	3.3	3733
LP16(LONGE 4)	27	2	3.3	1.5	3.3	2.5	3963
Min	24		2.5	1.5	3	2.5	3733
Max	30		3.5	2	3.8	3.75	5680
Mean	26.3		3.04		3.2	3.14	409.4
CV	12.57		11.01%		8.57%	12.20%	8.52%
LSD.005	6.8		0.684	NS	0.561	0.786	767.9