

Emergency Programme to Combat the Cassava Mosaic Disease Pandemic in East Africa

A SYSTEM-WIDE WHITEFLY IPM AFFILIATED PROJECT



First Quarterly Technical Report

Phase 2

October-December 1999

International Institute of Tropical Agriculture

February 2000

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I. Executive Summary

Quarterly Report

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Programme title: Emergency Programme to Combat the Cassava Mosaic Disease Pandemic in East Africa

Cooperative Agreement/Grant No: LAG-411-G00-3042-00

Country(ies)/Region(s): UGANDA, KENYA and TANZANIA

Disaster/Hazard: East African CMD Pandemic

Time Covered by This Report: October-December 1999

Activities Summary

Monitoring surveys were conducted in south Nyanza, western Kenya, and the area of Mara region, Tanzania, alongside the Kenya border. In Tanzania, assessments of CMD incidence and severity suggested that there was no significant change in the situation with respect to similar previous surveys. By contrast, a significant increase in both incidence and severity was observed in the Homa Bay-Kendu Bay area of south Nyanza. This represented a southwards shift in the coverage of the CMD pandemic and indicated that the physical barriers of the Winam Gulf and Kano Plains had been overcome.

36ha of new multiplication blocks were established in Rakai and Masaka districts, Uganda, and in Tanzania, further rapid multiplication activities at Ukiriguru and Bukoba have produced the cumulative total of more than 900,000 cuttings of CMD resistant varieties. New multiplication sites were established in Mara region using varieties TMS 4(2) 1425 and TMS 83/01762(6). Multiplication activities on this eastern shoreline of Lake Victoria should facilitate a rapid response to the anticipated southwards expansion of the CMD pandemic from western Kenya. In Kenya, multiplication sites, now totalling 45ha were gapped and weeded, and new potential primary multiplication sites were identified in south Nyanza.

An open quarantine facility covering approximately 5ha was established at ARI-Maruku, Bukoba, Tanzania. Joint action of Ugandan and Tanzanian researchers and plant quarantine staff facilitated the introduction to this site of more than 3ha of CMD resistant variety SS4 from Masaka, Uganda, and more than 500 new elite CMD resistant clones from the EARRNET regional germplasm development programme, Serere, Uganda. An additional 245 new clones were similarly introduced from the EARRNET programme to the western Kenya open quarantine site at Alupe. Evaluations of new germplasm continued in all three countries. A visit was made by the IITA tissue culture specialist to the regional plant quarantine facility, Muguga, Kenya, and recommendations and costings provided for the establishment of cassava tissue culture and virus indexing capabilities.

Training in CMD management was provided through a visit of Tanzanian farmers to counterparts in Uganda, and through stakeholders meetings held in western Kenya. Implementation plans for phase 2 of the Project were developed through stakeholders meetings in Rakai district, Uganda and in western and Nyanza provinces, western Kenya and through the Steering Committee meeting of western Kenya.

II. Programme Overview

A. Goal and Objectives of the Programme

Project Goal: To improve food security and alleviate poverty in the East African region through enhancing the sustainable production of cassava

Project Purpose: To strengthen sustainable production of cassava in areas of Uganda, Kenya and Tanzania most affected by the CMD pandemic through the exchange and development of cassava germplasm and the accelerated multiplication of CMD resistant varieties

Project Objectives:

1. **Monitoring and Diagnostics:** Provide up to date information on the extent of spread of the CMD pandemic and associated viruses and vectors in target areas, and develop forecasts and risk assessments to guide the implementation of control activities
2. **Multiplication:** Accelerate the multiplication of well adapted CMD resistant varieties and facilitate their distribution to farmers impacted by the CMD pandemic
3. **Germplasm diversification and exchange:** Increase the range of cassava materials available to farmers in areas targeted by the Project thereby reducing future risk of production collapse
4. **Training and technology transfer centres:** Provide options for the sustainable development of cassava production in the region through participatory germplasm evaluation and farmer training in pest and disease management and improved processing methods
5. **Project management, monitoring and impact assessment:** Build on links established with a wide range of stakeholders to facilitate effective co-ordination both within target zones and at regional level. Monitor Project impact.

B. Geographic Locations of Major Programme Activities

Country: Uganda

Site/Institution	District	County	Latitude	Longitude	Activity
IITA-ESARC	Mpigi	Kyadondo	0° 31.2' N	32° 32.7' E	Regional co-ordination
IFCD	Rakai	Kyotera			District-based co-ordination
DFI – Rakai	Rakai	Kooki	0° 40.5' S	31° 25.9' E	Multiplication
DFI – Masaka	Masaka	Kalungu	0° 18.3' S	31° 39.6' E	Multiplication/Germplasm
ICR	Rakai	Kakuuto	0° 48.5' S	31° 30.0' E	Germplasm

IITA-ESARC International Institute of Tropical Agriculture – Eastern and Southern Africa Regional Centre

IFCD Irish Foundation for Co-operative Development

DFI District Farm Institute

ICR International Care and Relief

B. Geographic Locations of Major Programme Activities (cont.)

Country: Kenya

Site/Institution	Province	District	Latitude	Longitude	Activity
KARI-Kakamega	Western	Kakamega	0° 17.0' N	34° 46.1' E	Co-ordination, Multiplication, Germplasm
KARI-Alupe	Western	Teso	0° 29.9' N	34° 7.5' E	Multiplication, Open quarantine, Germplasm
KARI-Kibos	Nyanza	Kisumu	0° 2.4' S	34° 49.0' E	Multiplication
FTC-Bungoma	Western	Bungoma	0° 36.0' N	34° 37.3' E	Multiplication
FTC-Siaya	Nyanza	Siaya	0° 5.0' N	34° 19.0' E	Multiplication
FTC-Busia	Western	Busia	0° 27.5' N	34° 6.9' E	Multiplication
FTC-Bukura	Western	Kakamega	0° 13.4' N	34° 37.3' E	Multiplication

KARI Kenya Agricultural Research Institute
FTC Farmer Training Centre

Country: Tanzania

Site/Institution	Region	District	Latitude	Longitude	Activity
Ukiriguru ARI	Mwanza	Mwanza			Co-ordination, germplasm
Maruku ARI	Kagera	Bukoba			Germplasm, Multiplication, Open Quarantine
Nyakasanga	Mwanza	Mwanza			Germplasm, Rapid multiplication
Masalakulungwa	Mwanza	Kwimba			Multiplication

ARI Agricultural Research Institute

III. Programme Performance

A. Progress in Attaining Programme Objectives

Objective # 1: Monitoring and Diagnostics

Kenya

- CMD diseased cassava samples were collected from 15 sites in Western and Nyanza provinces, western Kenya in October 1999. DNA was extracted from each of the samples, and virus diagnoses will be completed during the first quarter of 2000. Both PCR using specific primers and RFLP analyses will be used (Annex 7).
- CMD incidence and severity was assessed at 9 sites in south Nyanza in October 1999. Incidence ranged from 27% to 83%, and CMD was generally more prevalent in the northern part of south Nyanza, between Homa Bay and Kendu Bay. An increased incidence of recently infected plants with severe symptoms suggested that the Homa Bay-Kendu Bay area had recently been affected by the CMD pandemic. Previous virus diagnoses made from samples collected in this area had confirmed the occurrence of the pandemic-associated UgV/EACMV-Ug virus type. These data together provide evidence that the pandemic has been able to overcome the barrier to its southwards spread which was provided by the Winam Gulf of Lake Victoria and the Kano Plains in the Kisumu area.
- Whitefly adults and nymphs were collected from a proportion of sites sampled in the surveys described above. Abundance was generally low, although *B. tabaci* populations fluctuate significantly with seasons, and it was considered therefore that this was a seasonal effect, and not necessarily indicative of overall population levels. Whitefly abundance will be recorded on a more regular basis over full cropping cycles within the multi-locational trials.

Tanzania

- Eight sites in Tarime district, Mara region, immediately south of the Kenya-Tanzania border, were sampled during the survey of western Kenya described above, and CMD severity and incidence assessed. Incidence ranged from 0 to 83%, but averaged only 18.2%. There was wide variability of symptom severity, and there was a general trend towards more severe disease towards the eastern Lake Victoria side of the sampled area. Samples collected for virus diagnosis were preserved, DNA was extracted in Tanzania, and DNA samples were returned to the IITA-ESARC laboratory for analysis during the subsequent quarter. Whitefly adults and nymphs were also collected from a subset of the locations sampled. The overall assessment of the field situation in the part of Tanzania visited was that there appeared to be no clear evidence for the occurrence of the severe CMD characteristic of the pandemic.

Indicator: Risk levels, spread described: Ke – south Nyanza; Tz – Mara, Kagera
Pre/post epidemic whiteflies characterised; > 100 whiteflies characterised

Current Quarter's Measure: Pandemic progress in south Nyanza/Mara updated
Whiteflies collected from 10 sites

Cumulative Project Measure: Pandemic progress in south Nyanza/Mara updated
Whiteflies collected from 10 sites

Objective # 2: Multiplication of CMD resistant varieties

Uganda

- November 1998 planted plantings were ratooned in October 1999 giving 428 bags for the establishment of new multiplication blocks (Annex 1).
- In October 1999, IITA-ESARC supplied an additional 125 bags cv. SS4 to Masaka District Farm Institute to compensate for the loss of mature SS4 used to supply the Open Quarantine site at Bukoba, Tanzania.
- Ratooned stems were redistributed as follows:
 - 10% Open Quarantine, Tanzania
 - 20% Multiplication group for further expansion
 - 35% Multiplier for sale to maintain ratooned gardens
 - 35% IFCD for further multiplication by new groups
- 20ha new multiplication plots were established in Rakai district and 16ha in Masaka district.
- November 1998 (ratooned in 1999) and April 1999 planted plots were maintained.

Tanzania

- Varieties TMS 60142, TMS 30337, TMS 4(2) 1425 and TMS 30572 were multiplied at Ukiriguru and Maruku research stations and these were ratooned later in the season to produce 900,000 cuttings, of which 9,662 were used to establish 0.5ha at Maruku. The remaining cuttings were planted at Nyang'holongo in collaboration with a community-based group.
- Two varieties TMS 4 (2) 1425 and TMS 83/01762 (6) were planted in Mara region in collaboration with MARAFIP at two sites with 11,475 cuttings /site.
- Following the establishment of an open quarantine site at Maruku, Bukoba, multiplication of CMD resistant varieties introduced from Uganda was initiated. Introduced material of variety SS4 was planted in November 1999 at Maruku. The 50 bags introduced planted more than 3ha.
- > 4,000 vines of sweetpotato and > 28,000 minisetts of yams were distributed to farmers in CMD affected zones of Bukoba district to mitigate the immediate effects of the epidemic. These activities were supported by allied OFDA funded projects.

Kenya

- No new planting activities were implemented this quarter.
- Gap filling activities were completed at all sites between late October and early November. Blocks were also weeded during the quarter (Annex 2).
- A total area of 45.2ha is now under cassava bulking with SS4 and Migyera varieties constituting 68% and 32% respectively.
- Potential new primary multiplication areas were identified both in current multiplication sites and at new locations. Negotiations were held with staff from ICIPE's western Kenya station at Mbita Point on the possible use of up to 80ha of land for future primary multiplication in south Nyanza.

Indicator: Ug, Ke. - 3 million stems; Tz. - 2 million stems

Current Quarter's Measure: Tz. - 130,000 stems

Cumulative Project Measure: Ug. – 760,000 stems; Ke. – 450,000 stems;
Tz. – 190,000 stems

Objective # 3: Germplasm Diversification and Exchange

Uganda

- Continued demonstration of nine new cassava varieties at demonstration sites in Masaka and Rakai districts.
- Links established with postharvest researchers for quality profiling studies to be initiated in January 2000.

Tanzania

- An open quarantine facility was established at ARI-Maruku, Bukoba, Tanzania. 50 bags of cuttings of CMD resistant cv. SS4 were imported from Masaka DFI, Uganda and 510 clones from the EARRNET regional germplasm programme, Serere, Uganda. These were used to plant more than 3ha within the open quarantine facility.
- Evaluation of resistance to CMD was completed for 15 varieties in Tanzania. The varieties were evaluated at three sites in pandemic affected areas, Gera (high disease pressure), Bushasha (moderate disease pressure) and ARI-Maruku (low disease pressure). Four varieties were identified with acceptable levels of CMD resistance: TMS 30337, TMS 81983, TMS 4(2) 1425 and TMS 30572(6). Evaluations of 11 additional improved cassava lines from Ukiriguru were continued at three sites in Bukoba district, namely: ARI-Maruku, Mwogo and Nyamgaba. Three varieties appeared to be moderately resistant to CMD. These were: UKG 94/069, UKG 93/003 and Konyo.
- 10,000 *in vitro* plantlets were delivered to ARI-Ukiriguru from Ibadan, Nigeria in May 1999. These were transferred to the field following hardening off in November 1999.

Kenya

- Evaluations continued for the 14 best clones selected from the 600 clones introduced to Alupe from Serere, Uganda. These have been multiplied in preparation for multi-locational trials to be planted in March/April 2000.
- The 172 second best clones selected from the 600 clones at Alupe are being evaluated in preliminary yield trials and cyanide tests performed.
- 12 clones raised from seed are being assessed for resistance to CMD and acceptability to farmers in on-farm trials.
- 245 new clones were introduced from the EARRNET regional germplasm programme, Serere, Uganda to Alupe Open Quarantine in November 1999.
- In December 1999, 10 *in vitro* clones were introduced from IITA-Ibadan.
- The IITA tissue culture specialist visited KEPHIS, Nairobi, Kenya, from December 7-9, 1999. An assessment was made of the requirements for strengthening regional plant quarantine/tissue culture/virus indexing facilities for cassava (Annex 8).

Indicator: Clones introduced: Tz > 100 Vars. evaluated: Tz > 25; Ke > 15;
Vars to multiplication: Ke > 5; Ug > 5
Open Quarantine (OQ): Tz > 2ha SS4; Regional meeting

Current Quarter's Measure: Clones introduced: Tz = 510; Ke = 245
Vars evaluated: Tz = 15; OQ: Tz > 3ha SS4 + meeting

Cumulative Project Measure: Clones introduced: Tz = 510; Ke = 245
Vars evaluated: Tz = 15; OQ: Tz > 3ha SS4 + meeting

Objective # 4: Training and Technology Transfer Centres

Uganda

- Farmers in new multiplication sites trained in CMD management and rapid multiplication techniques.
- Extension workers trained in ratooning techniques used in cassava multiplication.
- Group of 13 farmers and research staff from Tanzania hosted by IITA, NARO and farmers groups in Uganda. Exchange of information between farmers on cassava farming techniques, pest/disease management and postharvest utilisation facilitated and technical training provided by IITA/NARO researchers (Annex 5).
- Research assistant trained in CMD aetiology, epidemiology and management at IITA-ESARC. Training provided for DNA extraction for virus diagnostics.

Tanzania

- Participation of farmers and researchers in Uganda visit (above).

Kenya

- Training on CMD in western Kenya provided through Stakeholders Workshops to 135 participants from Nyanza and Western provinces.
- Research assistant trained in DNA extraction for virus diagnostics.

Indicator:

Tech. Trans. Centres: Ug, Ke, Tz: 4 each
Farmers trained: Ug, Ke, Tz: > 400 each
Ag. Workers trained: Ug, Ke, Tz: > 50 each

Current Quarter's Measure:

Farmers trained: Tz = 9
Ag. Workers trained: Ke = 135

Cumulative Project Measure:

Farmers trained: Tz = 9
Ag. Workers trained: Ke = 135

Objective # 5: Project Management, Monitoring and Impact Assessment

Uganda

- Stakeholders in the multiplication programme in Rakai and Masaka districts met from 13th-18th September to discuss ratooning of the November 1998 planted crop and implementation plans for 1999/2000 (Annex 6).
- Two Uganda research assistants from IITA-ESARC and NARO participated in the Western Kenya Cassava Steering Committee Meeting, 17th-22nd October, 1999.
- IITA-ESARC and NARO staff participated in an evaluation of western Kenya multiplication sites, October 18-20, 1999.

Kenya

- The second Steering Committee Meeting for Cassava in Western Kenya was held from 21st-22nd October, 1999 and an implementation plan for activities for 2000 developed.
- 74 cassava stakeholders; comprising researchers, extension staff, councillors, farmers and NGO workers participated in the Nyanza province stakeholders planning meeting, 30th November, 1999.
- 61 cassava stakeholders; comprising researchers, extension staff, councillors, farmers and NGO workers participated in the Western province stakeholders planning meeting, 22nd December, 1999.

Tanzania

- A staff member from the Tanzania Root and Tuber Crops Programme participated in the Western Kenya Cassava Steering Committee Meeting, 17th-22nd October, 1999.
- The Mara Farmers' Initiative Project (MARAFIP), Mara region, was integrated into the cassava multiplication programme for the first time.
- Collaboration with KAEMP was strengthened and complementary funding agreed for the establishment of the open quarantine site, Bukoba.

Indicator:

Steering Committees: Ug, Tz
Stakeholder implementation plans: Ug, Ke, Tz
Impact reports: Ug, Ke, Tz

Current Quarter's Measure:

Stakeholder workshops: Ke (Nyanza and Western)
Implementation plans: Ke (Nyanza and Western)
Stakeholder meeting, implementation plan: Ug

Cumulative Project Measure:

Stakeholder workshops: Ke (Nyanza and Western)
Implementation plans: Ke (Nyanza and Western)
Stakeholder meeting, implementation plan: Ug

B. Programme Success Stories

Open Quarantine (OQ) is established in Tanzania

The speed of expansion of the pandemic of severe CMD in Kagera region in north-western Tanzania has been even more rapid than hitherto experienced in areas affected by the pandemic in Uganda and western Kenya. A rapid response was therefore critical in order to speed recovery from the cassava production collapse which is typically associated with the passage of the pandemic. A major objective of the OFDA CMD Project has therefore been to facilitate regional initiatives to transfer the open quarantine (OQ) approach from western Kenya, where it has proved to be very successful, to north-western Tanzania. This would then facilitate the importation to Tanzania of some of the best new CMD resistant cassava varieties and experimental material that is currently available in Uganda. An important stepping stone to the establishment of OQ in Tanzania was the organisation of study tours to OQ, Alupe, western Kenya and to the EARRNET regional germplasm development programme based at Serere, Uganda, which involved plant quarantine staff from Uganda, Kenya and Tanzania. A second key stage was the advocacy provided by Tanzanian plant quarantine staff and root crops programme researchers required to convince legislating authorities that this approach was both necessary and appropriate. Final approval was received for the establishment of an OQ site at ARI-Maruku, Bukoba, Tanzania in the third quarter of 1999, but it was not until October that plans were fully realised, with the transfer and planting of CMD resistant germplasm from Uganda, and the physical construction of the OQ site perimeter. This is considered to be a major achievement, for which the OFDA CMD Project has played a key facilitating role.

A first step is taken in the long term strengthening of regional germplasm exchange

Whilst the severe CMD associated with the pandemic has to date had a major impact only on a restricted area of the East African region, the potential for continued regional expansion and further spread to other countries is significant. In order to take a pro-active approach to tackling this potential problem in as yet unaffected countries, it would clearly be useful if strategic quantities of germplasm with known resistance to severe CMD could be sited in these countries 'in readiness' for a deterioration in the CMD situation. Since movement of vegetative material carries the risk of carrying the cassava mosaic geminiviruses responsible for the severe pandemic CMD, there is an evident need to be able to move material in virus-tested tissue culture form. Phase 2 of the OFDA CMD Project plans to take a key role in facilitating such an approach through contributing to the strengthening of the regional plant quarantine facility of the Kenya Plant Health Inspectorate Service (KEPHIS), based at Muguga, Nairobi. The first important step in this initiative was taken during the first quarter of the second phase of the OFDA Project, and comprised an assessment of currently available facilities and future needs by an IITA tissue culture specialist, Dr. Shou Yong Ng. Although the total cost of the rehabilitation needed will require the sourcing of additional funds to those currently available through the OFDA Project and EARRNET, it is anticipated that the first tissue culture work with cassava virus

indexing will be initiated during phase 2 of the Project. This will represent a further key success in the regional strategy to tackle the CMD pandemic.

C. Problems in Achieving Programme Activities

There were no major impediments to implementation of Project activities during the October-December 1999 quarter. Minor difficulties, however included:

1. Lack of clarity with respect to the responsibilities of multiplying partners in Rakai and Masaka districts, Uganda. This will be discussed and resolved with key players in the Ugandan work in February 2000.
2. Problems associated with the flow of funds through to multipliers in western Kenya. This issue was discussed and resolved during the SC meeting held in October 1999.
3. The departure of the cassava virologist of the Tanzania Root and Tuber Crops Programme for alternative employment at the end of 1999. A replacement will be identified and trained during the first quarter of 2000.
4. Lack of reliable transport in western Kenya and north-western Tanzania. The OFDA CMD Project is to share the cost of purchase of a vehicle for western Kenya and to purchase a motorbike for Tanzania, both during the first half of 2000.

Annex 1

Stakeholder Linkages and Details of Multiplication Activities in Uganda (Masaka and Rakai districts)

J. Ssennoga, Irish Foundation for Co-operative Development (IFCD)

1. Introduction

The Irish Foundation for Co-operative Development (IFCD) works with two categories of farmers:

- a) Vulnerable household families e.g. orphaned, widowed, elderly or female-headed families
- b) Potential commercial farmers i.e. those with the capacity to produce for commercial markets

2. IFCD operations

The IFCD programmes are geared toward the re-establishment of the co-operative movement in Rakai and Masaka districts as well as ensuring food security in the area. In dealing with potential commercial farmers, higher yields can be achieved thus reinstating co-operative marketing and re-introducing high incomes to families. IFCD channelled its aid through the existing groupings by collaborating with the other non-governmental organisations (NGOs) in the project area. IFCD thus provided grants to the groups in the form of high yielding seeds (beans and maize) for planting. For mosaic resistant cassava multiplication, IFCD closely collaborated with IITA. Vulnerable household groups and the District Farm Institutes were involved in Phase I of this programme because the cuttings were not sufficient for distribution to individual farmers (see table 1). The District Agricultural Offices provided the technical assistance and extension services. IFCD and IITA carried out the monitoring.

Phase II of the programme is being carried out by individual farmers and the District Farm Institutes (see table 2)

3. Resistant CMD multiplication Phase I

During November 1998, 300 bags of SS4 cassava cuttings were received for multiplication purposes. Delays in the delivery of planting material and unusually dry weather conditions led to poor germination of the cuttings delivered. The effective area under the crop was therefore restricted to 6.9ha (3.6ha in Masaka and 3.3ha in Rakai) instead of the planned 30ha. The targeted 30ha were achieved in April 1999 when a further 575 bags of SS4 cassava cuttings were delivered. These were used for gap filling and planting in the prepared fields that were left over when the cuttings

were insufficient in November 1998. The 300 bags of cuttings planted during November 1998 were ratooned between October and December 1999, giving 428 bags of cuttings. This reflects over 62 bags of cuttings per hectare. These were in turn redistributed as follows:

- 10% IITA (ESARC) – for open quarantine in Tanzania
- 20% Multiplication group for further expansion
- 35% Multiplier for sale to maintain ratooned gardens
- 35% IFCD for further multiplication by new groups

4. Implementation experience

Groups already being reached by other organisations working in Rakai and Masaka did a commendable job. This, however, meant having small multiplication centres scattered all over the two districts. This rendered monitoring and supervision cumbersome and expensive. To overcome this in the second phase of the multiplication process, IFCD has opted to work directly with farmers (with plots of at least 0.4ha) who are recommended by the partner organisations that IFCD is working with. The following observations were made on the response of partners to the new ratooning and replanting exercise:

1. A small number of partner NGOs did not fully support the groups with the extension service as expected. Roguing was not carried out immediately, thus CMD incidence was unnecessarily high in some plots.
2. Some partner NGOs did not fully understand the multiplication and re-distribution exercise (using the agreed percentages). They assumed that IITA/IFCD would continue providing cuttings for expansion.

5. Training

1. Stakeholders meetings were held in both Masaka and Rakai districts in September and October 1998 during which the District Agricultural Officers, IFCD extension workers and the partner NGOs planned the implementation of the resistant cassava multiplication.
2. CMD workshops were conducted during December 1998 in both districts for the extension staff involved in the programme.
3. A workshop for planning the ratooning exercise and Phase II activities was conducted in September 1999.
4. A biological control workshop (green mite) for agricultural extension workers was conducted in Rakai in November 1999. This was funded through the IITA/NARO cassava green mite bio-control project.

The ratooned cuttings brought the programme into Phase II. With the additional 125 bags from IITA to Masaka District Farm Institute, 37 hectares were planted in the project area (16 ha in Masaka and 21ha in Rakai) between October and December 1999. These will be ratooned in November 2000. The original plots (see table 1) will be ready for ratooning by March 2000.

6. Acknowledgements

On behalf of the farmers in the districts of Rakai and Masaka, IFCD would like to thank IITA/ESARC for the support rendered to them in ensuring food security in the project area. IFCD welcomes further collaboration with IITA in the implementation of any other project aimed at promoting food security.

Table 1. NGOs with which IFCD collaborates in Masaka and Rakai

Rakai district

Rakai District Authority	3.8 hectares
Lutheran World Federation/ Raca	1.6 hectares
Concern Worldwide	1.6 hectares
International Care and Relief (ICR)	1.6 hectares
Orphans Community Based Organisation (OCBO)	1.6 hectares
Masaka Diocesan Development Organisation (MADDO)	1.6 hectares
Kitovu Mobile	1.6 hectares
Women's Enterprise Association of Rakai (WEAR)	1.6 hectares

Masaka district

Masaka District Authority	5.4 hectares
World Vision	3.2 hectares
Masaka Diocesan Development Organisation (MADDO)	2.4 hectares
Kitovu Mobile	2.4 hectares
Redd Barna	1.6 hectares

Table 2. Phase II site number and area by county

County	Number of sites	Estimated hectares
Kabula	4	3.6
Bukoto	3	4.8
Kalungu	13	5.6
Kyotera	3	3.2
Kooki	8	8
Kakuuto	7	6.4
Masaka D.A	1	5.6
TOTAL	38	37.2

Annex 2

Cassava Programme in Western Kenya Quarterly Report, October-December 1999

H. M. Obiero, RRC Kakamega

1. Introduction

Cassava is an important food security crop in Western and Nyanza provinces. The crop yields well even under stress of moisture and low soil fertility. Yields which farmers realised in the past years before the on-set of the CMD epidemic were 7-10 t/ha.

In 1997, the disease had spread up to south Nyanza through Siaya. Almost 80-100% of plants of all the traditional varieties have been infected.

The two CMD resistant varieties, which were introduced in 1997 into open quarantine at KARI-Alupe, have been propagated using rapid multiplication techniques. The initial mother block was 0.2ha of each variety and by December 1999 there were a total of 45ha covered by the crop. At the start of the long rains in the year 2000, there will be sufficient planting material of the two varieties to cover 280ha. Much of this area is expected to be planted at the secondary level by stakeholders who will include NGOs, farmer groups and individuals.

2. Field trip to multiplication sites and data collection for germplasm evaluation

Two KARI scientists and a research associate with EARRNET conducted a field trip to all the seven primary cassava multiplication sites in western Kenya on 29th and 30th September 1999. Performance of the material was evaluated with respect to attack by CMD, CBB, CGM, and the general management of the crop was assessed.

All fields had cassava which was free from the major pests and diseases, although they were weedy and required immediate attention. Recommendations were made and multiplying institutions were provided with funds to weed immediately. It was also noticed that the plant population in most fields was 60-70%. Bungoma FTC had the lowest plant population of probably less than 40%.

The team collected data on germplasm trials as from 1st October 1999. Data collected was on CMD, CBB and the general morphology of the crop, which included branching and branching height.

3. Cassava steering committee meeting held at Kakamega, October 17th – 22nd, 1999.

The meeting was attended by two donor representatives, the EARRNET co-ordinator, the EARRNET agronomist, the RRC Kakamega centre director and agronomist, the national cassava co-ordinator, an NGO representative, two farmer representatives from the two provinces and two provincial crops officers from Nyanza and Western provinces. Also in attendance were two researchers from Tanzania, two from Uganda and one research student from Kenya. The steering committee members spent the first two days visiting the seven primary multiplication sites. Two further days were spent discussing progress reports, finances and the way forward.

Resolutions

- . Provincial crops officers to convene stakeholder workshops to discuss the way forward on secondary multiplication of the two resistant cassava varieties in their respective provinces. Also to discuss on-farm testing of the selected promising cassava clones at multi-locational sites in varied agro-ecological zones.
- . Train extension field staff and participating stakeholders on general agronomy of cassava, rapid multiplication techniques, identification of CMD and control methods. Resource persons will be district crops officers.
- . Researchers to draft modalities for the on-farm trials and produce budget estimates.
- . Gapping to be done within two weeks from the time of the meeting.
- . Steering Committee chairman to inform FTC principals about the change of management of the multiplication programme and that they are responsible for the maintenance of the material with financial facilitation from KARI-Kakamega.
- . Billboards to be erected in all multiplication sites.
- . A sub-committee to be formed in March 2000 to review progress made and address any other issues that may have arisen.
- . Some farmers to have a field trip to Uganda to discuss experiences of control of the CMD epidemic with Ugandan counterparts.

4. Stakeholder workshops in Nyanza and Western provinces

a) Nyanza

The stakeholder workshop for Nyanza province was conducted on 30th November 1999. The deputy provincial commissioner, Nyanza, Mr. Aggrey Mudinyu opened the workshop, which was attended by more than seventy-four stakeholders. The

stakeholders came from nine districts of the province. They included researchers, district agricultural officers, councillors, farmers and NGO representatives.

KARI scientists presented progress of the cassava programme in the region to the stakeholders. Activities and proposals for the next phase were also presented. The stakeholders were told that the purpose of the meeting was to request them to participate in the proposed phase, which included secondary multiplication of SS4 and Migyera cassava varieties, and on-station/on-farm testing of selected promising cassava clones. Farmer and NGO representatives also gave their views on the proposal. After a lengthy discussion, the following resolutions were agreed.

1. Each district will form a Steering Committee by 14th December 1999.
2. Each district will submit a report to the provincial crops officer detailing the following:
 - The part which each stakeholder will play in multiplication, delivery and distribution,
 - The time when crops officers will conduct training for relevant stakeholders. Details of the framework of events should be included in the report. The provincial crops officer will discuss these details and their implementation with KARI scientists based in Kakamega.

b) **Western province**

The stakeholders meeting for Western province was conducted on 22nd December 1999. The meeting was opened by the centre director, RRC Kakamega. A full report is provided in Annex 4.

5. Gapping and maintenance of multiplication and germplasm fields

Multiplication

Following the recommendation of the Cassava Steering Committee of 17th-22nd October, gapping operations commenced immediately as indicated below:

Bukura FTC. Gapping done on three-quarters of the field on 26th October to 1st November with materials from KARI-Kibos.

Siaya FTC. Gapping done on 26th-29th October with materials from the same field.

KARI-Alupe. Gapping done from 26th October to 15th November with SS4 cuttings taken from mother blocks at Alupe and Busia FTC.

KARI-Kakamega. Gapping done on part of the field from 26th-29th October.

Bungoma FTC. The entire field of Bungoma FTC was gapped from 1st-5th November with materials from KARI-Kibos.

Busia FTC. Gapped from 26th October to 5th November.

6. Germplasm

189 clones were received at Alupe on 7th November and were planted on 8th November. The weather was favourable since there was good rainfall and germination was good.

Cyanin tests were conducted on the 176 performance evaluation and 56 quarantine clones between 22nd and 30th November.

7. Maintenance and guarding of multiplication and germplasm fields

KARI-Kakamega. The 8ha multiplication field at KARI-Kakamega was hand weeded 3 times. Fast growing weeds were hand-pulled once. The field is in good condition with a plant population of approximately 70%. A little over 1% of plants showed CMD symptoms and these were rogued. The main source of infection appeared to be whiteflies since symptoms were apparent on younger leaves only.

KARI-Alupe. Three hand weedings were done in all fields during the October to December quarter. Fields 20 and 21 were guarded from October to prevent destruction by monkeys. Guarding was reinforced in December, especially at night for fields 20 and 21, because of human theft of stems and tuberous roots.

Bungoma FTC. Three hand weedings were done during the quarter. This particular field has a variety of problems, which were compounded by poor rainfall during the quarter. "Roundup" was purchased for weed control but could not be used due to the prevailing dry weather conditions. Moles and theft are additional problems. To control theft, a guard was put in place. Available materials will be ready during the long rains in the year 2000.

Siaya FTC. Three hand weedings were done during the quarter. The incidence of CMD in the field was recorded as approximately 1%, and these plants were removed. The materials will be ready for the long rains planting in the year 2000.

Bukura FTC. Three weeding were done during the quarter and the gapping done was successful. The field was fenced to protect and guard the crop. A small number of CMD diseased plants was observed and removed, mostly of variety Migyera.

KARI Kibos. On 2nd December 1999, discussions were held with the director, Kibos, and he was requested to manage the cassava materials at his centre. The field was becoming weedy and a budget was therefore developed for the weeding work required. Funds were advanced to the station and weeding was completed during the quarter. A small number of off-types are still present in the Kibos field.

Busia FTC. The initial 0.8ha of SS4 and Migyera was weeded three times. The newer area of 2.8ha of SS4 was weeded twice and CMD diseased plants removed. Many of these plants have been found to be Migyera.

8. Pledges for the expansion of multiplication

Siaya FTC. 1.6-2ha already ploughed in readiness to plant SS4 in the year 2000.

Bungoma FTC. 4.8ha made available for expansion and funds have been provided for the purpose of ploughing it in preparation for the long rains.

Other institutions. Bukura and Alupe were yet to provide information on areas available for expansion. Additional areas for primary multiplication in Nyanza province were discussed during the Nyanza stakeholders meeting. Potential sites proposed included Homa Bay FTC, KARI-Oyani and ICIPE (Kuja River).

9. Funding of the cassava project by Gatsby and OFDA.

The Regional Research Centre Kakamega account has been credited three times since September 1999. In September and on 16th October amounts credited were USD 3,000 and USD 10,000 (Ksh 217,856 and Ksh 734,800). These funds were received from the Gatsby Charitable Foundation. On 3rd December a further USD 10,000 (Ksh 729,300) was credited to the account. This was received from OFDA.

These funds have been used in maintaining all primary cassava multiplication sites in western Kenya, cassava materials in open quarantine at KARI-Alupe and in facilitating the Steering Committee Meeting at Kakamega and stakeholders workshops in Nyanza and Western provinces.

10. The way forward into the year 2000

Nyanza Province

a) Four institutions will provide land for primary cassava multiplication:

- 1) Maseno FTC
- 2) Homa Bay FTC
- 3) ICIPE-Kuja River
- 4) KARI-Oyani

Materials of SS4 and Migyera that will be allocated for this purpose during the long rains may cover 70ha. Materials to cover another 70ha will be allocated to other stakeholders such as NGOs, CBOs, or farmer groups.

b) Fourteen selected promising clones will be planted for multi-locational testing at four sites in the following districts:

- 1) Siaya or Bondo
- 2) Kisumu or Nyando
- 3) Homa Bay or Rachuonyo
- 4) Migori or Kuria or Suba

c) Multi-locational evaluation of twenty selected clones will be done at the following institutions:

- 1) Maseno FTC
- 2) Homa Bay FTC
- 3) KARI-Oyani
- 4) KARI-Kibos

The purpose of the multi-location trials is to evaluate a wide diversity of improved germplasm under varied agro-ecological conditions.

Western Province

a) Materials sufficient to plant approximately 140ha will be allocated to farmers in Western province. Some of the materials will go for expansion of some of the primary sites and other materials will be given to NGOs, CBOs and farmer groups for secondary level multiplication.

b) Multi-locational trials of the fourteen promising clones will be planted in the following districts:

- 1) Teso/Busia
- 2) Bungoma
- 3) Butere/Mumias
- 4) Kakamega

c) Multi-locational testing of the additional twenty promising selected clones will be done at the following institutions:

- 1) KARI-Kakamega
- 2) Busia FTC
- 3) Bungoma FTC
- 4) Bukura FTC

Varieties that will be selected by farmers will get into the multiplication stream in the year 2001.

11. Other Activities

Training

There will be training of the extension officers and others involved in project implementation by the district crops officers at district and front-line level between January and March 2000.

Field days

Field days for farmers and extension officers will be held to evaluate the varieties taken on-farm. Suitable varieties will be selected for further multiplication in the year 2001. The field days are likely to be in November/December 2000.

12. Constraints

▪ Funds

Activities envisaged for the year 2000 will be significantly more extensive and therefore costly than those of the previous year. Funding agencies should be aware of this potential constraint.

▪ Transport

The lack of reliable transport still remains a serious hindrance to the smooth co-ordination of Project activities.

13. Acknowledgements

I gratefully thank the Gatsby Charitable Foundation and OFDA for the financial support that has enabled Kenya realize the amount of work achieved in the past few years. I kindly request these agencies to continue supporting us so that even greater success can be achieved in the immediate future.

I would also like to thank the EARRNET Co-ordinator and his entire staff as well as IITA for their valuable technical collaboration and back up.

I would like to thank the director, KARI and RRC centre director for their continued advice. Lastly, thanks to all the researchers and extension personnel with whom we have been collaborating in this programme.

Annex 3

Stakeholders Meeting on Cassava Multiplication in Nyanza Province, Western Kenya – 30th November 1999

The meeting started with a word of prayer from one of the members. This was followed by self-introduction.

1. Introduction

The chairman appreciated the work that the NGOs have been doing on cassava multiplication. The meeting comprised stakeholders from various institutions and their presence was warmly welcomed. The participation of the donor community was also appreciated.

Cassava is important in Nyanza Province as a food security crop. It is a vital substitute for maize during periods of drought. Cassava in much of western Kenya has been affected by a devastating epidemic of cassava mosaic disease (CMD), which has spread from the Uganda border area to south Nyanza. Therefore we wish that after the workshop we will come up with solutions that will help reduce the spread of the disease. We also need to come up with solutions on how we are going to sustain the clean material and how best we can restrict diseased materials from coming in from neighbouring districts or countries. The chairman then called Mr. Kamau to give further introductory remarks.

2. Opening remarks

The chairman welcomed the provincial commissioner's (PC) representative and introduced the members of the workshop. He continued by informing the PC's representative that cassava is a very important crop in Nyanza and the aim of the workshop was to find a solution to arresting the spread and ameliorating the effects of CMD. He also informed the PC's representative about the various stakeholders and those organisations that have been at the forefront as far as cassava rapid multiplication is concerned. The PC's representative welcomed the members to Kisumu and thanked the organisers for having invited him to open the workshop. Nyanza Province requires about 9 million bags of maize. Cassava forms 55% of the food crop produced. Its production has been declining for the last five years. He appreciated the work being done by various organisations to arrest the situation e.g. KARI, donor agencies, the East African Root Crops Research Network (EARRNET) and the Ministry of Agriculture. The decline in yields and area of cassava has been due to CMD, mealybug, cassava bacterial blight, green mite and unavailability of clean planting materials. The disease entered into the province from Uganda and has now spread to Kuria. KARI has screened and multiplied two varieties that are tolerant to CMD. These are SS4 and Migyera. It is now necessary to multiply the crop. Therefore, to arrest the situation, it is important to have a workshop such as this

to discuss how to multiply the crop at institutions and in farmers' fields for distribution to other farms. We hope that the research will come up with more tolerant varieties, that extension workers will pass on technical knowledge to farmers and that the donors will continue giving the necessary support for cassava multiplication. The PC then officially opened the workshop.

3. An overview of the cassava multiplication programme in Kenya - KARI - Mr. Kamau

The problem started in 1995-1996. This was in Busia/Siaya and the complaint was taken to the Ministry of Agriculture then finally to KARI. Later on, the issue was followed up by KARI and LAGROTECH. Projects to tackle the situation were then developed and received funding from donor agencies. In 1997 the first stakeholders meeting was held and all the DAOs, Crops Officers and a number of farmers attended the workshop from Western province. Nyanza was represented by the provincial head, Kisumu district and Siaya. Dr. Onim represented LAGROTECH. During the meeting the following issues were discussed: where to get land to multiply the new varieties, how to distribute the material and who should be involved in the training. Germplasm was to be brought from neighbouring countries, held in open quarantine for a year, and the tolerant varieties were subsequently to be released. These were SS4 and Migyera. Initially there was 0.2ha of each of SS4 and Migyera at the open quarantine site. This material was subsequently used to set up primary multiplication sites at: KARI Kibos, KARI Alupe, Busia FTC, Bungoma FTC, Siaya FTC, Bukura FTC and KARI Kakamega. By the end of 1999, the total area was more than 40ha.

In March 1999, a Steering Committee was formed to oversee the cassava activities in western Kenya and to plan the multiplication and distribution of resistant varieties. A second meeting was held in October 1999. The committee consisted of members from KARI, PCOs, farmer representatives, NGOs, EARRNET, IITA and donors. During the meeting it was agreed that DALEOs, DAOs and crops officers were to be trained. This has subsequently been done. The training was on agronomy and cassava products.

4. What KARI has been doing?

In addition to the SS4 and Migyera cassava varieties currently being multiplied, 600 more CMD resistant clones have been introduced to the country through open quarantine. In May 1999, the best 14 clones were selected and their multiplication initiated. They will be planted in on-farm trials during the long rains of 2000. It is for the members of the workshop/farms to inform the researchers on which amongst the 14 are acceptable in terms of yield and quality characteristics. Others are still being bred/selected, and by 2001 more should be available for on-farm testing. Farmers are to assist in the management of the crop and they will again be expected to choose from the full group the ones they feel they like most. The breeding programme will continue to generate more germplasm.

5. The Objectives/Purpose of meeting

During the Western Kenya Steering Committee Meeting of October, it was agreed that the area of cassava under multiplication should be increased in Nyanza. Each district is to plant 20 ha. They will be provided with planting materials and the DALEOs will have to inform the Steering Committee on how they will multiply the material i.e. who will bring the materials, who will provide labour, who will contribute land etc. An additional 60 ha was earmarked for primary level multiplication, and potential sites for this were suggested as Homa Bay FTC, KARI-Oyani, and ICIPE (Kuja River).

6. Remarks from the Group

- 1) Kind of problems they are expected to encounter.
Late land preparation can lead to production problems. Interfering with roots during the weeding will affect production therefore land should be properly prepared so as to reduce the weed population, though other problems like theft are expected.
- 2) Are there problems of animals\ destruction of the crop?
Apart from CMD, the other problems are minor, but these include squirrels, porcupines, mealybugs and green mite.
- 3) What is the period to reach maturity?
SS₄ - 9 months to 1 year.
- 4) What area of land are farmers expected to give for the 14 clones to be tried?
Management of the crop - this is fully the responsibility of the farmer.
Replication of the 14 clones - 3 plots of the same clone. The size of the plots has not yet been determined.
- 5) Intercropping - no intercropping for trial plots but under normal cassava production, you can intercrop with the low crops e.g. beans, groundnuts, grams.
- 6) How do you differentiate the sweet from the poisonous varieties?
SS₄ is sweet (low cyanide) and can be eaten boiled from fresh. Migyera is considered to be a 'processing' variety, and is best processed before consumption.

7. Overview from the Farmer Representative:

Report from a Farmer Representative - Norman Oduor

The farmer representative informed the group that he has been involved in the overall programme. He informed the workshop that the farmers did not know about CMD. In 1994, farmers wrote a project on cassava production. The farmers know that there has been a decline in production due to the disease/pest and also poor marketing i.e. no marketing incentive. Soil infertility in the region and land unavailability have also

contributed to production declines. High yielding varieties are also lacking and some users lack knowledge. Therefore, during the workshop, farmers should discuss how to solve all the problems contributing to production declines. Cassava production was quite high in previous years. Farmers feel that participation of all stakeholders is important and the role of each stakeholder must be identified. The farmer participation, e.g. by providing land for the second stage of multiplication, is very important. Farmers should also be able to provide labour. There must be an organisation responsible for farmer empowerment i.e. the farmers should inform the Government what they want to do rather than being told what to do by the Government. The right varieties should be supplied to areas that are conducive to such varieties. KARI should eliminate unwanted varieties once the evaluation trials are over. The agricultural technical staff are important to ensure the training of both staff and farmers, and also to ensure that the right technical information is passed on. NGOs should also assist in the production because they can identify and train those relevant scientists who can assist in production, and they can assist in availing or searching for funds for cassava production. The provincial administration should also not be left out because it can assist in mobilising the local people.

8. Remarks from the Group

- 1) There is a need for the Government to set up a policy on cassava so that growing of cassava can be taken more seriously. This can only be done if other users are identified. The reaction from the farmer representative was that it is for the farmers to come up with a policy and submit it to the Government but not vice versa.
- 2) Some farmers complained of the lack of a market for cassava. The KARI cassava programme head suggested that the local market has not been exhausted; there was still much unexploited potential. Industries using cassava have to import cassava from Uganda and Tanzania. Countries like South Africa requested large quantities of dried cassava per week but this could not be met. Cassava leaves are also used to manufacture livestock feed.
- 3) One of the farmers felt that instead of concentrating on cassava alone, it is important that other root crops e.g. sweet potatoes should be considered. The new sweet potato released - K4 (Kakamega 4) is a very good variety and the meeting was informed that there is a programme on sweet potato multiplication based at Kakamega Research Station.

Stakeholders' roles, activities to be carried out and reporting were discussed.

9. Time frame

- When does the district send report on who's formed the Steering Committee and who will do what?
- When are you expected to be given material for planting? - this will be in March 2000. This will be the distribution of material for 20ha.

- Planting should be done in the month of March.
- Training of stakeholders/members for Steering Committee - this should be done before distribution.

The district have identified members to make up the District Steering Committees by 14th December 1999.

By 30th December 1999 districts should have produced reports on:

- 1) Who will undertake which activity
- 3) When the crops officer is going to conduct the training
- 4) Details on extent of land preparation
- 5) Timetable of events

Stakeholders were advised that they should not plant on black cotton soils, but rather on sandy and red soils. On shallow soils planting should be deep but this will affect the yields. Swampy places should be avoided.

10. On-farm trials and training by KARI

- Data collection should be undertaken by KARI staff. NGO staff within the locality will participate with farmers in the selection of the best variety among the 14 clones.
- Trials for the selection from the 176 clones currently in performance evaluation will be done at KARI-Alupe. A further 20 will be selected from these for on-farm testing in 2001. Institutions selected for trials are Mbita-ICIPE, Maseno FTC and KARI-Kibos. An average of 0.24ha needed from every site. There are six institutions to conduct the trials.

11. Closing remarks from PDALE

The PDALE thanked all the stakeholders who managed to get time to come and take part in the workshop. The number who attended overshot the target and this shows the level of seriousness that people have about the crop. He especially thanked councillors and NGOs. The PC who was supposed to come and open the workshop informed the PDALE to tell the meeting that we have to come out with a strategy to eradicate poverty. Even though it is difficult, the starting point is to produce sufficient food in Nyanza. People should be discouraged from having an idea that they should be given free things, but cost sharing is what is required. Total involvement of all the stakeholders is what is important. We have been trained together. You are now expected to form Steering Committees in your districts. From this meeting we are now expected to go and sensitise people to plant cassava. The PDALE finally ended the meeting by thanking the donors and wished the participants a safe journey back to their stations.

LIST OF PARTICIPANTS:

No.	NAME	ORGANIZATION	ADDRESS
1	J.W. Kamau	KARI	Box 340, Machakos
2	H.O. Mugeni	MoA&RD	Box 430, Bondo
3	Oyugi Amos	LAGROTECH	Box 1244, Kisumu
4	Nelson Tolo	LAGROTECH	Box 1244, Kisumu
5	Beatrice A. Nyongoro	LAGROTECH	Box 1244, Kisumu
6	Rose A. Ooko	LAGROTECH	Box 1244, Kisumu
7	C.A.O. Odongo	MoA&RD	Box 71, Homa Bay
8	Benter A. Adera	MoA&RD	Box 71, Homa Bay
9	Olive Akoth	AEP	Box 362, Homa Bay
10	Rafael P. Ongondo	Farmer	Box 497, Homa Bay
11	Moses Onim	LAGROTECH	Box 1244, Kisumu
12	Joseph Otengo	Cllr. Suba	Box 135, Magunga, Suba
13	Peter Nyongesa	ICIPE	Box 30, Mbita
14	Joyce Aluoch	MoA&RD	Box 1958, Kisumu
15	A.N. Baraza	MoA&RD	Box 1700, Kisumu
16	Nelson Nyangile Reuben	Farmer/LOMIZONE Services	Box 995, Suna-Migori
17	Joash A. Aduola	Cllr. M.C.C.	Box 985, Suna-Migori
18	Cllr. Zablon Aloo-Ogola	Bondon T. Council	Box 589, Bondo
19	J.N. Olum Oludhe	NALDO (NGO)	Box 53, Ndori
20	Easther Boke Mosabi	Farmer representative	Box 81, Kehancha
21	Felix Chacha	AEP	Box 362, Homabay
22	Wycliffe Okumu	MoAL&RD	Box 1958, Kisumu
23	Cllr. Jeash Akuku Apamo	Farmer	Box 149, Pap-Onditi
24	Lawrence Akeyo	Farmer	Box 149, Pap-Onditi

LIST OF PARTICIPANTS (cont.):

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25	J.O. Nyanapah	DAO-Kuria	Box 81, Kihancha
26	Barrack Guya	Interdiocesan Christian Community Services	Box 2490, Kisumu
27	Peter Orindo	Farmer, Upper Nyakach	Box 66
28	Peter Onoka	Farmer	Box 10, Kosele
29	Dr. John R. Rono	KARI - NSRC	Box 1221, Kisumu
30	John Ogecha	KARI	Box 523, Kisii
31	Priscillah Oluoch	O.I.P	Box 355, Oyugis
32	Dismass Okello	SCODP	Box 5, Sega
33	Ombalo D.O.	DAO, Nyando	Box 125, Ahero
34	George M. Tito	Ext. Officer	Box 362, Homa Bay
35	Pius Abonyo	Farmer	Box 340, Bondo
36	Joseph H. Odhok	MoA&RD	Box 66, Oyugis
36	Ireru D.N.	D.C.O	Box 29, Nyamira
38	John Nyakora	LAGROTECH	Box 1019, Siaya
39	J.M.O. Sewe	P.C.O. Western	Box 27, Kakamega
40	Dr. Apollo B. Orodho	Centre Director, KARI	Box 169, Kakamega
41	John Onyango	DAO	Box 113, Bondo
42	Miseda Joshua	MoA&RD	Box 81, Kehancha
43	Luke Nyatteng	Farmer	Box 6058, Kondele
44	Vincet A. Mboga	Farmer	Box 590, C. Kisa
45	Ignatius M. Saramu	Farmer	Box 3, Nyamarambo
46	Peter O. Nyakundi	MoA&RD	Box 7, Ogembo
47	Z.O. Oirere	MoA&RD	Box 52, Kisii
48	Omondi Hellen	MoA&RD	Box 52, Kisii
49	Ada A. Omulo	Farmer	Box 82, Ogongo

LIST OF PARTICIPANTS (cont.):

No.	NAME	ORGANIZATION	ADDRESS
50	Maurice Susi	MoA&RD	Box 1700, Kisii
51	Caleb Omondi	MoA&RD	Box 1958, Kisumu
52	Tobias O. Athiambo	CARE - Kenya	Box 526, Homa Bay
53	Ennah Egadwa	KARI-Kakamega	Box 169, Kakamega
54	H.M. Obiero	KARI-Kakamega	Box 169, Kakamega
55	H.A. Oduor	Farmer	Box 4794, Kisumu
56	Owino Nyadu	Farmer	Box 229, Sidindi
57	Nduga Ogola	MoA&RD	Box 70, Mbita
58	Peter Akongo	Diocese of Homa Bay Catholic	Box 362, Homa Bay
59	Dismas Oyugi	MoA&RD	Box 3, Siaya
60	John Oywa	Reporter (Nation)	Box 947, Kisumu
61	Mary A. Obwaka	Principal, Siaya FTC	Box 3, Siaya
62	W. Ndirangu	MoA&RD	Box 3, Siaya

ANNEX 4

Stakeholders Meeting on Cassava Multiplication in Western Province, Western Kenya – 22nd December 1999

MINUTES

Morning session

The meeting commenced with self-introduction of all stakeholders in attendance. All districts in Western province were represented, headed by either their DALEOs or DAOs and represented by their crops officers, one NGO representative, one DAC member and their respective DDOs. Also in attendance were programme leaders of the cassava project in RRC Kakamega and the Officer in charge of KARI-Alupe. The PDALE welcomed all participants and also commented on the good representation of the areas concerned.

1. Introduction by the centre director, RRC Kakamega

The centre director welcomed the participants to the forum. He said the main concern of his centre is to identify farmers' constraints and seek solutions to them. He said such meetings reduce the period between research findings and their utilisation by farmers. He also informed the participants that research normally spearheads development, not only here in our country but also in other countries. He said that he hoped the meeting would strengthen the research, extension, NGO and farmer linkages in the region. He also highlighted certain breakthroughs made at RRC Kakamega through working via similar linkages. These included the Bean Rot Project in Vihiga, *Striga* tolerant maize varieties and the CMD resistant cassava, the subject of today's meeting. He encouraged the interaction and active participation of all stakeholders. He also said that the effort would bear fruit if all stakeholders worked as a team.

2. An overview of the cassava production situation in western Kenya:

The provincial crops officer, Mr. Sewe, presented an overview of cassava and cassava production in western Kenya. He described some of the major pest and disease constraints, and illustrated recent losses caused by cassava mosaic virus disease (CMD). These were reflected in the recent production figures for Western province (Table 1).

Table 1. Fresh cassava production in Western province, 1992-98

Year	1992	1994	1996	1997	1998
Yield (t)	169,519	153,817	131,100	98,818	47,760

He informed the meeting that since 1992 cassava production in the province has reduced by 3 1/2 times. The major cause of this he informed the meeting was CMD.

3. Purpose of the Workshop (H. Obiero - Programme leader - RRC Kakamega)

Mr. Obiero explained that the main purpose of the workshop was to chart out ways of improving the already existing mechanism of rapid multiplication of cassava through the primary, secondary and tertiary phases, so as to reach the targeted farmers as agreed by the previous stakeholder meetings. He said that at the moment the programme was still at the primary level. The materials being multiplied are tolerant to CMD.

The other purpose is to look at the mechanism of distribution and other related activities in order to move materials from one stage to another and eventually to the farmer.

Finally, he told participants that more germplasm was currently being developed at Alupe, which would be superior to clones currently being multiplied. New clones would be tested in multi-locational trials within the affected areas.

4. An overview of the programme (H. Obiero)

The cassava multiplication programme started as a result of surveys conducted by KARI /NRI/IITA in 1993, 1996 and 1997. In the latter two surveys it was reported that CMD was spreading at an alarming rate within Teso/Busia districts and Siaya. The survey reports necessitated intervention in the concerned districts.

In 1997, KARI requested an open quarantine facility, which was opened in June 1997. 0.8ha of SS4 and Migyera were established. In the same year, 600 clones were selected and planted there (open quarantine). In December 1997, the first stakeholder meeting was held at RRC Kakamega and the following attended:

Provincial crops officers (Nyanza & Western)
District agricultural officers (NOW DALEOs)
District crops officers and district home economics officers
NGO representatives within districts concerned
Farmer representatives
KARI

During the meeting the following resolutions were made:

- Train farmers/extension/NGOs on rapid seed multiplication for the primary, secondary and tertiary stages of cassava multiplication
- Stakeholders agreed to begin primary level multiplication through the following sites decided on

1998

Busia FTC
Busia Prison - Discontinued due to bacterial blight infection
Teso - farmer
KARI-Kibos
Siaya FTC
Bukura FTC

1999

KARI-Alupe
KARI-Kakamega
Bungoma FTC

At the moment there are a total of 45.2ha under SS4 and Migyera. Early this year in March a steering committee was formed to oversee the whole process of cassava multiplication. Mr. Obiero also reported that in March 1999 there was a sensitisation meeting for all DAO (DALEOs) at Tom Mboya College - Kisumu. This was followed by a training of all district crops officers at the same venue for 3 weeks in May. Topics covered included cassava agronomy with an emphasis on rapid seed multiplication.

He also informed the meeting that 600 clones under quarantine were harvested in April. 176 selections were made and the best 14 clones were multiplied in readiness for multi-locational trials. Also in April, an additional 56 clones were introduced from Uganda to open quarantine at Alupe, and these were followed by a further 189 clones in late October.

5. Programme for the next phase (H. Obiero)

Mr. Obiero said in the next phase the following activities are planned.

- a) Establishment of secondary multiplication sites
- b) On-farm testing of 14 selected clones at multi-locational sites
- c) 20 clones to be selected from the 176 clones for on-station evaluation

He elaborated that the above activities will be done as follows:

a) Secondary phase multiplication - stakeholder participation and responsibilities (to be discussed in the plenary session)

b) Multi-locational trials – sites to be selected on the basis of CMD infection pressure, AEZ, and crop prioritisation in each region. Likely sites include:

- 1) Teso
- 2) Busia
- 3) Butere/Mumias
- 4) Kakamega

c) On-station trials will be limited to institutions as follows:

- 1) KARI-Alupe
- 2) KARI-Kakamega
- 3) Busia FTC
- 4) Bukura FTC
- 5) Bungoma FTC

At the end of the presentation several issues were raised. One participant wanted to know whether the two CMD resistant clones have been tested and found to be acceptable to farmers. The response was that this had been done in Busia. Another issue concerned the criteria used in the selection of districts participating in the on-farm trials. It was explained that selection was based on CMD pressure and AEZ zonation. Another issue was incidence of CMD in clean materials being bulked. It was explained that the materials are tolerant and that the small proportion of CMD-diseased plants should be rogued. Participants also enquired about the methods of transmission of cassava mosaic. It was said that the virus causing the disease is transmitted by a whitefly that sucks sap. Another source of infection was the use of diseased materials for planting.

The guest of honour was then invited to open the workshop officially.

6. Western provincial commissioner, Mr. Z. Ogongo

The provincial commissioner indicated that he was pleased to be personally invited to attend the workshop and officially open it. He pledged support for the problem being addressed. Due to the nature of the problem he understood why Busia has a food problem.

He said Western province is endowed with good land and adequate rainfall to raise both crops and livestock. He however said the main constraint has been the lack of application of recommended agricultural practices which can raise both crop and livestock production. He said blame for this non-adoption should be shared between farmers, extensionists, NGOs and researchers. He also indicated that the decline in cassava production is also due to demand for land from other newly introduced crops like sugarcane and maize. However he said our main objective is to identify cassava production constraints. Production data have shown that the main production constraint has been CMD. Incidence rose from 13% in 1993 to 80% in 1998. In practice, what this means is that in Busia and Teso there is virtually no cassava and therefore a food deficit. He however noted that through collaborative efforts of KARI and IITA a solution has been found. There are two clones that are CMD tolerant that are being multiplied, and others he was told are in the pipeline. He hoped that this would regenerate cassava production in the region.

The commissioner also thanked friends and donors who have supported the programme up to date- these included the Gatsby Charitable Foundation, USAID, Rockefeller and collaborative research organizations such as IITA, EARRNET, KARI, LAGROTECH, NGOs, opinion leaders, the local administration and farmer representatives. He also said they should continue sensitising the farming community

for better production of cassava. He said food production is not a business but for our own very existence. He thanked the research officers for efforts already made in introducing and multiplying the two varieties (clones). He said agricultural development begins with research institutes where adoption is initially not important but where new technologies are developed. However, these technologies must find their way into farmers' fields. In the case of cassava, since the research has been done, there should be a big emphasis on transfer of the technologies to farmers, and this should be done through collaborative efforts involving all stakeholders. As patience is needed to develop new technologies, so too there should be patience in trying to deliver them. Our aim must be to deliver clean cassava planting material to all of our farmers. In doing this, we will need to monitor our progress and identify new constraints along the way. Efforts must be made to sustain the programme, since not all donors will be able to provide support up to farm level. Our contribution must be well identified and specified and stakeholders should know their roles. The timeframe of the operation should be well specified and targeted areas clearly identified. As the work proceeds, the public should be made aware of what is being done and the project activities should be publicised. Each of us, above all, should have hope for better results in the future.

Lastly the commissioner thanked all who had come to participate in the workshop for rapid cassava multiplication. He said that hopefully by next year there would be a message of hope for the farmers of Western province. With these few remarks he declared the workshop officially opened.

7. Secondary multiplication implementation plans

Mumias Butere/Vihiga districts

Chairlady - Mrs. Walela – DALEO - Mumias/Butere
Secretary - C.O. Ogola - crops officers - Mumias/Butere

- 1) **Land provision**
Farmers
CBOs (Community-based organizations)
- 2) **Provision of labour**
Farmers (timeliness of activities a problem)
Risk of theft
Risk of piecemeal harvesting
- 3) **Distribution**
Extension
NGOs
Farmers

4) **Time frame**

Date	Activity	By Whom
3 rd wk Jan 2000	DFST Meeting	DALEO, KARI NGOs
4 th wk Jan 2000	Site selection Farmers selection	DALEO, KARI NGOs
3 rd wk Feb 2000	Training	DALEO, KARI NGOs
March 2000	Land preparation Seed acquisition	Farmers KARI, NGOs
April 2000	Planting	NGOs, Farmers CBOs
May 2000 and beyond	Supervision, monitoring	Farmers, Extension KARI NGOs

Kakamega/ Lugari districts

1) **Land provision**
Farmers

2) **Labour**
Farmer

3) **Seed distribution**
Extension
Provincial administration
KARI
NGOs

4) **Time frame**

Date	Activity	By Whom
2 nd wk Jan 2000	Meeting	DALEO, CBOs NGOs
3 rd wk Jan 2000	Training	KARI, DALEO, NGOs
1 st wk March 2000	Land preparation	Farmers
April 2000	Planting	Farmer, NGOs

After the presentation the issue of funding was discussed. It was felt that this was critical to the success of the proposed activities. Most participants expressed the fear

that if funding is not extended, planned activities may not take off. However it was explained that the stakeholders are expected to take cassava multiplication as part of their activities. Even the officer-in-charge and the provincial director of agriculture and livestock development concurred that stakeholders must be prepared to do without external funding and therefore look for better ways of implementing the programme without it.

8. Closing session

During the closing session, the provincial director of agriculture and livestock development stressed the need to exploit agriculture. There was tremendous potential within the province. He said Western province is 75% arable of which only 50% is utilized. He said that although most areas affected by CMD had increased cultivation of sweet potatoes, there was still a need to resume cassava production. He said that in order to support our efforts, the work done must be well documented for future reference. He further commented that there was a need to cultivate donor confidence through the timely and effective implementation of activities. Closer linkages between all stakeholders should also be fostered to strengthen cassava development in the region. With these few remarks the workshop was declared closed.

LIST OF PARTICIPANTS

1. P.P. Ting'aa
2. Dr. E.P. Mukhwana
3. Arim James
4. Mukhaniah Lucus
5. K.N. Koproti
6. Zakayo Shayo
7. Odari N.
8. Mayama Musala
9. Hesbon Naibei
10. Joseph O. Shiuchi
11. Maurice Erusi
12. Catherine N. Otsiva
13. L.M. Kisuya
14. M.W. Wambulwa
15. Consolata Etyang Papai
16. Luke Murabi Atema
17. Josephine Lubundi
18. Zadock Mbinji
19. Wycliffe Otieno
20. Patrick Onchieku
21. Ogalo Ber
22. Julia Malaho
23. Ndolo P.J.
24. Odhiambo I.D.
25. Ngare T.B.
26. Ben Amadala
27. Ngero jeremiah
28. E.N.A. Odero
29. Magobaic O.
30. Wangalwa, K.O.
31. Thomas Odhiambo
32. Wafula M.M.
33. Fredick Abuko
34. Patrick Wakhis
35. J.M.O. Sewe
36. H.M. Obiero
37. J.L. Mbato
38. L.S. Mutevi
39. K. Kungu
40. C. Obute Ogola
41. B.O. Butoyi
42. Mrs. Flora Mutua
43. Joshua T. Ayuya
44. B.M. Walela
45. Patrick Nekesa
46. Herman A. Oduor
47. Jacob Odondi
48. Joyce Kevogo
49. P.A. Malwa
50. Dr. A.B. Orodho
51. D.N. Nyasani
52. Joel Okwayo
53. Jemima Ikulakala
54. Dismas Okelo
55. Peter Shikanda
56. B. Asiko
57. C.P.O. Omolo
58. Sawula
59. Z. Shitanda
60. J. Mwinami
61. Z. Ogongo

Annex 5

Report on the Visit of a Tanzanian Farmers' Group to Uganda, 16th-20th November, 1999

Sseruwagi Peter, IITA-ESARC

A group of 13 farmers from the 'Lake Zone' of Tanzania visited their counterparts in Uganda from 16th to 20th November, 1999 to share experiences and learn new ways of farming. The farmers also had the opportunity to get some training based on the cassava, banana and yam work going on at the International Institute of Tropical Agriculture, Eastern and Southern Africa Regional Centre (IITA-ESARC) at Sendusu Farm, Namulonge. The group comprised farmers from a number of farmers' groups and staff from the Kagera Agricultural and Environmental Management Project (KAEMP), Ukiriguru Agricultural Research Institute (ARI-Ukiriguru) and Maruku Agricultural Research Institute (ARI-Maruku) (Table 1).

Table 1: Composition of visiting Tanzanian farmers' group, November 1999.

Farmers' group	No. of farmers
ARI-Maruku (Staff)	1
ARI-Ukiriguru (Staff)	2
KAEMP (Staff)	1
Masalakulangwa 'B' Farmers' Group, Mwanza	1
Farmers Research Group, Iteja Misungwi, Mwanza	2
Masalakulangwa 'A' Farmers' group, Shinyanga	1
Kilima Farmers Research Group, Bukoba	1
Byamtemba Farmers Research Group, Bukoba	1
KAEMP Groups, Bukoba	2
Bukiriguru Farmers Research Group, Biharamulo	1
TOTAL	13

On arrival in Uganda, the farmers were met by Dr. J.P., Legg, head of the cassava virology section at IITA-ESARC. The following day they visited IITA at Namulonge/Sendus and were introduced to a number of programmes including: cassava virology, nematology and post harvest sections, banana entomology and nematology sections and the yam section (Table 2). In each programme the farmers were introduced to the crop, its agronomy and pest and disease management. In the case of cassava, the farmers were briefed on the process of germplasm development and multiplication.

After the training at Sendusu, the visiting farmers had the opportunity to visit their counterparts at Kalagala and Vvumba in Luwero district. At Kalagala, the site of a pilot-processing project established by the post-harvest section of IITA as part of activities under the PL-480, USAID-funded project, the visiting farmers were introduced to the farmers' group manning the project. Mr. G. Ntibarikure (IITA staff, post harvest section) introduced the Kalagala farmers' group to the visiting farmers

Table 2: Farmers' groups and programmes visited in Uganda, November, 1999.

Farmer group/IITA-ESARC programme	Person/s in charge
Vvumba farmers' group, Luwero	Mrs. D. Kabuye
Kalagala farmers' group, Luwero	Mr. W. Kibirango
cassava virology, IITA-ESARC	Dr. J. P. Legg & Mr. P. Sseruwagi
cassava/banana nematology, IITA-ESARC	Ms. C. Kajumba
post harvest, IITA-ESARC	Mr. G. Ntibarikure
banana entomology, IITA-ESARC	Mr. D. Mukasa
yam, IITA-ESARC	Dr. N. Wanyera

and gave a brief history about its formation and objectives. He later introduced the leader of the group, Mr. W. Kibirango, who briefly explained to the visiting farmers the working of the group, the operation of the processing equipment, the utilization and marketing of the flour obtained, the proceeds and how they are shared among the group members and benefits obtained since the introduction of the processing equipment. After the talk, the farmers were taken to the field to have a look at the different cassava varieties grown, including Migyera, the main variety used for processing.

Later that day, the visiting farmers were taken to Vvumba, to visit another farmers' group working in close collaboration with the National Cassava Programme (NCP) of the National Agricultural Research Organisation (NARO). At Vvumba, one of many sites being used as technology transfer centres for new technologies from research institutes on cassava, beans, yams and sweet potato, the farmers had the opportunity to exchange experiences with their counterparts on matters regarding farming. Mr. W. Sserubombwe gave a brief introduction about the Vvumba farmers' group, highlighting the history of the formation of the group, its objectives and composition. Mrs. Kabuye Dorothy, the leader of the group led the visiting farmers around the site explaining to them the advantages and disadvantages of the different varieties of the crops grown. The group was later hosted to a luncheon, courtesy of the Vvumba farmers' group. This marked the end of the visit. The head of the visiting farmers' group expressed gratitude to IITA for making it possible for them to meet with their Ugandan counterparts. They appreciated the training obtained at the Institute at Sendusu and thanked all the staff involved. The group was happy with the work the farmers' groups in Uganda are doing and were especially very pleased with the Vvumba farmers' group. On behalf of the organizers, the farmers expressed their appreciation of the contribution of the staff of IITA at Namulonge and Sendusu and the farmers' groups at Kalagala and Vvumba in Luwero district towards the success of the programme.

Annex 6

Report on Cassava Multiplication Training Workshops and Evaluation Exercise of the Cassava Multiplication Programme in Rakai and Masaka districts

September 13th - 18th, 1999

Sseruwagi Peter, IITA-ESARC

1. Introduction

The 'Emergency Programme to Combat the Cassava Mosaic Disease Pandemic in East Africa', is funded by the Office for Foreign Disaster Assistance (OFDA) of the United States Agency for International Development (USAID). Since the inception of its activities in Uganda, a number of activities have been carried out in the project area, Rakai and Masaka districts. The activities include: monitoring and diagnostic surveys of cassava mosaic virus disease (CMD), establishment of stakeholder linkages, training and multiplication of CMD-resistant varieties. So far, one monitoring and diagnostic survey has been conducted in the two districts by staff from the International Institute of Tropical Agriculture, Eastern and Southern Africa Regional Centre (IITA-ESARC) based at Namulonge. Stakeholder linkages have also been established with partner institutions including: the district agricultural administrations and a number of non-governmental organisations (NGOs). Two training sessions on CMD and its management and cassava multiplication have been conducted for the stakeholders. IITA-ESARC coordinates the project funds and the purchase and transportation of planting material, while the Irish Foundation for Co-operative Development (IFCD), one of the NGOs, is charged with organizing and co-ordinating project activities by partner institutions. So far two rounds of multiplication have been carried out, with the first in November, 1998 and the second in April, 1999. In the first round, about 300 bags of CMD-resistant cv. SS4 were distributed in equal proportions to Rakai and Masaka districts for multiplication, targeting an area of 15ha per district. However, not only was the actual area planted (10.4 ha) below the targeted 30ha, the effective area under the crop was much lower (6.9 ha) than anticipated, owing to a number of factors. In order to make up for the deficiencies in the first round of multiplication, an additional 600 bags of cv. SS4 were purchased and distributed for multiplication to the two districts in the second round. The Irish Foundation for Co-operative Development (IFCD) co-ordinated the distribution and planting of the stems. Mr. G. Tusiime of IITA-ESARC visited and reported on the multiplication programme in the two districts. The report presented here, therefore, only gives a general picture of the state of the multiplication fields, especially those planted in during the first round (November, 1998). A report of the 'Cassava multiplication training workshops' conducted at Kalisizo, Rakai district and at Kamenyamigo District Farm Institute (DFI), Masaka district is also presented.

2. Cassava multiplication training workshops

Cassava multiplication training workshops were held at Kalisizo, Rakai district and at Kamenyamigo, Masaka district on September 15th and 16th, 1999. Participants at the workshops included project officers and extension staff from IFCD and district extension staff from Rakai and Masaka districts involved with the multiplication programme (Table 1).

Objective of the workshops

The workshops aimed at:

- i) Explaining to participants the concept of cassava stem multiplication
- ii) Training participants in techniques of cassava stem multiplication
- iii) Explaining to participants the concept of ratooning
- iv) Training participants in techniques of ratooning and management of the ratoon crop

Progress reports

The workshops started with introductory remarks by IFCD. The participants were called upon to present brief reports on the progress of the cassava multiplication programme in their respective areas of jurisdiction. The report format to be used included brief reports on the: number of bags of cassava stem cuttings obtained, area initially established, present condition of the crop and problems encountered for both the mature (planted in November, 1998) and the young (planted in April, 1999) crops. Reports on the performance of the mature crop were more positive than for the young crop. The mature crop had established better in many places, which ensured a better stand, more likely to yield more planting material in the next phase of the multiplication programme than the young crop. However, some mature fields were reported to have very poor plant stands and may not be harvested soon, as is reported in section 3 of this report. Reports on the performance of the young crop were dominated by poor germination and establishment in many places, although a number of them were reported to be doing well. The poor performance of the young crop was attributed to a number of factors including among others: delayed delivery of planting material from Namulonge and IFCD collection centres in the two districts, deterioration of cuttings due to drying, rotting or bruising of nodes during packaging and transportation and the effects of the prolonged drought in many parts of the two districts. In addition to the factors raised above, a number of young fields were also reported to have low plant populations due to excessive roguing. The roguing resulted from the frequent occurrence of CMD infected SS4 plants in the fields, which mainly occurred at sprouting (cutting infection) together with the occurrence of mixed varieties in some fields. The first implication of the presence of CMD infected SS4 plants and mixed varieties in the young crop is that selection of planting material was not thoroughly carried out. Secondly, it is likely that some whitefly infection occurred in the crop. However, on close examination of the reports, there seemed to be some confusion between the symptoms of cassava green mite (CGM) infestation and those of CMD infection. This was evidenced from the lack of a single report on

Table 1: Participants at the cassava multiplication training workshops in Rakai and Masaka districts

Institution	Rakai	Masaka
IFCD	21	20
ICR	1	-
Rakai District Administration (RDA)	1	-
CONCERN	1	-
LWF/RACA	1	-
WEAR	1	-
OCBO	1	-
World Vision	-	1
Redd Barna	-	1
MADDO	-	1
Kitovu Mobile	-	0
Masaka District Administration (MDA)	-	2
KWEAP	-	1
TOTAL	27	26

the presence of CGM, and yet field visits showed that it was very abundant in many of the multiplication fields. It is therefore likely that the CGM infested plants were mistakenly rogued instead of CMD infected plants. Additionally, although SS4 was the main variety anticipated for multiplication, a few field extension officers noted that a small number of Migyera cuttings were also supplied in mixture with the SS4 cuttings. For fear of mixing the two varieties during harvesting (ratooning), some extension officers rogued out the Migyera plants, while others (Rakai district administration multiplication) left the plants to grow together with the SS4 plants. The situation was regrettable, but not beyond remedy. It was advised that the cv. Migyera be encouraged as a variety to be consumed after processing. The concerned NGOs were also advised to seek technical assistance in post harvest technologies from the post harvest section at IITA-ESARC, Namulonge.

Training

The participants were introduced to the concepts of cassava stem multiplication and ratooning. They were also trained on basic techniques of ratooning, the different methods of cassava multiplication and the management of the ratoon crop. Other concepts pertaining to the epidemiology and management of the disease, cyanide levels of the different cassava varieties and post harvest related issues were also considered during the discussion period.

3. Evaluation of the cassava multiplication programme

Evaluation of the cassava multiplication programme was carried out on some of the mature crop (harvest age) plots in the two districts. The objective of the evaluation

was to assess the number of SS4 cassava fields ready for stem harvesting (ratooning) and the proportion of crop infected with CMD and CGM.

A summary of findings from the evaluation exercise is presented in table 2. Overall, 18 cassava multiplication fields were visited, with 9 fields from either district. The majority of the fields were well kept (weed-free), very vigorous and largely free from CMD infection. A rough estimate of the incidence of CMD put the infection level at 0-5% in most of the fields (Table 2). The disease was, however, slightly higher (10-25%) in the field controlled by the 'Women's Enterprise Association of Rakai' (WEAR) in Rakai district. CGM infestation ranged from 5-10% in 11 fields. Four fields had plants with signs of recovery from CGM infestation and the remaining two fields hardly had any symptoms of CGM infection. 15 out of the 18 fields were ready for harvesting. The remaining three fields were stunted and less vegetative and it was suggested that they be left in the field until the next season when they would be harvested (Table 2). The different proportions of stems harvested from the multiplication blocks to be used by each partner institution were outlined to the members. As was earlier agreed upon at the inception of the project, it was agreed that 40% of the stems would be given back to the project for re-distribution and establishment of new multiplication sites. The other 40% was to be sold by the multiplier (if possible) and the remaining 20% was to be used by the multiplier for either establishing new multiplication sites or for food production by the group members. It was noted, however, that it would be much easier for the larger multipliers, for example Masaka District Administration (MDA) to apportion out material as agreed than for the small groups of farmers involved in the multiplication. Nevertheless, it was agreed that all partner institutions stick to the agreement and that modalities concerning the harvested material be worked out by IFCD. The members were informed about the availability of funds for the second phase of the project to be availed to the project partners at the beginning of October, 1999. Members were called upon to prepare the fields in time to avoid delays in establishing the new crop.

In conclusion, although a number of limitations were encountered during the establishment of the multiplication fields, the results are promising and indicative of a modest level of achievement in the project goals. The second phase of the multiplication programme has had a lot to learn from the weaknesses of the first phase. As a result, therefore, a number of recommendations were made for consideration in the next phase and these include:

- i) Thorough selection should be done before harvesting to minimize CMD cutting infected plants and off types (non-SS4 plants) in the next crop.
- ii) Stem harvesting, packaging, distribution and planting should be done carefully and promptly as soon as the rains start, in order to minimize damaging the planting material and to ensure proper germination and crop establishment.
- iii) A detailed record of the name of the recipient, gender, quantity acquired, area established and location of the material distributed should be kept. This would serve as a data bank from which to monitor the extent of area established of the new crop.
- iv) The mature crop at every site should be maintained as a ratoon crop for subsequent stem production after the first stem harvest.

Table 2. Cassava multiplication fields and their condition in Rakai and Masaka districts, OFDA project, August, 1999.

District	Partner Institution/s	Area (ha)	Crop and field status	Comments
Rakai	ICR	0.1	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Not very vigorous ▪ 1 to 2 stems per stool ▪ <5% CMD infection ▪ <5% CGM infestation ▪ Weedy 	Ready for harvesting
Rakai	ICR	0.2	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ <5% CMD infection ▪ >5<10% CGM infestation ▪ Weedy 	Ready for harvesting
Rakai	ICR	0.2	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ <5% CMD infection ▪ Signs of recovery from CGM infestation ▪ Weed free 	Ready for harvesting
Rakai	Rakai district administration (RDA)	1.0	<ul style="list-style-type: none"> ▪ Mature ▪ >50<75% established plant stand present ▪ Not very vigorous (stunted) ▪ 1 to 2 stems per stool ▪ <5% CMD infection ▪ Signs of recovery from CGM infestation ▪ Weed free 	Not ready for harvesting

Table 2 continued.

District	Partner Institution/s	Area (ha)	Crop and field status	Comments
Rakai	WEAR	0.6	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ a ▪ >10% CMD infection ▪ Signs of recovery from CGM infestation ▪ Weed free 	Ready for harvesting
Rakai	OCBO	0.1	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Fairly vigorous ▪ 1 to 3 stems per stool ▪ <5% CMD infection ▪ No CGM infestation ▪ Weed free 	Ready for harvesting
Rakai	OCBO	0.1	<ul style="list-style-type: none"> ▪ Mature ▪ Mixed with local varieties ▪ >75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ <5% CMD infection ▪ Signs of recovery from CGM infestation ▪ Weed free 	Ready for harvesting
Rakai	OCBO NB: One other site is similarly like this one in every condition.	0.1	<ul style="list-style-type: none"> ▪ Mature ▪ <75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ <5% CMD infection ▪ No CGM infestation ▪ Weed free 	Ready for harvesting

Table 2 continued.

District	Partner Institution/s	Area (ha)	Crop and field status	Comments
Masaka	Masaka district administration (MDA)	1.2	<ul style="list-style-type: none"> ▪ Mature ▪ >50<75% established plant stand present ▪ Not very vigorous (stunted) ▪ 1 to 2 stems per stool ▪ <5% CMD infection ▪ <5% CGM infestation ▪ Weed free 	Not ready for harvesting
Masaka	Masaka district administration (MDA)	1.4	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ <5% CMD infection ▪ <5% CGM infestation ▪ Weed free 	Ready for harvesting
Masaka	Kitovu Mobile	0.4	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ <5% CMD infection ▪ <5% CGM infestation ▪ Weed free 	Ready for harvesting
Masaka	World Vision NB: 3 other sites are similarly like this one in every condition.	0.08	<ul style="list-style-type: none"> ▪ Mature ▪ <75% established plant stand present ▪ Very vigorous ▪ 1 to 4 stems per stool ▪ <5% CMD infection ▪ <5% CGM infestation ▪ Fairly weedy 	Ready for harvesting

Table 2 continued.

District	Partner Institution/s	Area (ha)	Crop and field status	Comments
Masaka	Kabula Women's Empowerment (KWEAP)	0.08	<ul style="list-style-type: none"> ▪ Mature ▪ >25<50% established plant stand present ▪ Not vigorous (Stunted) ▪ 1 to 2 stems per stool ▪ <5% CMD infection ▪ <5% CGM infestation ▪ Weedy 	Not ready for harvesting
Masaka	Kabula Women's Empowerment (KWEAP)	0.4	<ul style="list-style-type: none"> ▪ Mature ▪ >75% established plant stand present ▪ Fairly vigorous ▪ 1 to 3 stems per stool ▪ <5% CMD infection ▪ No CGM infestation ▪ Weed free 	Ready for harvesting

Annex 7

Cassava Steering Committee Programme in Western Kenya 17th –22nd October, 1999

Betty Owor, IITA-ESARC

1. Background

The second Steering Committee planning meeting for accelerated multiplication and distribution of healthy planting materials of improved cassava varieties in western Kenya was preceded by a three-day visit to the multiplication sites. The purpose of the meeting was to review the progress of the project and plan for activities for the current season and the long rains of the next year. Participants included representatives from donor agencies, KARI, the Ministry of Agriculture, the farming community, IITA and EARRNET (see Annex 2).

2. Tour of the multiplication sites

On the first day of the tour, after a courtesy call to the office of the Director KARI-Kakamega, the members visited the RRC-Kakamega multiplication site where 8.4ha of Migyera have been established. This site was established using cuttings of cv. Migyera from Siaya FTC. Bungoma FTC, where 3.2ha of SS4 has been established was also visited. The members then proceeded to trials in Mumias, where cassava varieties originally introduced from IITA, Nigeria in tissue culture, were being evaluated by groups of farmers. Sites visited on the second day were Bukura FTC, where 3.2ha of SS4 has been established, Kibos (2.6ha of SS4), Siaya FTC (1.6ha of Migyera) and a student's trial in Siaya. On the third day of the tour the members visited Busia FTC (4ha established with 3.6ha. under SS4 and 0.4ha. under Migyera), KARI-Alupe and farmers' fields in Teso district. KARI-Alupe, covering an area of 20ha, with 14.8ha under SS4 and 5.2ha under Migyera, was the largest multiplication site visited during this tour. At all the sites visited, leaf samples for PCR-based virus diagnostics were collected. Whitefly adults (*B. tabaci*) and nymphs were also collected from most of the sites visited. Methods and results of the virus diagnostics are described in the report on 'Monitoring and Diagnostics of CMD in western Kenya', which is attached as Appendix 1.

3. Steering Committee Meeting

On completion of the field trips, members convened at RRC Kakamega conference hall to discuss issues arising from the field trip, review flow of funds, future activities and other issues. The minutes of this meeting have been written up as a separate document. During the meeting, the progress of the project was reviewed and matters pertaining to germplasm, multiplication, training, finance and administration were discussed. Planning for activities for 1999/2000 was also done. These activities

included pest/disease monitoring, germplasm introduction and evaluation, multiplication, training and development of new proposals. It was also resolved at the meeting to convene a further Steering Committee meeting in March 2000 to prepare for the next cropping season.

Some members of the Steering Committee travelled to south Nyanza, western Kenya and Tarime district, north-western Tanzania to continue CMD monitoring and sample collection. Farmers' fields along the Tanzania-Kenya border and the Tarime-Kisumu route were also visited to assess the CMD situation and samples were picked from these fields for virus diagnostics. Results will be presented in the report for the next quarter.

Appendix 1. Monitoring and Diagnostics of CMD in Western Kenya and Tarime District, Tanzania.

Western Kenya

A total of 15 sites were visited during the monitoring and diagnostics visit to western Kenya. Some of the 15 sites visited were farmers' fields. CMD Incidence and severity of plants were estimated by scoring 30 plants at each location. Severity score was a single overall estimate of the severity of symptoms in diseased plants. The type of infection (whether derived from the cutting or from current season whitefly transmission) was also noted when incidence was being scored. At all the sites visited, leaf samples were picked from 2-3 plants showing symptoms. Results of the PCR tests will be presented in the report for the next quarter. Whitefly adults (*Bemisia tabaci*) and nymphs were collected from some locations. These will be sent to the University of Arizona for molecular characterisation and the development of whitefly diagnostics. Data on the geographical position of the sites was also recorded for every location visited. In Nyanza province, CMD incidence ranged from 27 to 83% with about 40% of the fields showing incidences of 60% or more. Symptom severity varied from location to location but most fields sampled contained CMD diseased plants with both mild and severe symptoms. Severe symptoms were more frequent, however, in the northern part of south Nyanza, along the Homa Bay to Kenya Bay road, and most of the infection was whitefly-borne. Severe symptoms were more frequent along this route than they had been during previous surveys in the same area. Earlier evidence has demonstrated the occurrence in the Kendu Bay area of the novel virus associated with the CMD pandemic (UgV/EACMV-Ug). Results of the October 1999 survey therefore suggest a further expansion of the CMD pandemic into south Nyanza. Numbers of whitefly adults were very low during the October survey. This was probably due to seasonal factors, the most important of which is likely to be the weather. Regular assessments will be made of whitefly populations within the proposed multi-locational germplasm evaluation trials. These data should provide a more reliable assessment of whitefly abundance in different parts of western Kenya.

Tarime District, Tanzania

The locations visited in the CMD monitoring and diagnostic survey in Tarime district, Tanzania, were farmers' fields located along the Tanzania-Kenya border and the Tarime - Kisumu route. Eight fields were visited and CMD incidence and severity scored at all locations. Leaf samples were picked from 2-5 diseased plants per location and DNA extracted for PCR analysis. Whitefly adults (*B. tabaci*) and nymphs were also collected at many of the locations visited. Results of tests will be presented in the report for the next quarter. CMD was recorded in all but one of the fields sampled. Average incidence was 18%, and approximately half of this was current season whitefly-borne infection. Symptoms were generally mild to moderate, although a small proportion of plants with severe symptoms were observed. These were more frequent to the western side of the sampled route, towards the Lake Victoria shoreline.

Annex 8

Trip Report to KEPHIS, Nairobi, Kenya 7th – 9th December 1999

Shou Yong Ng, IITA-Ibadan

Objectives: The objectives of the trip were to assess the tissue culture and virus indexing facilities available at the Muguga Plant Quarantine Station of Kenya Plant Health Inspectorate Service (KEPHIS), and to make recommendations for upgrading the facility.

1. Background

A severe cassava mosaic disease (CMD) outbreak continues to expand across the Lake Victoria zone of East Africa. The effect is the abandonment of cassava production in the areas affected by the disease. Losses in Western province of Kenya alone were estimated at \$10 million in 1998. The Office for Foreign Disaster Assistance (OFDA) initiated support to IITA, regional networks and a wide range of partner stakeholders to implement an emergency programme to tackle this problem in the region in 1998. Good progress has been made during the first year of the project and in 1999, Phase II of the project was approved.

Some of the main objectives of Phase II of the project are to accelerate the rate of multiplication of CMD resistant varieties, expand the diversity of germplasm under evaluation and multiplication, and introduce new germplasm into the multiplication system. To enhance the safe exchange of germplasm in the region and within countries, Phase II of the project has included the upgrading of the tissue culture and virus indexing facility at the Plant Quarantine Station, Muguga, Kenya to undertake this task with back-stopping from IITA scientists.

2. Itinerary

7 th December 1999	Depart from Lagos
7 th December 1999	Arrive Nairobi
7 th December 1999	Courtesy call to KEPHIS
7 th December 1999	Visit to PQS, Muguga
8 th December 1999	Visit to PQS, Muguga, together with Dr. J. Whyte
8 th December 1999	Wrap-up with the Managing Director, KEPHIS
9 th December 1999	Depart from Nairobi

3. Persons met

Dr. C.J. Kedera, Managing Director, KEPHIS

Dr. W. Songa, Assistant Director, Plant Protection Services, KEPHIS

Dr. A.N. Kingiri, Plant Protection Services, KEPHIS

Mr. P. Njoroge, Head, Plant Quarantine Station at Muguga, KEPHIS

Mr. J.W. Kamau, Co-ordinator, National Cassava Programme, KARI

4. About KEPHIS

KEPHIS was created in October 1997. It has three technical divisions, Plant Protection Division, Quality Control Division, and Plant Breed Rights Division. Under the Plant Protection Division there are several departments including biosafety, plant quarantine stations and inspectors in different regions, with the biggest ones being at Mombasa and at Nairobi's international airport. The Quality Control Division deals with the quality of agricultural inputs such as fertilizer and pesticide residues, and seed certifications. The Plant Breed Rights Division handles the registration of varieties.

5. Visit to Plant Quarantine Station (PQS) at Muguga

The role of plant quarantine services is to ensure that farmers and scientists obtain plant materials from the best sources, to encourage introduction of genetic resources but also ensure health of the plant materials. The Tissue Culture Laboratory (TC Laboratory) is under the Plant Health/Seed Health Unit of the PQS. The function of the TC Laboratory is: 1 - Cleaning up of germplasm; 2 – Micro-propagation and 3 - Exchange of germplasm. Currently they are working on potato and sweet potato with the International Potato Centre (CIP), pyrethrum with the pyrethrum board of Kenya and sisal with the sisal industry. Facilities available at the PQS for tissue culture and virology are:

- I. Tissue Culture laboratory. Consists of three separate buildings within walking distance: the main laboratory, the culture facility for pyrethrum, potato and sweet potato, and the thermo-therapy facility.
 - a. Main Laboratory - The main laboratory comprises:
 1. Washing room with benches.
 2. Media preparation room: equipped with one coarse balance, one pH meter, one water distiller, two pressure cookers, one small autoclave (horizontal), one vertical autoclave (on loan), and one magnetic stirrer.
 3. One storeroom and a refrigerator.
 4. Two transfer rooms each equipped with one transfer hood.
 5. One small and one large culture room. The air conditioner in the small culture room is not functioning properly and it is not in use at the moment. The large culture room is functioning and is mainly filled with sisal cultures and some cassava cultures.
 - b. Culture facility for pyrethrum: this facility has three culture rooms.
 - c. Culture facility for potato and sweet potato: this facility has three culture rooms and a transfer hood.

- d. Thermo-therapy facility: For use in heat treatment of plants. The facility is equipped with light, benches and a heating facility.
- II. Plant Pathology: Conduct testing of presence of fungal and bacterial pathogens for incoming and outgoing plant materials. The only dissecting microscope
- III. Virology: Conducts virus diagnostic and testing using the test plant method and ELISA. Interpretation of ELISA results is based on visual observation. There are many glasshouses available.

6. Cassava tissue culture activity and facility requirements

The objectives of the proposed cassava tissue culture activity at PQS are to facilitate safe exchange of cassava germplasm in the region as well as within the country, and to conserve the regional core collections of cassava germplasm. Cassava germplasm selected from countries in the region will be subjected to meristem culture at PQS for virus clean up, and micro-propagation for *in vitro* distribution. The selected core collections of cassava from participating countries will be sent to PQS. At PQS the germplasm will be transferred and maintained *in vitro*. One set of the collections will be duplicated at the *in vitro* genebank at IITA, Ibadan. PQS will also receive from IITA Ibadan, virus-tested *in vitro* cassava plantlets for micro-propagation and distribution in the region.

To accommodate the above-proposed activities, the existing tissue culture and virus indexing facility requires modifications in terms of laboratory and glasshouse space, equipment/supplies and personnel.

Culture rooms and transfer room

For effective and efficient execution of the work, the idea of the renovation of an existing building that is some distance from the main laboratory (where media preparation, washing, and transfer room facilities are located) was ruled out. The building is also too small and will require substantial inputs to put things in place. The idea of expanding the culture facility by extending the main laboratory is recommended. The dimension proposed for the extension of the building is 6m x 15m. There will be three rooms in this extended facility, two culture rooms and one transfer room. The larger culture room will be used for virus clean up and micro-propagation, and the smaller room will be used for germplasm conservation (sketches for the proposed extension together with measurements are with Mr. Njoroge).

Glasshouse space

Three units of glasshouse (No. 1, 2, and 3) will be made available to the project. The dimensions of each unit are 5.25m x 2.4m. Each unit has two compartments, a and b. One unit will be used for growing the introduced germplasm, one for growing the plants derived from meristem culture and awaiting virus indexing, and one for growing test plants and virus indexing. Suggestions for modifications are:

1. Connect the two compartments, a and b, of each unit by a door.
2. Each unit will install a double door system. Metal structure is preferred.
3. Two units will be equipped with benches (for growing test plant and virus indexing, and one for acclimatizing and growing of plantlets derived from meristem culture)

Screenhouse

There is a tunnel type screenhouse available which could be used as a nursery for growing virus-tested cassava plantlets to obtain ministakes. The dimensions of this screenhouse are 2286cm x 640cm. However, the screen material has to be replaced and the doors need repair.

Personnel

Two staff from KEPHIS will be assigned full time to this project with the supervision of the head of PQS and support from the virology section.

Training and backstopping

It is recommended that one of the staff assigned to the project attend a 4 –6 weeks attachment training at IITA Ibadan in cassava tissue culture with particular focus in virus clean up technique and processes. One staff member from virology should attend a two weeks attachment training in virus indexing focusing on PCR methods at IITA, Uganda. Backstopping from IITA in tissue culture and virus indexing is necessary.

Equipment, chemicals and supplies

A list of equipment required was compiled and prioritised based on the need and urgency. They were categorized as priority 1, 2, and 3.

1. First priority

- Dissecting microscope
- Transfer hood
- Test tube racks
- Glasswares
- Air conditioners: initially 2 units (one 1.5 horsepower and one 2-horse power.
- Screen material for the screenhouse
- Light fittings, shelves and light timer for the culture rooms
- Refrigerator
- ELISA reader
- Anti-serum for virus diagnostics
- Chemicals and supplies for tissue culture and virus indexing
- Generator*

2. Second Priority

- Autoclave
- Automatic media dispenser
- Cupboards and shelves for glassware
- PCR
- Water distiller/de-ionizer
- Stirrer/hot plate
- Oven

3. Third Priority

- Analytical balance
- Microwave oven
- Temperature control room for indicator plants

* With power rationing in Kenya, a generator is considered as the highest priority. This is beyond the current means of the Project. It is recommended, however, that the Project contribute towards the purchase of a generator.

Actions

Actions to be taken are:

1. Mr. Njoroge and Kamau to obtain quotations for the renovation of the culture facility and glasshouses.
2. Mrs. Ng to provide the cost of the equipment and supplies
3. Mrs. Ng to assist in placing orders for overseas purchase and ship them directly to Kenya.
4. Dr. J. Whyte and Mr. Kamau to ensure that the MOU between IITA and Kenya is signed.
5. Dr. Whyte requested that the air conditioner in the small culture room be repaired and used to accommodate the micro-propagation of the ten genotypes Mrs. Ng brought with her.

7. Wrap-up meeting with Managing Director, KEPHIS

Mr. Njoroge on behalf of the group presented our conclusion at the wrap up meeting with Dr. C.J. Kedera. In general Dr. Kedera is very positive and supportive of the proposed plan. He informed the group that KEPHIS might be able to provide funds for materials locally available such as cupboards and shelves. Dr. Whyte also informed the group that EARRNET would contribute US\$10,000 to the realization of this project. The issue of having a generator for the PQS was also discussed. It was agreed that KEPHIS will call a stakeholders meeting and this issue will be discussed. The issue of having a well for water supply will also be discussed during the stakeholders meeting. It was also agreed that since this is a collaborative project of IITA, EARRNET, KARI, and KEPHIS, there will be no extra charges for work carried out under this project.

Estimated cost for the equipment and supplies for the tissue culture facility at KEPHIS, Kenya

Description	Option 1 Cost (US\$)	Option 2 Cost (US\$)
Priority 1		
Dissecting microscope with light source and spare bulbs	2,950.00	2,950.00
Transfer hood with spare main filter and pre-filters	3,894.00	3,894.00
Test tube racks	1,905.00	1,270.00
Glassware	1,050.00	0.00
Air conditioners (2)	4,000.00	2,000.00
Light timers*	800.00	400.00
Screen for the screenhouse	2000.00	0.00
Refrigerator with freezing compartment	895.00	0.00
ELISA Reader	6,495.00	0.00
Chemicals and supplies for tissue culture and ELISA (from overseas)	6,250.00	5,250.00
Chemicals and supplies to purchase locally	<u>1,500.00</u>	1,000.00
Sub-total	<u>31,739.00</u>	16,764.00

* KEPHIS to provide estimates for culture shelves and lights

	Option 1	Option 2
Priority 2		
ELISA Reader		6,000.00
Screen for the screenhouse		2,000.00
Air conditioners (1)		2,000.00
Light timers		400.00
Test tube racks		635.00
Refrigerator with freezing compartment		895.00
Chemicals and supplies		2050.00
Culture containers	2000.00	2000.00
Autoclave with trays and spare gaskets	9,219.50	9,219.50
Automatic media dispenser with spare tubing	1,950.81	1,950.81
Cupboards and shelves for glassware*		
PCR	40,000.00	
Water distiller	952.00	952.00
Stirrer/hot plate	416.50	416.50
Oven	2,635.00	2,635.00
Sub-total	55,173.81	31,153.81

* KEPHIS to provide the estimates

Priority 3	
Analytical balance	2,635.00
Microwave oven	500.00
Temperature control room for indicator plants*	
Sub-total	3,135.00

* KEPHIS to provide the estimates

Note: All cost estimates are based on 1999 price list. They are the actual costs and do not include shipping and handling charges.