

Cassava Mosaic Disease Pandemic Mitigation in East Africa

**A SYSTEM-WIDE WHITEFLY IPM
AFFILIATED PROJECT**



Second Quarterly Technical Report

January-March 2001

International Institute of Tropical Agriculture

May 2001

Table of Contents

I. Executive Summary	page 1
II. Programme Overview	
A. Goal and Objectives of the Programme	page 2
B. Geographic Locations of Major Programme Activities	page 2
III. Programme Performance	
A. Progress in Attaining Programme Objectives	page 4
B. Programme Success Stories	page 9
C. Problems in Achieving Programme Activities	page 10
ANNEX 1 – Multiplication activities in Uganda - CEDO	page 11
ANNEX 2 – OFDA CMD activities in Kenya - KARI	page 13
ANNEX 3 – OFDA CMD activities in Tanzania - LZARDI	page 19
ANNEX 4 – Whitefly molecular diagnostics report – UA, USA	page 23
ANNEX 5 - Kenya report – Steering Committee meeting	page 26

I. Executive Summary

Quarterly Report

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Programme title: Cassava Mosaic Disease Pandemic Mitigation 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: January-March 2001

Activities Summary

Characterization of whitefly biotypes continued at the University of Arizona, and a number of novel approaches to developing practical diagnostics for use in East Africa were initiated including the sequencing of portions of the *kdr* nuclear gene and consideration of the use of EPIC primers.

Ratooning of the 1998-planted plots was done in Uganda after which ownership of the plots reverted to the original owners. 82 bags of planting material were obtained, of which 47 were sold and the rest distributed to vulnerable households in the project area.

A new primary site was established at KARI-Oyani, and 16 and 12ha of land prepared in Western and Nyanza respectively for establishment of secondary multiplication sites.

Multiplication sites in Tanzania continued to be maintained during the quarter. 3.4ha of multiplication plots were established through KAEMP. Additionally, 2 sites in Muleba and 1 in Bukoba were established through FAO Farmer Field Schools.

In Kenya, data collection continued for both the on-farm trials at Amukura, Siaya and Rachuonyo and the on-station trials at Alupe and Mbita Point. Several of the clones in the on-station trials have shown resistance to CGM.

Data collection continues for the EARRNET clones and tissue culture material in Tanzania. Mealybugs were observed on I 92/0600 and I 93/0571 at Gera and Bushasha. These plants were rogued out to prevent spread of pest to other plants. There was routine maintenance of the Open Quarantine facility at Maruku. Bacterial blight was observed to be a problem especially on SS4. New clones were brought in from Uganda, 400 clones for evaluation and seven new varieties for rapid multiplication. These have already been planted and have sprouted well. During this quarter, the 2000 planted second set of clones in Gera, Bushasha and Maruku were harvested. TMS 4 (2) 1425, TMS 30337 and TMS 81983 performed best in high and moderate disease pressure areas (Gera and Bushasha respectively). Farmer assessment of the material was also done at all the three sites. Farmers selected the varieties based on their own criteria, the two most important of which were sweetness of both raw and cooked tubers and yielding ability. Varieties Msitu Zanzibar, 106 and Rushura (all CMD susceptible) were selected in order of preference, highlighting the importance of identifying CMD-resistant varieties with farmer-preferred quality characteristics.

TTCs were established in the districts of Butere/Mumias, Kuria and Siaya in Kenya. A total of 280 farmers participated at the end of which they were each given 300-500 ministem cuttings.

In Tanzania, IPM/N farmer groups were trained on management of cassava. 19 extension workers from Muleba and Bukoba also participated in a training of trainers' workshop.

The Kenya National Cassava Steering Committee meeting was convened at Mlimani Hotel, Kisumu. Steering Committee members and donor representatives met to discuss progress of the project and future activities and field sites were visited and assessed. An important development was the initiation of private sector involvement in the regional multiplication program.

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
CEDO	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

CEDO Community Enterprises Development Organisation

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	2° 43.1' S	33° 1.0' E	Co-ordination, germplasm
Maruku ARI	Kagera	Bukoba	1° 25.0' S	31° 46.8' E	Germplasm, Multiplication, Open Quarantine
Nyakasanga	Mwanza	Mwanza	2° 46.3' S	32° 56.6' E	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

- The University of Arizona team continued with cassava whitefly biotype characterisation work (see Annex 4). This effort is based on preliminary evidence suggesting that there were significant genetic differences between *Bemisia tabaci* whitefly biotypes from cassava in areas affected by the CMD pandemic and biotype(s) from unaffected areas. The main aims have therefore been to initially develop a technique for distinguishing between the putative 'epidemic' and 'non-epidemic' populations, secondly, to produce diagnostics which can be readily used in East Africa to separate these populations thereby facilitating their tracking, and thirdly to transfer these methods to East Africa for practical usage.
- During previous quarters, good progress has been realized in characterizing *B. tabaci* populations in the project target zones through sequencing a portion of the mitochondrial cytochrome oxidase I (MtCOI) gene. Four clearly defined genotypes have been recognised: Genotype I – the so-called 'invader' type which has been associated with the 'front' and 'behind the front' zones of the CMD pandemic; Genotype II – an 'indigenous' cassava type found in Uganda, Kenya and Tanzania; Genotype III – an 'indigenous' type found most commonly in Tanzania; and Genotype IV – a non-cassava type collected occurring on sweetpotato in Uganda.
- Whilst it initially appeared from examination of Ugandan populations that 'invader' and 'indigenous' types could be separated relatively simply on the basis of MtCOI sequences, more extensive sequencing of material from Kenya and Tanzania has suggested a more complex scenario, with abundant epidemic associated populations from these two countries having MtCOI sequences with a high degree of homology to those of the 'indigenous' types. In view of this, other nuclear coding region sequences are being investigated for their potential both to discriminate between epidemic and non-epidemic cassava *B. tabaci* biotypes, and their potential to provide simple diagnostic tools that could be readily transferred to East Africa. PCR primers amplifying a portion of the *kdr* gene have been used for 8 *B. tabaci* populations from different parts of the target zone in East Africa, and amplified PCR products for each are currently being sequenced.

Uganda

- An IITA/NARO team of A. Kalyebi, J. Ogwang and Muaka Toko conducted monitoring and evaluation surveys for cassava green mite at the end of February 2001 in the two districts of Rakai and Masaka. Whilst not funded through the OFDA project, this activity provides an important complement in the overall effort to assure cassava plant health in OFDA Project target zones

Kenya/Tanzania

- No additional surveys were conducted during this quarter of the project.

Indicator: CMD, EACMV-Ug spread maps; > 30 early warning farmers trained, Whitefly biotype map; > 30 impact survey sites Ug, Ke, Tz; radio bulletins, newspaper articles

Current Quarter's Measure: Monitoring and evaluation of CGM in Rakai and Masaka
Initiation of *kdr* sequencing for whitefly biotype characterization

Cumulative Project Measure: > 100 virus samples diagnosed, W. Kenya
Maps developed for CMD pandemic spread, W. Kenya

Objective # 2: Multiplication of CMD resistant varieties

The January to March quarter is a dry period throughout most of the target zones of East Africa, and most of the multiplication activities therefore involved maintenance of existing sites and little further ratooning and planting was undertaken.

Uganda

- Phase I plots planted in October 1998 were ratooned for the second time and these plots reverted back to their original owners. Ratooning was done according to requirements of the beneficiaries. The material was distributed to vulnerable households. A total of 82 bags were ratooned from the sub-counties of Kisekka (28 bags), Kasasa (47 bags) and Lwanda (7 bags). Out of these, 47 bags were sold at Ush 8,000 per bag. Further ratooning will be done as the rains begin.

Kenya

- Maintenance of all primary sites continued during this quarter of the project. Weeding and top dressing with CAN to increase crop vigour was done. Funds were provided for purchase of tools at most primary sites. An allocation scheme for provision of planting material for the 2001 long rains by each of the primary sites to the 17 districts in western Kenya was worked out. See Annex 2. Old secondary sites continued to be maintained in this quarter. Hailstorms damaged many of the sites but all recovered except the Sang'alo site.
- During this quarter, new primary and secondary multiplication sites were established. A 4 ha primary site of SS4 and Migyera was planted, each on 2 ha at KARI-Oyani site. A total of 16 ha and 12ha in Western and Nyanza Provinces respectively were prepared for secondary multiplication.

Tanzania

- During this quarter, there was continued maintenance of multiplication plots both at Maruku and Ukiriguru. Weeding, gap filling and roguing of infected plants was done.
- New secondary multiplication sites were established in collaboration with KAEMP, FAO/FFS, Rubya Project, DALDO Office Bukoba and World Vision Misenyi ADP. A total of 3.4 ha was established through KAEMP. 2 sites in Muleba and 1 in Bukoba were established through FAO/FFS.

Indicator:	Ke. - 6 million stems; Tz. - 3 million stems; Ug - 2 million stems
Current Quarter's Measure:	Ug. - 8,200 stems; Ke.-4 ha primary site established Tz.- 3.4 ha established, 2 sites in Muleba and 1 in Bukoba
Cumulative Project Measure:	Ug. - 136,000 stems; Ke. - 270,000 stems; 4ha primary site established; Tz. - 230,160 stems; 3.4 ha established, 2 sites in Muleba and 1 site in Bukoba

Objective # 3: Germplasm Diversification and Exchange

Uganda

- The participatory evaluation trials in the technology transfer centers were maintained during this quarter. Preparations were made for the final evaluation, harvest and replanting of the material which would be done in the next quarter. Staff from CEDO continually monitored the technology transfer centres in the two districts.

Kenya

- During this quarter, there was continued maintenance of the on-farm trials at Amukura, Siaya and Rachuonyo. 3MAP and 6 MAP data were recorded at Amukura and Siaya districts respectively. Data were not recorded in the districts of Rachuonyo, Migori and Kuria because of transport constraints. This will be done at a later date. Fast-track varieties being tested in the on-farm trials are generally continuing to show good levels of resistance to CMD
- For the on-station trials at Alupe, 9MAP data were recorded for both the AYT and PYT. However, persistent hailstorms greatly affected the crop. At Kakamega, 6 MAP data were recorded. Several clones have shown promising resistance to green mite infestation. At Mbita Point, data has been collected only once and this site may have to be abandoned, although performance of germplasm here has been very encouraging. There are preparations to establish a site at Oyani to replace the one that was at Homabay FTC.

Tanzania

- Data collection continued on the evaluation plot of the fast-track EARRNET clones.
- Evaluation of tissue culture-derived material continued during this quarter. Data collection on disease severity and occurrence of pests continued on a monthly basis. Mealybug infestation was recorded on I 92/0600 and I 93/0571 at Gera and Bushasha sites. These plants were rogued out to avoid further spread of the pest
- There was routine maintenance of the Open Quarantine facility. Research officers from Maruku carried out routine inspection of the fields. It was observed that bacterial blight was a common problem on SS4.
- The second set of the 1999 planted trial was harvested in February. At the end of the exercise, the farmers were given planting material. TMS 30572(6) with a mean of 49.6t/ha had the highest fresh weight at Maruku, although yields at Gera and Bushasha were significantly lower. In terms of disease resistance and yield performance, TMS 4(2) 1425, TMS 30337 and TMS 81983 performed best in high and moderate disease pressure area (Gera and Bushasha) respectively. These varieties were recommended for multiplication.
- An assessment of the second set of clones by farmers was done at all the three sites of Gera, Bushasha and Maruku. Farmers were invited to select varieties based on their own criteria, most important of which were sweetness of both raw and cooked tubers and yielding ability. Based on these 2 important criteria, farmers selected Msitu Zanzibar, 106 and Rushura respectively in order of preference. Since these are all CMD susceptible varieties, a key future target should be the identification of varieties that combine CMD resistance with high quality raw and cooked root characteristics.

Indicator: Clones introduced: Tz > 100 Vars. evaluated: Tz 8; Ke 8; Ug 6
Vars to multiplication: Ke 4; Tz 4
OQ Tz - 10 clones to fast-track multiplication; 80 clones to prelim. eval.
PQS Ke - Virus indexing established; 10 vars indexed

Current Quarter's Measure: On-going var. evaluation: Tz > 40; Ug. 9; Ke 14
OQ Tz - 80 in prelim. evaluation

Cumulative Project Measure: On-going var. evaluation: Tz > 40; Ug 9; Ke 14
Vars to multiplication: Tz 6; Ug 1
OQ Tz - 80 in prelim. evaluation

Objective # 4: Training and Technology Transfer Centres

Uganda

- The TTCs in the two districts were closely monitored by the staff of CEDO during this quarter of the project. It is anticipated that harvesting of the material will be done at the beginning of the next quarter.
- 12 sets of processing machinery were manufactured for TTCs in Uganda, Kenya and Tanzania. Each of these sets comprised a motorised grater, a motorised chipper and a screw press. Training on the usage of this equipment will be provided to farmers' groups in all three countries during the April-June and June-September quarters, and machinery will be located in TTCs in the final quarter of this phase of the project.

Kenya

- Technology transfer centres were established in the districts of Butere/Mumias, Kuria and Siaya. At the end of the exercise, farmers were trained on the agronomy of cassava and multiplication. The farmers were also given 300-500 ministem cuttings for their own gardens. A total of 280 farmers participated.
- The new Provincial Crops Officer for western Province toured the province for training/familiarization with on-going cassava activities.

Tanzania

- IPM/N groups were trained on phytosanitation and management of cassava fields. Training was done to ensure that farmers are equipped with knowledge to manage their own fields and the evaluation trials that have been established. Farmers were advised on the importance of weeding on time and roguing diseased plants in the multiplication plots to reduce disease spread.
- A training of trainers was conducted at ARI-Maruku for field officers working under FAO Farmer Field Schools (FFS). Aspects covered in the training included control of CMD and rapid multiplication techniques. A total of 19 extension workers from Muleba and Bukoba actively involved in the FFS participated.

Indicator: Tech. Trans. Centres: Ug, Ke, Tz: 8 each
Farmers trained: Ug, Ke, Tz: > 160 each
Resistant variety multiplication on-going: TTCs Ug, Ke, Tz

Current Quarter's Measure: Tech. transfer sites: Ke - 5 clusters established; Ug - 4 sites running; Tz - 8 sites in Bukoba, Muleba, Geita, Musoma and Tarime districts running
Farmer training: Ke - 280; Tz IPN/M farmer groups, 19 extension officers

Cumulative Project Measure: Tech transfer sites: Ug 4; Tz 8; Ke 5
Farmers trained: Ke > 280; Tz IPM/N groups
Extension Workers trained: Tz 19
TTC multiplication: Ug 4 sites; Ke 5 clusters; Tz > 50 sites

Objective # 5: Project Management, Monitoring and Impact Assessment

An impact study will be conducted by Dr. Ousmane Coulibaly of IITA-Benin during the April-June quarter of 2001. During the current quarter, socio-economist partners were identified in Kenya and Tanzania.

Uganda

- There was continued monitoring of project activities by CEDO, the NGO coordinating project activities in the two districts of Rakai and Masaka
- About 47 bags of cuttings were sold to interested buyers.

Kenya

- The National Cassava Steering Committee Meeting was convened at Mlimani Hotel Kisumu from the 12-16th March 2001. Steering Committee members and donor representatives, including representatives of the Rockefeller Foundation, the Gatsby Charitable Foundation and USAID's Office for Foreign Disaster Assistance, attended the meeting. During the meeting, progress and achievements of the project were highlighted. Plans for steering the project into the future and aspects of commercialization were also discussed. A key development was the involvement of the private sector in cassava multiplication work in the region. It was recognized that this could provide an important potential impetus to the cassava multiplication program in the region, however, some concern was raised on the monitoring of private sector cassava operations, and most notably, the potential carriage of the epidemic associated virus, EACMV-Ug, if cassava planting material is carried outside of western Kenya. It was agreed that dialogue needs to be initiated with private sector partners both to strengthen existing activities in the region and mitigate any future potential problems. The task of co-ordinating other NGOs was assigned to CARE-Kenya which was charged with the task of harnessing more funds to support activities of the project
- The new Provincial Crops Officer Western, Mr. Malinga made a tour of the province to acquaint himself with activities of the project.
- The PCO Nyanza also made a tour of Nyanza Province to assess progress of activities in preparation for the tour by Steering Committee members

Tanzania

- Scientists from the Lake Zone Agricultural Research Institute visited IITA-ESARC, Kampala in late March both to participate in analyzing and writing up evaluation trial results and to link with Uganda National Cassava Programme, EARRNET and Plant Quarantine Service partners in collecting new germplasm and transporting it to the open quarantine station in Bukoba, Tanzania

Indicator:

Regional Stakeholders meeting
SC meetings: Ug, Ke, Tz
Impact reports: Ug, Ke, Tz

Current Quarter's Measure:

Ke- Steering Committee meeting

Cumulative Project Measure:

Regional Stakeholders meeting - Kampala
Stakeholder implementation plans updated
New country stakeholders identified: DRC, Rw, Bu
Steering Committee meeting - Ke

B. Programme Success Stories

Continued commercialization and distribution of CMD resistant material in Uganda

Of the 82 bags of CMD resistant material ratooned from the sub counties of Kasasa, Kisekka and Lwanda, one women's group sold 47 bags at 8,000 UGS per bag (approximately 1,700 Uganda shillings equal 1 US\$). Proceeds from this sale boosted income of the group. The rest of the material was distributed to the vulnerable households in the project area.

CMD resistant varieties identified in Tanzania

The 2000-planted trials at Gera, Bushasha and Maruku were harvested. Varieties TMS 4 (2) 1425, TMS 30337, TMS 30572 and TMS 81983 performed better in the high and moderate disease areas. These varieties were confirmed as the most suitable for large-scale multiplication based on their resistance to CMD. This will further enhance the existing germplasm base available enabling farmers have a wider range of varieties to choose from. Two of these newly evaluated varieties, TMS 4 (2) 1425 and TMS 30572 have already been distributed for multiplication.

Strong regional links again facilitate sharing of germplasm between countries

A further introduction of new CMD resistant germplasm from Uganda to Tanzania was made possible through close collaboration between the national root crops programmes of Uganda and Tanzania, plant quarantine authorities of the two countries and with co-ordinating support from IITA. At the end of March, scientists from Tanzania's Lake Zone Agricultural Research Institute were able to visit Uganda to follow up on earlier requests made to their Ugandan counterparts requesting additional CMD-resistant germplasm to further broaden the base of varieties available to pandemic affected farmers in north-western Tanzania. Following consultations with colleagues in the national programme, from the Plant Quarantine Service and IITA, bags containing 400 elite EARRNET-derived clones and material from some of the latest Ugandan released varieties and pre-release material was loaded onto two trucks and transported to the Open Quarantine Station at Bukoba, north-western Tanzania.

Technology Transfer Centres are established in Kenya

Technology Transfer Centres (TTCs) were established in 5 clusters in Western and Nyanza provinces in western Kenya during this quarter of the project. 280 farmers were introduced to the objectives of the TTCs and were trained in the management of cassava pests and diseases and rapid multiplication techniques.

C. Problems in Achieving Programme Activities

Mole rats posed a serious problem in the multiplication plots at Maruku, Bukoba, Tanzania. The extent of damage was serious enough to warrant control interventions. The Tanzanian team are trying to control the problem by trapping. The same problem was also reported in Homabay FTC.

Heavy hailstorms at KARI-Alupe greatly affected bulking of the crop. There was also an upsurge of annual weeds following rains at KARI-Alupe but these weeds were controlled using Roundup and by hand weeding. At ICIPE, a heavy mealybug attack was reported. All planting material to be obtained from this site will have to be treated with an insecticidal dip prior to being moved. Also in Western Province, porcupines completely destroyed a secondary multiplication site at San'galo.

Transport constraints in western Kenya also greatly delayed activities of the project during this quarter of the project. Whilst the Project vehicle arrived during the quarter, it is not clear if it will be possible to clear it without paying import duty.

Annex 1

OFDA CMD Activities in Uganda – Jan.-March 2001 Community Enterprises Development Organization (CEDO)

Rosemary Mayiga

Locations/Contact Persons:

The plots that were planted in October 1998 (Phase 1) have been ratooned for the second time and the plots have reverted to the plot owners. These were mainly vulnerable household (VHH) groups under the management of partner non-governmental organizations (NGOs) in the project area. From these plots, the NGOs got cuttings for distribution to other vulnerable households who badly needed them because there were no healthy cassava stems available in the area.

The locations and contact persons of plots established during Phase 2 (December 1999) remain as indicated in the sixth quarterly report and have been ratooned once. The ratooned crop is doing well and will be ready for ratooning by May 2001.

Cassava Status:

Planted	Ratooned	Height	Status	Hectares
October 1998	Reverted To VHH groups	_____	_____	10.6
April 1999	Dec. 1999 April 2000 Dec. 2000	4-5ft	Healthy	19.4
October 1999	Aug. 2000 Dec. 2000	4-5ft	Healthy	39.0
Sept. 2000 (92/00067)	_____	3-4ft	Healthy	20.0

All these plots have healthy cassava stems, which are mosaic free.

Technology Transfer Centres (TTCs):

The four TTCs, which were established in the Districts of Rakai and Masaka, are progressing well. The communities have satisfactorily maintained the plots despite the continuous rains received in the project area. Farmers anxiously await the tasting of the different varieties to make choices of varieties of cassava to be multiplied and retained in the area. CEDO staff carried out supervision of these TTCs during their routine field monitoring. An IITA/NARO team comprising Andrew Kalyebi, James Ogwang and Muaka Toko conducted a cassava green mite (CGM) monitoring and evaluation exercise during the last week of February

2001. Some farmers around the TTCs received the variety I92/00067 in September 2000. They have maintained their plots very well. The crop is 3-4ft tall and has already branched. When these plots mature, farmers will give back equal numbers of bags of cassava cuttings they received for further distribution.

SS4 Cassava Cutting Distribution.

The crop was ratooned according to the requirements of farmers who needed the cuttings and had ready plots. The prolonged rains caught many farmers unaware and so their farming plans were slightly disrupted. The multipliers offered their share of the cuttings for distribution to other farmers. One women's group, however, sold its share at 8000/= per bag.

Below was the distribution of SS4 cuttings during the quarter under review:

Plot Ratooned	Sub-county	No. of Bags	Beneficiary
Sheik Khalid	Kisekka	28	56 households
Kalungi w/g	Kasasa	47	sold to MADDO
Rakai DFI	Lwanda	7	14 households

With the onset of the rains for season "A"2001, more ratooning of the crop will be done and further distribution of SS4 cuttings will be made especially to the vulnerable households to ensure food security in their homes.

Related Issues:

For various reasons, our colleague James Ssenoga left the organization. Mr. Fred Kagimu Bikande is now in charge of the cassava programme. The monitoring of the plots continues to be carried out by officers of the respective counties.

Annex 2

OFDA CMD Activities in Kenya – Jan.-March 2001 Kenya Agricultural Research Institute (KARI)

H. M. Obiero

Specific objectives under review

- Multiplication and maintenance of primary and secondary sites
- Establishment of new primary and new secondary sites-
- Activities undertaken at the on-farm trials
- Activities undertaken at the on-station trials
- Monitoring and evaluation of the project
- Other activities e.g. meetings

Description of activities

Primary sites

KARI-Alupe

There was some rain during the months of January-March 2001 at site. There were sporadic storms, which affected all bulking plots. Annual weeds were also a big problem at this site. Hand weeding and spraying with round up was undertaken to combat the weeds. Hailstorms have drastically affected planting materials from the site for the long rains 2001. The newly established 2.4 ha plot of SS4 was hand weeded and top dressed with nitrogen (CAN).

KARI-Kakamega

Multiplication of Migyera was maintained weed free by slashing and spot hand weeding. No planting materials were supplied to farmers because it was fairly dry. The 0.5 ha of SS4 was hand weeded and the materials will be ready for planting during the long rains 2001.

Kibos Sugar Research Centre

The 2.6 ha of SS4 were maintained by hand weeding and slashing. The crop was also pruned and top-dressed with CAN to increase the vigor.

Bukura FTC

The crop was maintained by slashing and spot hand weeding. Funds were provided to purchase tools in preparation for the ratooning exercise. Funds were also provided for preparation of planting materials for farmers and for districts' 2 ha multiplication blocks.

Siaya FTC

The Migyera multiplication field was maintained by slashing and spot weeding throughout this quarter. The SS4 field was hand weeded and the crop will be ready for stem cutting and distribution to farmers during the long rains 2001. Funds were provided for purchase of tools and repairing the fences around the crop for security purposes.

Bungoma FTC

The fields were kept weed free by slashing in and around the field. Funds were provided to purchase tools and repair fences for protection of the crop. Migyera was doing well but SS4 was less vigorous despite having been top-dressed with nitrogen fertilizer. A decision still has to be made on whether the crop will be maintained for another season or not.

Busia FTC

Weeds were controlled by slashing during this quarter of the project. Funds were also provided for purchase of tools.

Homabay FTC

The field was maintained by slashing, spot hand weeding and spraying with an herbicide. The field was also gap filled. Despite all that has been done, the crop is not very vigorous and weeds are still persistent. Mole damage was also reported though some trapping using indigenous knowledge was being undertaken. The field will provide a limited quantity of planting material for the farming community in Homabay district.

ICIPE

All the fields at ICIPE's three farms; Nguku, Amoyo and Mbita Point were kept free of weeds by hand weeding. SS4 variety at Mbita Point had pre-sprouted a lot and was heavily attacked by mealy bugs. It was advised that Rogor E (insecticide) spray be used before cutting and distributing the materials to farmers. At Nguku farm, SS4 was not doing well probably because the variety is unsuitable for the area. However, Migyera at Amoyo was performing well and had grown quite fast. It is expected to be ready for cutting and distribution to farmers during the long rains of 2001.

Allocation of planting materials from primary sites to the seventeen districts in western Kenya has been prepared as indicated below: -

Table: 1 a. Allocation of planting materials, long rains 2001, Western Province

Districts	Source of materials	Variety	Area (ha)	Number of bags of mini stem cuttings
1. Lugari	Bukura FTC	SS4	8	60
	Bungoma FTC	Migyera	8	60
2. Kakamega	Bukura FTC	SS4	12	50
	KARI-Kakamega	Migyera	4	45
3. Vihiga	Kibos Sugar	SS4	8	60
	KARI-Kakamega	Migyera	4	45
4. Bungoma	Bungoma FTC	SS4	4	45
	Bungoma FTC	Migyera	8	60
5. Busia	Busia FTC	SS4	12	90
	KARI-Alupe	Migyera	6	45
6. Butere-Mumias	Bukura FTC	SS4	8	60
7. Teso	KARI-Alupe	SS4	12	90
		Migyera	4	30
8. Mt. Elgon	Busia FTC	SS4	4	30
	Bungoma FTC	Migyera	4	30

Table 1 b. Allocation of planting materials, long rains 2001, Nyanza Province

Districts	Source of materials	Variety	Area (ha)	Number of bags of mini stem cuttings
1. Siaya	Siaya FTC	SS4	4	30
	Siaya FTC	Migyera	4	30
2. Bondo	Kibos Sugar Research C.	SS4	6	45
	KARI-Kakamega	Migyera	3	45
3. Kisumu	Kibos Sugar Research C.	SS4	8	60
	KARI-Kakamega	Migyera	6	45
4. Nyando	Kibos Sugar Research C.	SS4	12	90
	KARI-Kakamega	Migyera	6	45
5. Rachuonyo	KARI-Kakamega	SS4	8	60
	KARI-Kakamega	Migyera	6	45
6. Homabay	Homabay FTC	SS4	4	30
	ICIPE (Nguku farm)	Migyera	4	30
7. Suba	ICIPE (Mbita Point farm)	SS4	6	45
	ICIPE (Nguku farm)	Migyera	6	45
8. Migori	ICIPE (Mbita Point farm)	SS4	4	30
	ICIPE (Nguku farm)	Migyera	6	45
9. Kuria	ICIPE (Mbita Point farm)	SS4	6	45
	KARI-Kakamega	Migyera	6	45
10. KARI-Oyani (primary	Kibos Sugar Research C.	SS4	6	45
	KARI-Kakamega	Migyera	6	45

Adjustments will be made depending on availability of materials and demand from various stakeholders in the region.

Old Secondary sites

Western Province

All the earlier established secondary sites were maintained by hand weeding during this quarter of the project. The sites established during the long rains of 2000 will provide planting materials for long rains of 2001. Although there were hailstorms in most areas, the crop at most of the sites has recovered except the one at Sanga'lo. At this site, porcupines invaded the crop after the hailstorm and destroyed the entire crop. This site is also risky because there is no security. The few remaining plants cannot be maintained. However, the district has selected another site, ploughed and planted another crop to replace the Sang'alo site.

Nyanza Province

All the sites were maintained by hand weeding. The earlier established sites will provide planting materials to farmers during long rains of 2001.

New Primary and Secondary sites

KARI- Oyani primary site

Four hectares of land was prepared at KARI-Oyani Sub-Center. SS4 and Migyera varieties have been planted, each on two hectares of land.

New secondary sites

The following sites were prepared for secondary multiplication during the months of January to March 2001 in both Nyanza and Western Provinces in readiness for planting: -

Western province

District	Area (ha)
1. Lugari	4.0
2. Kakamega	4.0
3. Vihiga	2.0
4. Bungoma	4.0
5. Mt. Elgon	2.0
Total	16.0

Nyanza province

District	Area (ha)
1. Bondo	4.0
2. Nyando	4.0
3. Suba	4.0
Total	12.0

On farm trials

Teso district (Amukura)

The trials were well maintained by farmers and 6 MAP data was recorded on 13th February 2001. The trial was doing well with most of the clones showing resistance to CMD and CGM.

Siaya district (Ukwala)

The trial was well managed by the farmers. 3 MAP data was taken on 1st March 2001. The trial was doing well at the time of observation.

Rachuonyo, Migori and Kuria districts

6 MAP data has not been taken on the trials in the above districts due to transport constraints. These data will be taken soon.

On-station trials

KARI-Alupe

9 MAP data were taken for AYT and PYT trials during the month of February. The trials were also hand weeded but suffered from persistent hailstorms, which affected the crop drastically. The trial will be evaluated but it may have to be repeated.

KARI-Kakamega

6 MAP data for the trial was taken. The trial is doing well and the final (third) hand weeding was done in February 2001. Several clones have shown some resistance to cassava green mite in comparison to SS4 and Migyera, which are used as controls in the trial.

ICIPE - Mbita Point

Data collection on the trial was done once. The site may have to be dropped since the area is not a major cassava growing zone and hence not very representative. Also because the site is irrigated, this may cause considerable divergence of the results from those of other sites that are under natural rainfall.

KARI-Oyani Sub-centre

An on-station trial will be established at the center to replace the one that was at Homabay FTC. Bush clearing and plowing started in Feb/March 2001 in preparation for planting in April.

Monitoring and Evaluation

Tour in Western province by the PCO

The new provincial crops officer Western province, Mr. Malinga, toured the districts to be briefed on the progress of the cassava project in the province.

Tour in Nyanza province by the PCO

The PCO Nyanza toured districts in Nyanza province in preparation for the tour by the steering committee members who would be meeting in Nyanza.

Other activities

Cassava Steering Committee

A cassava steering committee was convened at Mlimani Resort Hotel, Kisumu from 12th to 16th March 2001. It was well attended by all donor representatives of the project and members of the steering committee. The progress of the project in the year 2000 was discussed and achievements were acknowledged. The way forward in the year 2001 was also discussed and the aspect of commercializing seed bulking was advocated for and encouraged. The NGO representative, CARE Kenya, was asked to co-ordinate other NGOs with a view to soliciting for funds to support the project.

Annex 3

OFDA CMD Activities in Tanzania – Jan.-March 2001 Lake Zone Agricultural Research Institute (LZARDI), Tanzania

S. Jeremiah and I. Ndyetabula

Training

IPM/N group farmers in Kagera were trained in phytosanitation and management of cassava fields. This training aimed at equipping those farmers with the best techniques in cassava field management, so that the fields established for the purpose of involving farmers in evaluation of varieties, control of cassava mosaic using resistant varieties and rapid multiplication in the last quarter were managed well. The aspects emphasized included weeding established plots on time and roguing of diseased plants in multiplication plots to maintain the disease-free status of the plots and prevent subsequent transmission of disease through the planting material produced.

A training of trainers' workshop was conducted at ARI Maruku for field officers working under FAO farmer field schools (FFS). Aspects covered in the training included cassava mosaic disease and its control, and rapid multiplication techniques. Nineteen extension workers from Muleba and Bukoba districts who are actively involved in farmer field schools in these areas were involved in this training. Through FFS, plots for multiplication of resistant varieties will be established in early May.

Evaluation trials

Evaluation of clones introduced from EARRNET

The best clones selected in October 2000 and planted in the evaluation plot were well managed and the data on disease severity and pest incidence were recorded. Characterization was done in early April 2001. The characterization was based on morphology of the plant, and on pest and disease susceptibility. It was observed that all ten best clones being evaluated were susceptible to cassava bacterial blight, exhibiting mild to medium symptoms of the disease but all were free of CMD infection. Only two plants showed cassava green mite (CGM) infestation.

CMD was observed amongst the second tier of 80 clones selected from open quarantine. Eleven plants were found to be infected with CMD. The clones infected were MM 96/453, MM 96/5870, MM 96/4883, MM 96/8408, I 91/0316, MM 96/3385, MM 96/4466, MM 96/8450 and two clones that lost their identity during open quarantine evaluation last year.

IITA tissue culture evaluation for resistance to EACMV-Ug

IITA tissue culture material is being evaluated at three sites (Maruku, Gera and Bushasha) for resistance to cassava mosaic disease and other diseases and pests prevalent in Bukoba. Data collection on disease severity and pests' occurrence was done on a monthly basis during this quarter.

The varieties I 92/0600 and I 93/0571 (3X) were found to be partly infested by cassava mealybug at the Gera and Bushasha sites. The plants affected by cassava mealybug were recorded and rogued to avoid further spread of the pest.

Open quarantine facility at ARI Maruku

The open quarantine facility at ARI Maruku was kept free from weeds. Inspection of the material was done several times by the research officers at Maruku. Bacterial blight was observed to be the most common problem at the open quarantine in the SS4 plots.

At the end of March, new clones from Uganda were imported. Four hundred clones were planted for evaluation and seven new varieties were planted for rapid bulking.

The varieties planted included:

1. I 91/00063
2. TME 14
3. I 91/0057
4. I 91/0067
5. MH 95/0414
6. I 91/2324
7. I 91/2327

The sprouting of the clones planted at open quarantine was good due to favorable weather condition. Planting was done at a spacing of 1m X 0.5 m for bulking and 1m X 1m for evaluation. Data collection will be done at two-weekly intervals starting from sprouting. This will involve monitoring for any new and local pest and disease occurring in the plot.

Germplasm diversification and evaluation

The second set of the trials planted in 2000 was harvested in February 2001. Yield data were recorded during harvest. An assessment was also conducted by farmers, at the end of which they were provided with some planting materials.

The variety TMS 30572 (6) had the highest fresh root yield at the Maruku site during 1999, with a mean of 49.6 t/ha. The same variety yielded 10.2 t/ha at Bushasha and 1.1 t/ha at Gera during the same year of study. In the year 2000, the variety TMS 42029 had the highest fresh root yield at Maruku site (24.9 t/ha)

followed by TMS 4(2) 1425 (16.8 t/ha) and Rushura - local check (14.2 t/ha). During the same year variety TMS 4(2) 1425 was leading at Bushasha site whilst the variety Msitu Zanzibar performed better at Gera site with a mean of 8.6 t/ha. Lwakitangaza had high yields at all sites (with the root yield above the site average) despite the high disease incidence, which was close to the mean at Gera and Bushasha.

In terms of disease resistance and yield performance, varieties TMS 4(2) 1425, TMS 30337, TMS 30572 and TMS 81983 performed better in high and moderate disease pressure areas (i.e. Gera and Bushasha respectively). These varieties were recommended for multiplication.

Assessment of the material by farmers was done as planned at all sites (Gera, Maruku and Bushasha). During the exercise, farmers from the locality were invited to select varieties they preferred based on their own criteria. Two major criteria were mentioned during selection of the material. Other criteria were considered once the two major criteria were had been met. The two major criteria were sweetness of the harvested tuber when raw and cooked, and yielding ability of the variety. These two were mentioned as the determining factors for selection. Based on these criteria, farmers were asked to select the top three varieties. Msitu Zanzibar was rated the best followed by 106 and then Rushura. All of the selected varieties are sweet but susceptible to severe CMD.

Multiplication of promising cassava varieties

All primary multiplication plots at both Maruku and Ukiriguru were kept free of weeds. All infected plants were rogued and gap filling was done to reduce the gaps in the plots. New secondary multiplication plots were established in collaboration with KAEMP, FAO/FFS, the Rubya project, DALDO office Bukoba and World Vision Misenyi ADP. Two farmers near Kemondo bay – Bukoba established their own multiplication plots. TMS 4(2) 1425 and TMS 30572(6) were distributed to farmers in this quarter. 3.4 ha of multiplication plots were established through KAEMP.

Planting of TMS 4(2) 1425 will be done in the last week of April. This will not be possible in Tarime and Musoma due to the shortage of rainfall at this time.

Two sites and 1 site in Muleba and Bukoba district respectively for establishment of multiplication plots were prepared through FAO/FFS. These plots will be planted during the last week of April.

Future plans

During the next quarter of April to June the following activities will be undertaken:

- Conduct farmers' assessment of each variety at different TTCs/IPM/N groups established during the last quarter in Bukoba, Mara and Geita district. The

assessment will be based on field observations. Farmers in TTC/PPM/N groups will be asked to select varieties basing on their own selection criteria.

- Continue with maintenance of both primary and secondary multiplication plots already established. New secondary multiplication sites will be established in Muleba, Bukoba and Karagwe districts. It is expected that the variety TMS 4(2) 1425 will be the most widely distributed variety to farmers in this quarter.
- Maintenance of on-farm and on-station evaluation plots and data collection will continue until harvest.
- A diagnostic survey will be conducted in the Lake zone to monitor the spread of severe CMD and to evaluate the status of CMD in the post-epidemic, epidemic and pre-epidemic areas.
- Training of farmers and extension officers on cassava mosaic disease and its control will be conducted.
- Maintenance of open quarantine at Maruku will continue. The materials reserved for evaluation and multiplication at the open quarantine site will be assessed during this quarter in the Lake Zone.
- Early warning systems will be implemented in some areas in the Lake Zone. Researchers will go back to the farmers who were trained in this system last year to find out how they are progressing. This will help in determining the applicability of this system to farmers. Farmers in Geita, Biharamulo and Musoma district will also be trained under this system.

Problems encountered

Mole rats were a problem in multiplication plots at Maruku site. This is a very common problem faced by the farmers producing root and tuber crops in Bukoba. These pests were controlled by trapping in order to save the crop in the field.

Annex 4

Identity and Distribution of Whitefly Vector Variants Associated with Begomovirus Infections of Cassava in Eastern African Countries January-March, 2001

Dr. Judith K. Brown

Project Goal and Approach. The goal of this study is to apply a PCR based-methodology to determine the identity and map the distribution of whitefly vector biotypes associated with cassava-infecting begomoviruses in Eastern Africa. The purpose is to better understand the identity, dynamics, relationships, and specific circumstances surrounding whitefly vector populations in cassava, in relation to the new begomovirus epidemic and ACMV/EACMV/EACMV-Ug in cassava.

Objectives:

1. To continue to use a strategy recently developed in the Arizona laboratory by which *B. tabaci* variants/biotypes/topotypes can be identified or differentiated using PCR amplification of the mt cytochrome oxidase I gene fragment. This sequence has been found to be highly useful for discriminating between *B. tabaci* variants by comparative analysis with reference sequences in the mt COI database developed in the Arizona laboratory.
2. To develop a combined PCR/restriction-enzyme approach for identifying the most common biotypes of *B. tabaci* in cassava, and thereby, permit monitoring of whitefly vector activity on-site. This will involve development of diagnostic DNA patterns for each commonly occurring *B. tabaci* found thus far in Kenya, Tanzania, and Uganda. The objective requires the identification of unique restriction enzyme sites within the mt COI amplicon for each unique population.

Methodologies: Whitefly adults and nymphs will be collected from infested plants and placed live in 70-95% alcohol. These samples, when identified as *B. tabaci* using classical taxonomic criteria (Gill, 1982; 1990) by our IITA collaborator, will be provided to the US laboratory for molecular analysis to achieve provisional 'typing' or identification of the particular variant. The following information will be recorded for each sample: locality, host plant, begomovirus disease symptoms and/or levels of whitefly infestation, and date of collection.

The mitochondria cytochrome oxidase I gene (COI) will be used as an informative molecular sequence for predicting identity, and thereby, associated biogeographic characteristics of *B. tabaci* biotypes in cassava. Total nucleic acids will be extracted from individual female whiteflies as described (Frohlich et al., 1999). Extracts will be incubated at 65C for 15 min and 95C for 10 min and centrifuged to pellet debris. The aqueous supernatant will be used for PCR amplification. PCR primers will be C1-J-2195 (5' ttg att ttt tgg tea tcc aga agt 3') and L2-N-3014 (5' tcc aat gca cta atc tgc cat att a 3') obtained from the UBC Insect Mitochondria DNA Primer Oligonucleotide Set, compiled by B. J. Crespi

and C. Simon (Simon et al., 1994). PCR products will be obtained as described (Frohlich et al., 1999) and subjected to automated DNA sequencing. DNA sequences will be obtained in both directions for a minimum of two-three individual whiteflies per sample and two-three clones per PCR reaction.

Sequences will be aligned to reconstruct a COI phylogeny, and unique sequences will be added to the database housed at the Whitefly LINK at the GEMINIDETECTive website at the UA (gemini.biosci.arizona.edu). Whitefly mtCOI sequences will constitute valuable 'reference sequences' to facilitate identification of variants using the BLAST algorithm available at the site. Ultimately, a distribution map for all distinct variants (biotypes, topotypes) will be constructed to enable monitoring of 'known' and newly up surging *B. tabaci* in agroecosystems, worldwide.

Several common restriction enzymes will be explored for their ability to digest the mt COI amplicons at unique sites for the biotypes occurring most commonly in Kenya, Tanzania, and Uganda. Our goal is to generate diagnostic patterns to permit on-site tracking of *B. tabaci* in cassava at IITA. This tool will enable tracking of the whitefly vector, and thereby, complement ongoing work to monitor begomoviruses in cassava in epidemic and non-epidemic areas.

Results to Date: During the first three months of 2001, we have explored possibilities for developing user-friendly PCR assays to differentiate between the main genotypes of *B. tabaci* associated with cassava in Uganda transects and adjacent locales to which the disease has spread in cassava, and a non-cassava host. We expect that this technology will be put into place at IITA to enable scientists there to identify the commonly occurring biotypes, and thereby be prepared to detect changes in populations that may be related to the epidemiology of cassava-transmitted begomoviruses.

We selected individual collections representative of four genotypes, based on mt COI analysis of *B. tabaci* in year one.

1. Genotype I - Uganda Behind the Front/At the Front (invasive genotype)

UG1	4 I zone Bukoba 3 AH (like invader) ahead of the front
UG14	14 M zone Nakanyonyi1 (BH) - behind the front
UG31	B zone Kawanda FR (at the front)

2. Genotype II - Uganda Ahead of the Front (indigenous genotype)

UG33	Bzone Kiyunga AH
UG35	Bzone Kitende AH

3. Genotype III - Common in Tanzania (indigenous); not found in Uganda

TZ3	Tanzania 3
UG20	20M zone Ntanzil AH (looks like close relative to Tanzania)

4. Genotype IV - Non-Cassava Outgroup

UG 38	Namulonge Sweet potato (unique genotype compared to rest)
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1. Mitochondria cytochrome oxidase I gene. We have exhaustively explored the design genotype-specific primers for mtCOI sequences. These sequences are far too A-T rich and too highly conserved, except for flanking regions around which existing primers were designed, to enable genotype-specific primer design within the coding region in hand. We used two primer design programs which yielded the same conclusions.

We also designed several sets of primers by visual assessment and tested these. The result was less than satisfactory and reactions yielded multiple bands. We attempted to optimize the PCR reaction by employing a hot start approach, along with altering the annealing temperature, Mg²⁺ concentration, and amount of template and we did not obtain satisfactory results.

2. Nuclear coding region. For this approach, we selected the whitefly *kdr* gene, a nuclear coding region implicated in insecticide resistance in whiteflies (Morin, Dennehy, and Brown unpublished). Primers have been designed and used successfully to amplify an expected size PCR product from whiteflies. PCR products for several candidates (list above) and for the Arizona A and B reference colonies have been obtained. PCR amplicons have been sent for automated DNA sequencing. We expect the sequences to provide the information we need to identify useful (unique) restriction sites or perhaps stretches of DNA around which genotype-specific primers may be feasibly designed. If this is not feasible, we will most certainly be able to identify unique restriction sites in this gene to differentiate the candidate whitefly genotypes.

There are three main advantages to this approach: (1) nuclear sequences are not A-T rich making them more amenable to primer design, (2) nuclear genes can be used to study and track sympatric interbreeding and non-interbreeding, and allopatric populations because they are not exclusively maternally inherited as is the mtCOI, and (3) if this gene proves to be involved in insecticide resistance in whiteflies as preliminary data suggest, we will be able to simultaneously monitor changes in the *kdr* receptor related to insecticide resistance, and to achieve our initial goal which is to detect small changes occurring in nuclear sequences with population level accuracy.

Whether genotype-specific PCR primers can be designed is not yet known. If unique restriction sites can be identified in this coding region, PASA can be used to differentiate these populations based on single nucleotide changes.

3. EPIC primers. A third possible approach could be explored that involves use of EPIC primers (exon-priming, intron-crossing). Such primers have been used to amplify introns (which vary at a higher frequency than coding genes) by anchoring primers in the conserved coding region. This approach has been a great asset for studying population level genetics of other invasive insects. We do not yet know whether this approach will be necessary.

Annex 5

Report on Accelerated multiplication and distribution of healthy planting materials of improved cassava varieties in Western Kenya presented at the Steering Committee Meeting 12th -16th March 2001

Progress report for the year 2000

H.M. Obiero

Executive summary

Rapid multiplication

All the old primary multiplication sites were maintained and weeds were controlled by roundup herbicide (glyphosate), spot hand weeding and slashing. Roundup effectively controlled couch grass but annual broad-leaved weeds soon germinated and were easily controlled by spot weeding and slashing. The herbicide was applied to the ratoon crop when it was at an approximate height of 60 cm. Six of the seven primary sites were cut three times during the year while the other site was cut twice. Each of the seven sites provided 5106.5 large bags of planting material. Expansion of the old primary sites and the two new primary sites totaled 37 ha. The total area under primary sites now stands at 80.2 ha.

In Nyanza province a total of 42 ha, each 2 ha, of secondary multiplication was prepared though only 32 ha are on the ground. The other 10 ha were destroyed by the extended dry spell of April-July, 2000. In Western province 26 ha of secondary multiplication were established. Establishment of secondary sites is financially supported by the project. The support caters for land preparation, transportation of planting materials from source, planting, weeding and per diems for the implementing extension officers.

Individual farmers and farmer groups including NGOs/or CBOs who supported farmers, were provided with planting materials from the primary sites. This arrangement falls under tertiary multiplication whose activities are not financially supported by the project. Planting materials were supplied to some farmers in all the seventeen districts of Nyanza and Western provinces. Due to unfavorable weather only 60% of the materials provided survived. Over 85% of the materials supplied during the short rains 2000 established well because of the prolonged rains. Farmers who have planted improved cassava varieties through tertiary arrangements in Nyanza and Western provinces are 1049 and 2770 respectively. The acreage under multiplication under the same arrangement in Nyanza and Western provinces are 165.8 ha and 335.7 ha respectively.

Germplasm diversification

All the introduced germplasm at KARI-Alupe was kept weed free by use of herbicide (glyphosate), hand weeding and slashing.

Preliminary yield trial (PYT)

In March 2000, fifty-six clones were released by KEPHIS. Fifty one (51) of the clones were certified and planted in a replicated PYT at Alupe. The trial has been maintained by hand weeding. 3 MAP data has been taken.

Advanced yield trial (AYT)

Out of the 172 clones, which were under PYT at Alupe, 96 clones were selected based on CMD resistance, yield and cyanide potential. They were used to establish a replicated AYT at KARI-Alupe in May 2000.

From the same 172 clones, thirty clones were selected based on the same criteria above and planted in a replicated AYT at KARI-Kakamega, Homabay FTC, and ICIPE (Mbita Point).

On-farm trials

The fourteen most promising clones were planted in replicated trials in six districts at seven sites between June and August 2000. A total of twenty-eight farmers undertook the activity. Most farmers have maintained the trials by hand weeding. 3 MAP data has been taken for all the sites.

Training

A demonstration training was conducted by the PCOs of both provinces for farmers implementing rapid multiplication in the seventeen districts between January and March 2000. Farmers trained were 804 and 790 in Nyanza and Western provinces respectively.

Training and technology transfer centers (TTCs) were established in five clusters in Nyanza and Western provinces. The farmers were trained on agronomy of cassava production and rapid multiplication. The same farmers were provided with 300-500 mini-stem cuttings to plant in their homes. Farmers who were trained were two hundred and seventy.

Monitoring and diagnostics

A monitoring and diagnostics survey to track the spread of CMD and related diseases and pests was conducted from the 15th to 27th of August, 2000 in fifteen districts of Nyanza and Western provinces. The survey revealed that incidences of CMD are higher in the northern region than in the southern region.

Project management and monitoring

Provincial directors of Agriculture, Livestock Development and Extension Officers of Western and Nyanza provinces, Centre Director-Kakamega and Provincial Crops Officers visited primary, secondary and tertiary sites, and the replicated on-farm trials in the region to assess the progress of the project during

the month of November 2000. A team of biometricians led by professor Sagary Nokoe visited the on-farm and on-station trials in the region in November 2000.

Dr. DeVries of Rockefeller Foundation and Mr. Torino, a consultant with Rockefeller Foundation visited the region in December 2000 to assess the progress.

Project Overview

Project goal

Improve food security and alleviate poverty in the lake basin region of western Kenya.

Project purpose

1. Provide farming communities in Western Kenya with healthy and improved cassava planting materials.
2. Develop flexible and decentralized cassava planting materials and delivery system.
3. Develop capacity for sustainable development of cassava in the lake basin region

Project objectives

1. Rapid multiplication and distribution of CMD resistant clones.
2. Germplasm diversification.
3. Training and technology transfer.
4. Monitoring and diagnostic surveys.
5. Project management and monitoring.

Project performance

Rapid multiplication

Table 1 a: Quantities of planting materials supplied to districts during long rains 2000.

Primary site	District	VARIETIES (Quantity in bags)		Total number of bags
		SS4	Migyera	
1. KARI-ALUPE	Busia	38	32	70
	Teso	62	32	94
	Bungoma	40	-	40
	Mt. Elgon	20	4	24
	Suba	30	10	40
	Homabay	35	7	42
	Bondo	34	-	34
	Migori	7	-	7
	Kuria	34	7	41
	Siaya	70	16	86
	Rachuonyo	40	-	40
	ICIPE	30	20	50
	Total	440	128	568

Table 1 b: Quantities of planting materials supplied to districts during long rains, 2000.

Primary site	District	VARIETIES (Quantity in bags)		Total number of bags
		SS4	Migyera	
2. KARI-KAAKAMEGA	Bungoma	-	49	49
	Nyando	-	42	42
	Migori	-	33	33
	Rachuonyo	-	46	46
	Suba	-	16	16
	Homabay	-	22	20
	Total	-	206	206

Table 1.c: Quantities of planting materials supplied to districts during long rains, 2000

Primary site	District	VARIETIES (Quantity in bags)		Total number of bags
		SS4	Migyera	
3. KARI-KIBOS	Vihiga	21	-	21
	Kisumu	132.5	-	132.5
	Nyando	26	-	26
	Homabay	24	-	24
	Migori	72	-	72
	Kuria	14	-	14
	Siaya	54	-	54
	Total	343.5	-	343.5

Table 1 d: Quantities of planting materials supplied to districts during long rains, 2000.

Primary site	District	Varieties (Quantity in bags)		Total number of bags
		SS4	Migyera	
4. SIAYA FTC	Bondo	-	12.5	12.5
	Nyando	-	11	11
	Siaya	-	22	22
	Total	-	45.5	45.5

Table 1 e: Quantities of planting materials supplied to districts during long rains, 2000.

Primary site	District	Varieties (Quantity in bags)		Total number of bags
		SS4	Migyera	
5. BUKURA FTC	Butere-Mumias	51	-	51
	Kakamega	90	-	90
	Vihiga	2	-	2
	Total	143		143

Table 1 f: Quantities of planting materials supplied to districts during long rains, 2000.

Primary site	District	Varieties (Quantity in bags)		Total number of bags
		SS4	Migyera	
6. BUNGOMA FTC	Bungoma	79.5	-	79.5

Table 1 g: Quantities of planting materials supplied to districts during long rains, 2000.

Primary site	District	Varieties (Quantity in bags)		Total number of bags
		SS4	Migyera	
7. BUSIA FTC	Busia	207	-	207
	Bungoma	17	-	17
	Total	224	-	224

Table 2. a: Quantities of planting materials supplied by primary sites during the beginning of short rains, 2000.

Primary site	Varieties (Quantity in bags)		Total number of bags
	SS4	Migyera	
1. KARI-Alupe	612	179	791
2. KARI-Kakamega	-	470	470
3. KARI-Kibos	391	-	391
4. Siaya FTC	-	53	53
5. Bukura FTC	155	-	155
6. Bungoma FTC	149	-	149
7. Busia FTC	366	-	366
Total	1673	702	2375

Table 2.b.: Quantities of planting materials supplied to districts by primary sites during the prolonged short rains, 2000.

Primary site	Varieties (Quantity in bags)		Total number of bags
	SS4	Migyera	
1. KARI-Alupe	360	72	432
2. KARI-Kakamega	-	450	450
3. KARI-Kibos	116	-	116
4. Siaya FTC	98	-	98
5. Bukura FTC	87	-	87
6. Bungoma FTC	128	-	128
Busia FTC	-	40	40
Total	789	562	1351

Table 2. c.: Primary multiplication established during the long rains and short rains, 2000.

Primary sites	Varieties and area in ha			Status
	SS4	Migyera	Total	
1. Homabay FTC	2.0	-	2.0	50% established, materials ready for distribution long rains 2001.
2. ICIPE -Nguku farm	5.8	3.0	8.8	SS4 50% established, Migyera 80%; materials ready for distribution long rains, 2001
-Amoyo farm	-	10.0	10.0	80-90% germination and gapped
-Mbita Point	1.2	-	1.2	60% established, ready for distributing long rains 2001.
3. Bungoma FTC	-	4.8	4.8	80% established, provide planting materials long rains 2001
4. Siaya FTC	2.0		2.0	60% established and gapped
5. Busia FTC	-	0.4	0.4	Not well established
6. KARI-Alupe	2.4	2.0	4.4	-80% established, materials available long rains. 2001
	2.4	-	2.4	-80% take, just establishing
7. KARI-Kakamega	0.4	-	0.4	-90% take, provide materials 2 nd season 2001.
Total	16.2	20.2	36.4	

**Table 2.d: Secondary multiplication established during long rains, 2000
WESTERN PROVINCE**

Districts	Variety	Area (ha)	Status
Busia	SS4	1.2	80% established, will provide seed long rains, 2001.
Bungoma	Migyera	2.0	Not very well established
Total area		3.2	

**Table 2.e. Secondary multiplication established during long rains, 2000
NYANZA PROVINCE**

Districts	Variety	Area (ha)	Status
1. Kisumu	SS4	2.0*	Destroyed by drought
2. Nyando	SS4	2.0*	Destroyed by drought
3. Rachuonyo	SS4	2.0*	Destroyed by drought
4. Migori	SS4	1.2	Established, will provide seed long rains, 2001.
	Migyera	0.8	
5. Kuria	SS4	1.6	Established will provide seed long rains, 2001.
	Migyera	0.4	
6. Suba	SS4	2.0*	Destroyed by drought
7. Bondo	Migyera	2.0*	Destroyed by drought
8. Siaya	SS4	2.0	Getting established
9. Homabay	SS4	2.0	60% established will provide seed long rains, 2001
	Migyera	1.2	60% established will provide seed long rains, 2001
Total		19.2	

Key * Destroyed by drought. Only 8 ha were able to establish for seed multiplication.

**Table 2. f: Secondary multiplication established during short rains, 2000
WESTERN PROVINCE**

Districts	variety	area (ha)	status
1. Busia	Migyera	2.0	90% germination, weeded ounce
	SS4	6.0	90-100% germination, weeded ounce
2. Butere-Mumias	SS4	2.0	90% germination, weeded ounce
3. Kakamega	Migyera	1.2	80% germination, weeded ounce
	SS4	2.0	80% germination, weeded ounce
4. Mt. Elgon	SS4	1.2	90% germination, weeded ounce
	Migyera	1.2	90% germination, weeded ounce
5. Vihiga	SS4	2.0	90% germination, weeded ounce
	Migyera	1.2	90% germination, weeded ounce
6. Teso	Migyera	2.0	70% germination, weeded ounce
Total		20.8	

**Table 2. g: Secondary multiplication established during short rains, 2000
NYANZA PROVINCE**

Districts	Variety	Area (ha)	Status
1. Kisumu	Migyera	4.0	80% germination
	SS4	2.0	80% germination
2. Rachuonyo	Migyera	6.0	80% germination
	SS4	2.0	80% germination
3. Homabay	SS4	2.0	80% germination
4. Kuria	SS4	4.0	80% germination
5. Migori	Migyera	2.0	90-100% germination
6. Siaya	SS4	2.0	90% germination
Total		24.0	

**Table 2. h.: Tertiary multiplication, long rains, 2000
Western Province**

District	Number of farmers who planted cassava	Area (ha)
1. Kakamega	406	30.4
2. Lugari	59	6.4
3. Butere-Mumias	210	28.8
4. Vihiga	158	10.0
5. Busia	413	64.8
6. Bungoma	318	27.6
7. Mt.Elgon	36	14.6
8. Teso	168	22.8
Total	1768	205.4

**Table 2. i: Tertiary multiplication, long rains, 2000
Nyanza Province**

District	Number of farmers who planted cassava	Area (ha)
1. Kisumu	123	16.8
2. Nyando	92	16.0
3. Rachuonyo	128	14.0
4. Homabay	56	16.8
5. Migori	78	14.0
6. Kuria	58	10.0
7. Suba	61	10.0
8. Bondo	126	16.0
9. Siaya	138	20.2
Total	860	133.8

**Table 2.j: Tertiary multiplication, short rains, 2000
Western Province**

District	Number of farmers who planted cassava	Area (ha)
1. Kakamega	210	16.4
2. Butere-Mumias	48	12.2
3. Vihiga	127	11.2
4. Lugari	36	2.4
5. Bungoma	128	17.4
6. Busia	148	22.0
7. Teso	64	20.0
8. Mt. Elgon	36	5.2
Total	797	106.8

**Table 2. k: Tertiary multiplication, short rains, 2000
Nyanza Province**

District	Number of farmers who planted cassava	Area (ha)
1. Kisumu	58	12.0
2. Siaya	73	6.0
3. Bondo	29	1.5
Total	160	19.5

Germplasm diversification

Advanced Yield Trial (AYT)

KARI-Alupe

Ninety-six clones were selected in March 2000 from PYT of 172 clones at KARI-Alupe. The basis of selection was resistance to CMD, yield and other important agronomic characteristics. The clones were planted in a replicated trial. 3 MAP data has been taken

Homabay FTC

An AYT trial of thirty-two clones was established at Homabay FTC on 4th August 2000. At the time rains were good and germination of 90-100% had been achieved. When the trial was weeded in September 2000 the rains had stopped. As a result, the majority of the clones dried up. To date the site has not improved.

ICIPE (Mbita-Point)

A replicated trial of 32 clones was established at Mbita Point on 5th of August 2000. Establishment was good but termites destroyed many of the plants. Gap filling was done and the termites controlled of with an appropriate chemical.

KARI-Kakamega

The same trial of 32 clones was established at KARI-Kakamega on 10th August 2000. The trial has been weeded three times and is in good condition. 3 MAP data has been taken.

Preliminary Yield Trial (PYT)

A preliminary yield trial of fifty-one (51) entries replicated three times was planted at KARI-Alupe on 11th May 2000. The trial has been weeded four times. 3 MAP and 6 MAP data has been taken.

On-farm trials

On-farm trials were established at seven sites on twenty -eight farmers' fields. An augmented design was adopted. Indicated below are the districts where the on-farm trials were established:

1. Butere-Mumias
2. Siaya
3. Teso
4. Rachuonyo
5. Migori
6. Kuria (two sites, Kehancha and Subakuria)

Quarantine

The 189 clones introduced into quarantine in 1999 were kept weed free by hand weeding throughout the year. Data on CMD and other related agronomic characteristics have been recorded.

Bulked clones

The previous fourteen (14) fast track (promising) clones mother block was maintained by use of herbicide (*glyphosate*) and slashing throughout the year.

Training and technology transfer (TTCs)

Training and demonstration

Training on agronomy and rapid multiplication of cassava was conducted by district steering committees in all the seventeen districts of Nyanza and Western provinces between January and March 2000. The number of farmers trained is as shown below:

Table.3.1.: Number of farmers trained

Province	Number of farmers trained
1. Nyanza	804
2. Western	790
Total	1,594

Cluster technology transfer

Farmers in clusters were trained in cassava agronomy and rapid multiplication. Demonstrations were then conducted and planting materials of 300-500 mini-stem cuttings were given to those farmers who had attended the training and demonstration sessions. They were encouraged to go and plant as they had learnt.

Table3.2. : Clusters and number of farmers trained

District	Site	Number of farmers trained
1. Vihiga	Luanda	106
2. Butere-Mumias	Khwisero	45
	Matungu	28
3. Teso	Amukura	36
4. Kuria	Kegonga	45
5. Siaya	Ukwala	20
Total		280

IITA-KARI CGM Project training course

IITA-KARI CGM Project organized a three days' training course from 22nd - 25th of Nov. 2000 at Migori. Farmers and Extension officers involved in cassava green mite trials in Nyanza attended. Representatives of an NGO involved in cassava promotion and one from the Western Kenya cassava project also participated. Some of the topics covered in the training included identification and control of cassava green mite (CGM) and other insect pests and diseases affecting cassava in the region. Participants were also trained on rapid

multiplication techniques. The participants were also briefed on the activities of the cassava project in the region

Monitoring and diagnostic survey

A monitoring and diagnostic survey was conducted in western Kenya from 15th - 27th of August 2000. The major objective of the survey was to assess the spread of CMD, other related pests and diseases of economic importance in the lake basin region. The survey was conducted in fifteen districts on more than 100 farmers' plots.

Incidence of CMD in the northern region was 80-100% while most of the districts in southern region had an incidence of 0-20%. Cutting infection was more frequent than whitefly transmitted infection. However, the level of CGM is high in the southern districts. Also mealybug infestation was reported from a number of localities in the region.

Project management and evaluation

Respective provincial directors of Agriculture, Livestock and Extension of Nyanza and Western provinces in the company of the Centre Director-Kakamega visited their respective provinces to assess the progress of cassava project on 6th - 10th of November and 21st-24th November 2000.

Biometricians headed by Prof. Nokoe from IITA/Ibadan visited and assessed performance of on-farm and on-station trials established in the region. Dr. DeVries of Rockefeller Foundation, Nairobi office and Mr. Torino, a consultant for Rockefeller Foundation New York office visited western Kenya on 4th-5th and 7th-8th of December respectively.

Achievements

- (a) Roundup (glyphosate) herbicide was effective in controlling grasses in ratoon crops. For a young newly established crop of cassava, use of herbicide was not possible since grasses grow faster than cassava.
- (b) More primary sites were established; secondary multiplication and tertiary multiplication activities were initiated.
- (c) Six technology transfer centres were established.
- (d) On-station and on-farm trials are being conducted.

Constraints

- (a) The demand for CMD resistant planting materials exceeds supply by far.
- (b) Vagrant weather experienced during the long rains, 2000 seriously affected multiplication of CMD resistant material
- (c) Lack of reliable means of transport for the project seriously hampered monitoring activities.

(d) A few stakeholders do not honor the pledges of their roles and also delays in surrendering imprests seriously affects the project's workplan.