A farmer checking vines planted using roots from Triple S technology in Kole district, Uganda.
Photo by Sam Namanda- CIP Uganda

Delivering and Disseminating Biofortified Crops in Uganda

Final Report
January–December 2013

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International Potato Center (CIP), National Crops Resources Research Institute (NaCRRI)/National Agricultural Research Organization (NARO), Makerere University (MAK) and BioCrops

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Prepared by

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Summary

During this reporting period, the promising OSP clones in on-farm and on-station trials; SPK004/2006/1136 and NASPOT7/2006/292 were released by the Variety release Committee as NASPOT 12 O (Namulonge Sweetpotato 12 orange) and NASPOT 13 O, respectively. CIP in collaboration with NaCRRI planted 55 on-farm trials with six OSP clones, Ejumula(OP)2012/3, Ejumula(OP)2012/11, Ejumula(OP)2012/9, Ejumula(OP)2012/10, Resisto(OP)2012/1 and NASPOT 10 O (common check). The clone Resisto/2012/2 had the highest average yield of 20 tons/ha followed by Ejumula/ 2012/10 which yielded 16.3 tons /ha on average. The 2 clones are promising and will be assessed further in the second season. CIP setup curing and storage trials in September 2013 in Masaka, Rakai and Mukono districts. Curing trials were set up with 2 curing treatments- under-ground curing for 2-5 and 7 days and curing in moist saw dust for the same period. Storage experiments were also setup with 2 treatments- storage in sand and storage in the open. Roots left in the open had lost a lot of weight after 60 days (16-73 %) compared to those stored in sand (8-24 %). NASPOT 8 had the highest weight loss in sand (24%) while the local variety SOCCADIDO had the lowest weight loss. Similarly roots stored in sand, had less weevil infestations compared to those left in the open. When tasted for palatability, NASPOT 8 stored in sand for 60 days was more preferred than the one that had been freshly harvested because it was very sweet. The rest of the varieties that had been stored had a bad appearance and taste, and were therefore not liked. Roots cured in ground for 3, 4 and 5 days were stored for 60 days with minimal rotting, shriveling and sprouting, and could still be eaten. In ground curing for 3- 5 days is therefore showing good prospects especially for the market where traders keep the roots for about 1-2 weeks. BioCrops continued with vine multiplication activities in the screen house and supplied 40,000 vine cuttings to CIP. MAK continued conserving in vitro plantlets of the three varieties, Ejumula, Kabode and Vita. A total of 85 community resource persons, 9 extension workers and 53 farmers were trained in application of the triple S method to produce sweetpotato planting material. Demonstrations were also setup with triple S method of producing vines. At all sites, the triple S method significantly (P=<0.05) resulted in more numbers of cuttings produced per root-shoot than from previously harvested fields.

1.0 Introduction

This is the second year of the project “Delivering and Disseminating Biofortified Crops in Uganda,” (BIOFORT Uganda). BIOFORT Uganda is a 5 year project with annual contracts to partners. The project is implemented by 5 partners, the International Potato Center (CIP), HarvestPlus, Makerere University, Department of Agricultural Production, College of Agricultural and Environmental Sciences (MAK), the National Crops Resources Research Institute (NaCRRI) of the National Agricultural Research Organization (NARO), and a private company, BioCrops Uganda Limited. The second year of the project was a continuation of year 1 activities.

It was realized that lack of a good supply of virus planting material could not allow sustainable cultivation of the susceptible orange sweetpotatoes (OSP) varieties. This would thus make it difficult to exploit the benefits of the vitamin A rich sweetpotato varieties. Under this project, Makerere University Department of Agricultural Production (MAK) provided virus free tissue

culture derived sweetpotato plantlets/cuttings to the private company, BIOCROPS (U) Ltd, for the initial commercial multiplication of disease-free material. Initially, HarvestPlus would deliver the expanded volumes of clean vines to farmers through farmer groups and/or zonal vine multipliers, a role that is envisaged to be taken over by the private/commercial sector. During year 2 of the project MAK conserved virus free plantlets as a backup and for supply to NaCRRI and BIOCROPS (U) LTD. NaCRRI continued with breeding activities, on-station and on-farm trials while BioCrops continued with multiplication and supply of virus free OSP materials. CIP has coordinated all activities and led research on Triple S, post-harvest handling of sweetpotato roots and on-farm evaluation of OSP clones in partnership with NaCRRI. We sincerely thank all our partners with whom we worked tirelessly from breeding to assessment of the released varieties in different agro-ecologies. The report has a brief text, Tables (1-16), photos (A to N) and appendices (1-8). This is the final report for the second year of the project with component objectives.

1.1 Project Objectives

The project's main objectives are to:

1. Establish a sustained supply and conserve virus-free plantlets of major OSP varieties at Makerere University and at NaCRRI.
2. Establish capacity of a private sector operator (BioCrops) to produce cuttings of primary foundation material.
3. Facilitate the adoption of at least three new OSP varieties to local conditions of northern and western Uganda.
4. Identify in every district, 2 commercially oriented, large-scale vine multipliers with excellent management skills.
5. Have at least 30% of target households in areas with prolonged dry seasons (>4 months) adopt the Triple S technology.
6. Test and refine recommended practices for curing sweetpotatoes by smallholder farmers to increase longevity in storage.

2.0 Major Accomplishments during the reporting period

2.1 Post-harvest experiments

Materials for post-harvest experiments were planted in Masaka, Rakai, Soroti and Mukono.
In Masaka, Rakai and Mukono, we planted 1.5 acres of land with 6000 heaps (1500 heaps each of Kabode (NASPOT 10 O), NASPOT 8, NASPOT 1 and the local variety 'SOCADIDO', respectively). In Soroti we planted a total of 2 acres (half an acre each with NASPOT 10 O, NASPOT 1, NASPOT 8 and SOCADIDO).The roots from the materials were used to set up curing and storage experiments in September 2013. The experiments were setup in Masaka and Mukono starting 28th September 2013. The trials were set up with 2 curing treatments- under-ground curing for 2-5 and 7 days and curing in moist saw dust for the same period. Storage experiments were also setup with 2 treatments- storage in sand and storage in the open. Roots stored in sand were cooked at 60 days of storage and palatability tests done to determine the time the roots can remain palatable while in storage. Generally, there were significant

differences in all aspects between sweetpotato roots stored in sand for 60 days and those left in the open. Roots left in the open had lost a lot of weight (16-73 %) compared to those stored in sand (8-24 %). NASPOT 8 had the highest weight loss in sand (24%) while the local variety SOCCADIDO had the lowest weight loss (8.8%). Similarly roots stored in sand had less weevil infestations compared to those left in the open. The local variety SOCCADIDO had the highest weevil infestations both in sand and in the open followed by NASPOTS 10 O and 8 (See Table 1, for details). When tasted for palatability, NASPOT 8 stored in sand for 60 days was more preferred than the one that had been freshly harvested because it was very sweet (Data not shown). The appearance of the stored NASPOT 8 was also not as bad as the rest of the varieties (Photos H, I). The rest of the varieties that had been stored had a bad appearance and taste and were therefore not liked.

Roots cured in saw dust sprouted and rotted by the 21st day of storage and were therefore discarded. Generally there were significant differences between treatments and varieties (P=0.05). Three days of in-ground curing resulted in the least weight loss (17%), and NASPOT 8 overall had the least weight loss after 41 days of storage. NASPOT 8 and NASPOT 10 O responded better to in-ground curing than NASPOT 1 and the local variety SOCCADIDO. There were no differences between treatments for rotting and sprouting amongst the different varieties. NASPOT 10 O and NASPOT 1 sprouted more than the other 2 varieties by the 41st day of storage. All the varieties were infested by weevils in storage, but they generally preferred NASPOT 1 and SOCCADIDO. In ground curing for 7 days generally increased the level of weevil infestation in storage by the 41st day (See details in Table 2). Generally, in-ground curing for 3 and 5 days resulted in less weevil infestation in storage. Cured roots were still looking good by the 41st day and could be eaten while uncured roots were completely shriveled. In- ground curing of sweetpotato roots for 3-5 days is showing good prospects for prolonged shelf life in storage.

2.2 Release of orange sweetpotato varieties NASPOT 12 O and NASPOT 13 O

Promising clones SPK0042006/1136 and NAS7/2006/292 from the 2012 on-station and on-farm trials were officially released by the Variety Release Committee as NASPOT 12 O (Namulonge Sweetpotato 12 Orange) and NASPOT 13 O. Tables 3 and 4 show the performance of the released varieties.

Table 1. Weight loss (%), sprouting, shriveling, rotting and weevil infestation of four sweetpotato varieties stored in sand and the open for 60 days.

Variety	Treatment	Wt loss (%)	Sprouting	Shriveling	Rotting	Weevil
NASPOT 1	Open	-*	1.0	3.0	3.5	4.5
NASPOT 10 O	Open	23.8	1.0	3.5	2.0	5.0
NAS 8	Open	33.8	1.0	3.0	2.0	5.0
SOCCADIDO	Open	16.9	1.0	3.0	2.0	6.5
NASPOT 1	Sand	17.1	2.0	1.5	1.5	2.5
NASPOT 10 O	Sand	11.8	1.5	2.0	2.0	3.5
NASPOT 8	Sand	24.2	1.5	1.5	1.5	3.5
SOCCADIDO	Sand	8.8	2.0	1.5	1.5	3.0
Mean		NA	1.4	2.4	2.0	4.2

$LSD_{0.05}$	NA	0.6	1.2	0.9	1.0
CV (%)	17.6	25.7	14.9	8.8	23.2

*Roots were eaten by rats in storage

Sprouting, shriveling, and rotting: Codes: 1= absence of defect, 5= severe

Weevil damage: scale of 1-9, where 1=no infestation/damage and 9=very severe damage

2.3 On-farm evaluation of promising OSP clones

On-farm trials for season 2013a and b were established in Isingiro, Kabale, Rakai, Buyende and Oyam districts. The 1st season trials were established in June 2013 while the second season trials were established in August to October 2013 depending on the weather conditions in the different locations. The 1st season trials were established late due to shortage of planting materials. In the 1st season we planted a total of five trials (1 trial per district) with 6 OSP clones; Ejumula(OP)2012/3, Ejumula(OP)2012/11, Ejumula(OP)2012/9, Ejumula(OP)2012/10, Resisto(OP)2012/1 and NASPOT 10 O (common check). We planted 5 heaps per clone per farmer with 3 cuttings (30 cm) per heap or 15 cuttings on a ridge at a spacing of 30 cm between cuttings and 1 m between ridges. The heaps were spaced 1m from each other. In the second season we planted a total of 50 trials; 10 per district (Table 3 and 5).

First season trials were harvested from November to December 2013, depending on location (Photos B-E). The clone Resisto/2012/2 had the highest average yield of 20 tons/ha followed by Ejumula/2012/10 which yielded 16.3 tons/ha on average. The 2 clones were however not better than the check clones NASPOT 10 O (22.3 tons/ha) and NASPOT 13 O(25 tons/ha). All the clones had SPVD scores less than 3, indicating some level of resistance to SPVD (See Table 5 for details). The clone Ejumula/2012/11 yielded well in Rakai and Oyam but it was very susceptible to Alternaria blight (Average score=5; indicating 5-10% level of infection per plot).

Table 2. Weight loss, rotting, shriveling and weevil infestations for four sweetpotato varieties cured in ground for 2-7 days and stored for 41 days in the open

		% weight loss		Rotting		Shriveling		Sprouting		Weevil	
	Day	21	41	21	41	21	41	21	41	21	41
Variety	Treatment										
NASPOT 1	2	19.3	23.6	1.2	1.9	2.1	3.0	1.2	1.4	2.6	5.7
	3	20.0	36.7	1.0	1.0	1.0	2.0	1.7	1.7	1.0	4.7
	4	21.3	23.2	1.0	1.0	1.0	1.3	1.0	2.3	1.0	3.3
	5	20.4	20.4	1.2	1.2	1.2	1.2	1.0	2.0	1.6	5.1
	7	33.2	38.6	1.3	1.2	1.3	1.8	0.9	1.5	1.5	5.1
NASPOT 10 O	2	19.6	21.9	1.0	1.0	1.0	1.7	1.0	1.7	1.0	4.0
	3	15.8	16.7	1.0	1.0	1.0	1.7	1.0	1.7	1.3	4.0
	4	35.3	52.4	1.0	2.0	1.1	3.1	0.9	0.9	1.1	6.1
	5	9.2	12.3	1.0	1.0	0.8	1.3	1.2	1.7	1.2	3.7
	7	9.4	15.8	1.0	1.0	1.0	1.3	1.0	1.3	1.0	4.0
NASPOT 8	2	6.4	14.8	1.0	1.0	1.0	1.7	1.3	1.7	1.0	5.3
	3	6.7	12.5	1.0	1.0	1.0	1.3	1.0	2.0	1.0	3.7
	4	9.1	14.3	1.0	1.0	1.0	1.3	1.7	2.0	1.0	4.0
	5	10.3	14.0	1.0	1.0	1.0	1.3	1.0	1.7	1.0	4.3
	7	24.2	43.5	1.3	1.0	1.0	2.0	1.0	1.7	1.0	6.0
SOCCADIDO	2	31.0	47.3	1.0	1.0	1.3	1.3	0.8	1.3	1.8	5.3
	3	4.8	23.4	1.0	1.0	0.8	1.3	0.8	1.3	0.5	4.0
	4	11.3	53.8	1.0	1.0	0.9	1.9	1.0	2.0	0.8	5.8
	5	19.1	19.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	3.5
	7	50.0	54.1	1.0	1.0	1.1	1.1	0.9	1.4	1.5	5.0
Mean		18.8	27.9	1.1	1.1	1.1	1.6	1.1	1.7	1.2	4.6
$LSD_{0.05}$		13.1		0.5		0.8		0.8		2.1	
CV (%)		33.7		20.9		29.3		30.9		36	

Sprouting, shriveling, and rotting: Codes: 1= absence of defect, 5= severe, Weevil damage: scale of 1-9, where 1=no infestation and 9=very severe damage

Table 3. Performance of on farm candidate clones (SPK004/2006/1136 and NASPOT 7/2006/292) across the five districts, Isingiro, Byende, Rakai, Oyam, and Kabale (trials were planted April/May and harvested in September 2013)

Clones	Root yield (tons/ha)	SPVD Symptom score	harvest Index	Weevil damage score	Alternaria symptoms score	Marketable roots (%)	Flesh color
NASPOT 10 O	10.2	2.3	0.5	3	1.3	50.0	7
NASPOT7/2006/1185	6.3	2.2	0.3	2.4	1.3	39.8	8
SPK 004/2006/1136	13.5	2.5	0.5	2.5	1.8	46.4	7
NASPOT7/2006/292	8.7	2.5	0.4	2.6	1.5	44.5	8
Mean	9.7	2.4	0.4	2.6	1.5	45.2	NA
$LSD_{0.05}$	3.2	0.5	0.1	0.9	0.4	9.8	NA
CV	27.9	31.0	21.2	29.5	29.5	21.1	NA

Table 4. Summary, performance of orange sweetpotato (OSP) clones in advanced yield trial at four sites, Namulonge, Kachwekano, Ngetta and Serere, 2 seasons 2012/2013, harvested 5.5 – 6 months after planting.

Co	Clone name	SP	Alt[1]	Wv[2]	Yield (t/ha)			HI[5]	DM[6]	Root color		β-carotene[7]
de		VD[1]			Vine	Ttl rt[3]	Bio[4]		(%)	Skin	Flesh	(mg/100g FW)
1	NASPOT 1	4.0	3.3	3.5	33.8	33.2	67.0	0.50	33.5	C	P/Y	0.12
2	NASPOT7/2006/1185	2.8	2.0	3.3	38.8	18.9	57.7	0.33	33.3	P/R	DO	11.03
3	SPKOO4/2006/1136	3.1	2.6	3.4	31.3	46.1	77.4	0.60	30.3	P/R	DO	11.03
4	JEWEL(OP)/2005/6	3.0	2.6	3.6	41.0	17.3	58.3	0.30	29.9	C	C	0.00
5	NASPOT 8	2.8	2.3	3.2	26.5	39.8	66.3	0.60	34.4	P/R	IO	3.76
6	NKA	2.4	2.7	2.6	45.3	7.9	53.2	0.15	31.2	P/R	W	0.00
7	NASPOT7/2006/292	3.1	2.3	3.2	41.7	27.8	69.5	0.40	32.7	B/O	I/O	11.03
8	DIMBUKA	3.8	2.5	3.5	39.6	18.3	57.9	0.32	34.4	C	C	0.00
Mean		3.1	2.5	3.3	37.3	26.2	63.4	0.40	32.5	NA	NA	NA
LSD(0.05)		0.5	0.5	0.7	7.9	6.6	11.9	0.06	3.6	NA	NA	NA
CV (%)		21.3	25.0	27.9	25.9	35.1	24.3	18.90	6.5	NA	NA	NA

[1]SPVD symptoms/Alternaria blight: scored 4 to 6 weeks after planting, scale from 1 to 9, where 1 = no virus/Alternaria symptoms, 2 = unclear virus/Alternaria symptoms, 3 = clear virus/Alternaria symptoms at one plant per plot, 4 = clear virus/Alternaria symptoms at 2 to 3 plants per plot, 5 = clear virus/Alternaria symptoms at 5 – 10% of plants, 6 = clear virus/Alternaria symptoms at 10 – 25 % of plants, 7 = clear virus/Alternaria symptoms at 25 – 50% of plants, 8 = clear virus/Altrnaria symptoms at nearly all plant per plot, 9 = clear virus/Alternaria symptoms and clearly reduced growth in all plants.

[2]Weevil damage (Wv) or any damage (cracking (Crk), sprouting (Spr), rotting (Rot), 1-5 scale: 1- None, 2- Light (few roots affected), 3- Medium (10-30% roots affected), 4- Severe (30-60% roots affected), 5- Very severe (>60% of roots affected).

[3]Ttl rt = Total root yield

[4]Bio = Biomass yield

[5]HI = Harvest index
[6]DM = Dry matter content of storage roots
[7]β-carotene values were determined from using the CIP/HarvestPlus 2007 Color Chart

Table 5. Average performance of 6 OSP clones evaluated in on-farm verification trials in Rakai, Isingiro, Buyende and Oyam districts

District /Clone	Mean SPVD Symptom score)	Mean Alternaria Symptoms score	Mean Root yield (tons/ha	Total Biomass (tons/ha)	Mean Weevil damage score	Flesh color
Oyam						
Ejumula/2012/10	2.3	1.0	26.1	29.9	2.7	7
Ejumula/2012/11	2.3	5.7	25.3	32.2	1.0	8
Ejumula/2012/3	2.0	1.3	21.3	734.3	1.0	7
Ejumula/2012/9	2.0	1.0	5.2	7.8	1.3	7
NASPOT 10 O	2.0	1.0	24.9	36.4	1.7	8
Resisto/2012/2	2.3	1.0	33.3	44.4	1.3	8
NASPOT 13 O	2.3	1.0	26.7	36.1	1.7	7
Mean	2.2	1.7	23.3	31.6	1.5	NA
Rakai						
Ejumula/2012/10	2.7	1.0	2.8	24.4	1.0	8
Ejumula/2012/11	3.0	6.3	19.6	36.7	1.0	8
Ejumula/2012/3	2.7	2.3	6.8	40.4	2.3	7
Ejumula/2012/9	2.3	1.0	7.7	32.8	2.3	6
NASPOT 10 O	1.3	1.0	12.2	21.5	3.3	8
Resisto/2012/2	2.7	1.7	13.9	29.4	2.7	8
NASPOT 13 O	1.0	2.3	30.4	46.3	2.3	7
Mean	2.2	2.2	13.4	33.1	2.1	NA
Isingiro						
Ejumula/2012/10	1.0	1.0	25.0	56.4	1.0	6
Ejumula/2012/11	3.0	1.3	16.1	74.2	1.0	8
Ejumula/2012/3	3.0	2.0	21.1	36.4	1.0	8
Ejumula/2012/9	2.0	1.3	4.7	58.3	1.0	8
NASPOT 10 O	1.0	1.0	38.6	95.8	1.0	8
Resisto/2012/2	2.3	1.0	19.7	26.1	1.0	8
NASPOT 13 O	2.3	1.0	32.5	86.9	1.0	7
Mean	2.1	1.2	22.5	62.0	1.0	NA
Buyende						
Ejumula/2012/10	2.0	1.0	11.5	17.4	3.7	8
Ejumula/2012/11	2.3	5.3	9.6	15.9	2	8
Ejumula/2012/3	2.7	1.0	11.7	21.9	2.3	8
Ejumula/2012/9	2.0	1.7	2.8	26.1	2.3	6

NASPOT 10 O	2.7	1.0	13.3	23.9	2.0	8
Resisto/2012/2	2.0	1.0	15.9	29.6	2.0	8
NASPOT 13 O	2.0	1.0	10.1	29.6	2.0	7
Mean	2.2	1.7	10.8	23.5	2.3	NA
$LSD_{0.05}$	2.8	1.3	0.04	19.6	0.3	NA
CV	24.1	31	21.2	32	29.5	NA

Table 5a. Performance of OSP clones across districts (farms)

Clones	Mean SPVD Symptom score)	Mean Alternaria Symptoms score	Mean Root yield (tons/ha	Total Biomass (tons/ha)	Mean Weevil damage score	Flesh color
Ejumula/2012/10	2.0	1.0	16.3	27.0	2.1	7
Ejumula/2012/11	2.7	4.7	17.7	35.8	1.3	8
Ejumula/2012/3	2.6	1.7	15.2	48.1	1.7	8
Ejumula/2012/9	2.1	1.3	5.1	23.2	1.8	7
NASPOT 10 O	1.8	1.0	22.3	42.2	2.0	8
Resisto/2012/2	2.3	1.2	20.7	40.0	1.8	8
NASPOT 13 O	1.9	1.3	25.1	46.5	1.8	7
Mean	2.2	1.7	17.5	37.5	1.8	NA

Pests and diseases scored on a 1-9 scale , where 1=no infestation/damage and 9=very severe damage; Flesh color scored: 7 = pale orange, 8 = deep oarange
NA = not applicable

2.4 Establishment of in-vitro OSP stock at NaCRRI

A total of 103 in-vitro virus-free plantlets of NaSPOT 9 O (Vita) and 92 of NASPOT 10 O (Kabode) were multiplied and are available at the NaCRRI tissue culture lab. This will provide starter materials for an upcoming project: “Keeping disease free vines closer to farmers”. Table 6 shows the progress by NaCRRI.

Table 6. Status of progress by NaCRRI

Planned activities	Targets	Actual Achievements	Remarks
Evaluate on-farm trials	Extensive farmer participation in key target areas	5 OSP clones (Ejumula(OP)/2012/3, Ejumula(OP)/2012/9, Ejumula(OP)/2012/10, Ejumula(OP)/2012/11, & Resisto (OP)/2012/2) were multiplied in the swamp and were used for planting participatory trials in farmers’ fields. Also, verification trials were planted in Oyam, Buyende and Isingiro districts. Consequently 2 new varieties were released: SPK0042006/1136, and NAS7/2006/292 were released as NASPOT 12 O & NASPOT 13 O,	Delayed rains in some areas caused delays in planting on-farm trials

		respectively	
Conserve in vitro OSP stock	Establish a stock of virus-free plantlets of major OSP varieties at NaCRRI	A total of 103 in-vitro virus-free plantlets of NaSPOT 9 O (Vita) and 92 of NASPOT 10 O (Kabode) are available at the NaCRRI tissue culture lab.	CIP will provide Virus free SPK004/2006/1136, NAS7/2006/292, Ejumula & Kakamega in 2014
Workshops /meetings	Train lead farmers in project areas	A total of 25 farmers were trained, 16 of them were female.	Appendix 8 shows the list of farmers trained.
Identify at least 2 OFSP clones	Clones for cleanup to be done at Muguga	SPK0042006/1136 and NAS7/2006/292 were provided to CIP for cleanup.	
Document experience and load results to sweetpotato Knowledge portal	Information loaded on Sweetpotato Knowledge Portal	Quarterly reports and the variety release document have been compiled	A manuscript of the release paper for journal will be put together for publication in 2014

2.5 Transfer of the Triple S technology at scale and building a cadre of trained extension personnel to monitor its adoption

Sam Namanda conducted trainings on 'Triple S' vine conservation and multiplication approach (February 7 – 15, 2013) for 4 pilot districts (Lira, Kole, Gulu and Oyam) in Northern Uganda (Photo G). Three main categories of field cadres participated in the training, including Community Resource persons (CRPs), Community Development Assistants/ field extension workers (FEWs) and farmers (Appendices, 4-9). The trainings covered:

a) Background: review of importance of sweetpotato in household food and nutrition security,
b) Importance of using the choice of sweetpotato roots for seed,
c) Positive selection of clean and preferred sized seed roots,
d) Timing of storage and method of storage,
e) Establishment of irrigated root beds and agronomic practices

Three sites of root bed nurseries each in Lira, Kole, Oyam and Gulu districts were planted to validate the Triple S method to produce sweetpotato planting material for early season planting. Kakamega variety was planted at all sites and Kabode was only planted at 3 sites because of limited seed roots. A total of 85 community resource persons, 9 extension workers and 53 farmers were trained in application of the Triple S method to produce sweetpotato planting material. A total of 37 females and 100 male participants were trained (See Table 7). Thirty farmers were selected to host demonstration sites for the Triple S demonstrations. A total of 123 Triple S leaflets were provided to selected participants for reference. Follow up on trainings and monitoring on the progress of root beds is continuous. More reference material for host farmers are being prepared and will be provided.

Table 7. Summary of the categories of participants trained in Gulu, Oyam, Lira and Kole districts, and projected demonstration sites for season 2013A

District	Female participants			Male participants			Total participants	Total Demo sites
	***CRPs**	***FEWs/CDAs**	**Farmers**	**CRPs**	**Fews**	**Farmers**		
Gulu	11	1	12	15	1	2	42	11
Oyam	4	0	0	25	2	0	31	9
Lira	5	1	5	14	2	10	37	5
Kole	3	0	5	8	2	19	37	5
Total	23	2	22	62	7	31	147	30

Please refer to appendices 1 to 4 for details.

*CRPs = Community Resource Persons

*FEWs/CDAs = Field Extension Workers/Community Development Assistants

2.5.1 Results for on-farm validation of Triple S method of producing sweetpotato planting material in 4 districts in northern Uganda

Two sets of data were collected a) Using Kakamega variety to compare the differences in production of planting material under Triple S and farmers' previous harvested fields and b) comparing Kakamega and Kabode varieties in producing planting material using the Triple S method variety at different sites.

Under (a) 2 sites that were hosting the Triple S trial, with access to a previous harvested field of Kakamega variety were randomly selected from each of the three research zones, namely Gulu, Oyam and Kole/Lira in northern Uganda. Fifteen growing root-shoots were randomly selected for assessment of the number of 30-cm long cuttings harvested at 45 days after planting the seed roots under watered beds. The study was conducted at least 3 weeks after the start of rains when the shoots from previous fields had also emerged and growing. The number of stems and branches on each root-shoot were counted and the total number of 30-cm long cuttings harvested or ready for harvesting from the stems and branches counted by respective farmer groups. The results obtained from either method were compared and appraisals made by farmers to conceptualize the aim of the study. The cuttings from either source method were planted for production of ware sweetpotato.

Under (b) the procedure in (a) was repeated for each root-shoot for each of the varieties Kabode and Kakamega for at least a site in each of the geographical locations. Note that Kabode treatment was limited so data under (a) did not include this variety. ANOVA was done using the using GenStat programme.

At all sites the Triple S method significantly (P=<0.05) resulted into more numbers of cuttings produced per root-shoot than from previously harvested fields (See Table 8a and 8b) (Photos G, J - N)). Differences in the number of cuttings across different sites were due to difference in the age of roots, and storage period before sprouting. Okello had the lowest number of cuttings generated per root because the roots over sprouted and lost turbidity, which resulted in more rotting of planted roots. Petwa had the highest average number of cuttings per root because of earlier planting compared to the rest of the sites, and she did ample and regular watering, at

least once every week. Generally, higher numbers of cuttings were harvested in Lira and Kole notably because the crop was 3 weeks older than the other sites in Gulu and Oyam.

Table 8a. Analysis of variance for average number of total 30-cm long cuttings harvested from shoots of 15 roots of Kakamega variety (orange sweetpotato) sampled from Triple S and Previous harvested farmers' fields

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Site	5	22270.1	4454.0	17.61	<.001
Source of cuttings	1	80518.0	80518.0	318.38	<.001
Site x source of cuttings	5	16096.8	3219.4	12.73	<.001
Residual	168	42486.5	252.9		
Total	**179**	**161371.5**			

Table 8b. Mean number of total 30-cm long cuttings harvested from shoots of roots of Kakamega variety (orange sweetpotato) sampled from Triple S and previous harvested farmers' fields (Each site = replication, each rep = 15 roots)

		Source of planting material		
District	**Site**	**Triple S**	**Previous harvested fields**	$Lsd_{0.05}$
Gulu	Acaye Margaret	39.7	2.9	8.11[b]
Gulu	Okello	19.3	0.5	
Oyam	Akello Patrick	39.3	1.3	
Oyam	Renge	35.8	0.7	
Kole	Rose Akoi	44.9	0.8	
Lira	Petwa	86.7	5.7	
$Lsd_{0.05}$		4.68[a]		

[a] Separation of means between sites , and [b] separation of means between sources of planting material

Table 9a: Analysis of variance for average number of total 30-cm long cuttings harvested from shoots of 15 roots each of Kakamega and Kabode varieties (orange sweetpotatoes) sampled from Triple S plots

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Site	2	27.0	13.5	0.05	0.947
Variety	1	13739.4	13739.4	55.66	<.001
Site x Variety	2	380.0	190.0	0.77	0.466
Residual	84	20733.5	246.8		
Total	**89**	**34879.8**			

The significant (P=<0.05) variety differences in numbers of 30-cm cuttings between Kakamega and Kabode were mainly due to the more wide spreading and branching growth habits of Kakamega than Kabode variety.

Table 9b: Average number of total 30-cm long cuttings harvested from shoots of Kakamega and Kabode varieties (orange sweetpotatoes) sampled from Triple S plots (Each site =

replication, each rep = 15 roots)

Site	Variety		$Lsd_{0.05}$
	Kakamega	**Kabode**	
Acaye Margaret	39.7	17.1	
Rosa Akoi	44.9	18.7	**6.59**
Akello Patrick	39.3	18.2	

Tables 9a and 9b show that Kakamega significantly (P= <0.05) produced more average number of cuttings per planted seed root attributed to the differences in spreading growth habits. Notably the different maturity status of the roots and duration of storage also contributed to the different numbers of cuttings obtained. Kabode roots were sourced from Soroti and seemed harvested from a young crop due to due to limited availability of roots in the experimental sites. Generally, Rosa Akoi site in Kole district was planted much earlier than the other 2 sites and received more rains than the other sites which influenced more vigorous growth.

2.6 Exploratory snap study on assessing the gross margins of sweetpotato planting material produced under the Triple S method and previously harvested fields of Kakamega variety in Gulu district

Introduction

During the time of data collection, it was noted that sweetpotato planting material was being sold in Gulu town by street vendors. This prompted the interest to conduct a case study on determining the expected gross value of the planting material that was generated from the plots under triple S method of 15 seed lots using the existing market price. Since the average value of the number of cuttings had already been determined, samples of 10 bundles being sold were bought, cuttings counted and average number of cuttings established for the existing unit price of UgSh. 500 (see Table 10). A case study was also conducted in Gulu to obtain an estimate of the relative value of the planting material harvested, 10 samples of bundles of planting material sold on the streets in Gulu were randomly selected and bought from the different vendors (sellers), and cuttings in each bundle counted. Although the price at which the material was retail and not farm gate, it provided a realistic equivalent of the expected worth of the material harvested. Notably the price did not vary among the varieties and the bulkiness (stem thickness contributed to the fewer numbers of cuttings per bundle) of the cuttings that were being sold on the streets. Notably, the size of bundles being sold was based on thickness and not numbers within the bundle resulting in different numbers of cuttings per bundle. Thus, the need to compute the average numbers for easy of computations.

Table 10. Samples of mini bundles of sweetpotato planting material sold on roadsides of Gulu town

Bundle unit	# of cuttings	Unit price	Comment
1	83	500	Tinny stems
2	50	500	Thick stems
3	35	500	Thick stems

4	65	500	Tinny stems
5	80	500	Tinny stems
6	62	500	Tinny stems
7	75	500	Tinny stems
8	60	500	Tinny stems
9	80	500	Tinny stems
10	60	500	Tinny stems
Average	65	500	

Table 10 shows that on average, 65 vines were sold at UGSH. 500/= at open market price in Gulu.

Table 11. Extrapolation of gross benefits gained from irrigated seed root beds of roots sprouted from Triple S and farmers' previous harvested fields in Gulu and Oyam districts

#		Irrigated seed roots (Triple S)			Previously harvested fields		
	Parameter	Acaye Margaret	Minakulu	Average	Acaye Margaret	Minakulu	Average
A	Total # of cuttings/15 roots	596	290	443	44	8	52
B	# of bundles = Value in A /65	9	4	7	0	0	0
C	Unit sales price (UgSh.)	500	500	500	500	500	500
D	Gross sales (UgSh.)	4,500	2,000	3,500	0	0	0

* Number (65) of cuttings used in (B) computation is from Table 7 which is the average number of cuttings for UGSH 500 at open vine market in Gulu

Table 11 shows that no selling of vines could be obtained from previously harvested fields within 3 weeks after the rains had started basically because most sprout shoots emerged after rains had started.

2.7 Season 2013A (April planting) demonstrations on using clean sweetpotato planting material

Clean planting material sourced from Biocrops (cycle 0) was planted in the second week of April in Mukono, Kamuli, Buyende and Rakai/Lyatonde with 3 sites in each district. Besides the Biocrops source, farmers in Kamuli had during the previous season of September 2012 planting received planting material from Biocrops. The material had been grown for a single season and then conserved by farmers in the wetlands for March/April 2013a season re-planting. This lot of vines referred to as cycle 1 was also sourced from a farmer in Kamuli and re-planted during second week of April 2013 (2013a season) in the four districts already named to assess the trend of root yield decline. Thus, the trials on clean material in 2013a were planted with 2 objectives as summarized below and will be repeated in subsequent seasons.

1: To demonstrate the yield and disease performance of clean (Biocrops) and farmer own

source of Ejumula (SPVD susceptible) and Kabode (SPVD resistant) planting material
2: Follow up the yield and reaction to disease in a series of generations of clean (Biocrops) of Ejumula (SPVD susceptible) and Kabode (SPVD resistant) planting material.

Table 12. Demonstration plan of clean against farmer planting material

On-farm planting season	# of sites	Source of material	Cycle of planting material
2013a	12	*Biocrops	0
(March/April planting)	12	On-farm (Kamuli)	1
2013b	12	*Biocrops	0
(July/August planting)	12	On-farm	1
	12	On-farm	2

* Only 3 successive lots will be sourced

In Table 10, demonstration plots, each 36 m^2 or 36 mounds were planted using each of the 2 (Biocrops and farmer own) sources of planting material of 2 (Ejumula and Kabode) varieties. Planting in Mukono, Kamuli, Buyende districts was done in the second week of April and in Rakai/Lyatonde planting was done in mid-May.

Data collection
Data on visual symptoms of SPVD (scale of 1 – 9) was recorded at 1 and 2 months after planting. Other data on marketable, unmarketable storage root yield and foliage weight were taken at 100 – 120 days. The aim of the second objective is to follow up the performance of three lots of clean planting material of Ejumula and Kabode varieties initially sourced from Biocrops (Generation 0) during successive seasons as indicated in Table 4 below. Lot 1 started during September 2012b planting and lot 2 was first planted in April 2013a season. The third lot of material from Biocrops was planted in July 2013b season. During subsequent year, trials will continue with only re-cycled material for the 3 different lots.

Data collection
Pre-harvest data on sweetpotato virus disease (SPVD) incidence and severity is being recorded at 4 and 8 weeks after planting. Biomass data will be taken at harvesting and will be analyzed using GenStat programme.

Table 13. Design of on-farm follow up study on performance of 3 lots of Biocrops material during successive seasons of planting

Month/ planting Season	Vines Lot 1	Vine Lot 2	Vines Lot 3
Sept 2012b	Biocrops (Cycle 0)		
April 2013a	Cycle 1	Biocrops (Cycle 0)	
July 2013b	Cycle 2	Cycle 1	Biocrops (Cycle 0)
2014			

NB: The assessment of re-cycled vines will continue during subsequent 2014 year

2.8 Tissue culture plantlet multiplication – MAK

MAK has been able to maintain the *in vitro* plantlets of 3 orange sweetpotato (OSP) varieties at Makerere University Plant Tissue Culture Laboratory at Kabanyolo. A total of 100 in vitro

plantlets of each variety, namely Ejumula, Kabode (SPK004/6/6) and Vita (SPK004/6) are still being conserved. The *in vitro* plantlets are being sub-cultured onto multiplication medium every 3-4 weeks, and later hardened and weaned in the screenhouse at Kabanyolo. MAK is also maintaining three varieties (Ejumula, Kabode, and Vita in the screenhouse at Kabanyolo and climbing (trellised) vines. The vines planted in the screenhouse were replanted September 2013. Screenhouse maintenance of Kakamega (SPK004) was put on hold following the suspicion and later testing positive to *Sweetpotato chlorotic stunt virus* (SPCSV). Table 14 shows the progress made by NaCRRI.

MAK has so far delivered 50 and 20 *in vitro* sweetpotato plantlets (culture bottles) to BIOCROPS (U) Ltd and NaCRRI for primary multiplication and hydroponics multiplication, respectively. We have also supplied 10 bags (of 1,000 vine cuttings each) to BIOCROPS for further multiplication and delivery to zonal vine multipliers. Two additional technicians from BIOCROPS were also trained in sweetpotato tissue culture techniques during November 2013.

Table 14. Status of achievements by MAK

Planned Activities	Targeted outputs	Target Date	Baseline	Status	Comments
MAK Tasks					
In vitro multiplication and maintenance	100 in vitro plantlets of each variety.	December 2013	%0 bottles	100% (continuous activity)	100 bottles (of 2-3 plantlets) of each variety are being maintained. Sub-culturing is done at least once every month. Plants have already been established in the screenhouse for further multiplication. MAK will continue delivery to BIOCROPS at a cost.
Training	4 persons	December 2013	2	100%	Another 2 BIOCROPS technicians were trained during November 2013 in sterilization of sweetpotato explants, initiation and serial culture of auxillary buds.
Assess the cost of TC multiplication in Uganda	1 report	November 2013	0	50%	Assessment is on-going to obtain data on costs.

2.9 Vine multiplication at BioCrops

Under the partnership project of developing and delivering biofortified crops in Uganda, BioCrops received supported from CIP to enhance its capacity of multiplying virus free sweetpotato vines. In 2012 BioCrops received a virus free sweetpotato stock of varieties, had members of the staff trained in sweetpotato tissue culture and sweetpotato vine multiplication under nursery conditions. The support was extended in 2013 to supply another 40,000 clean vines of OSP varieties, Ejumula, Kabode and Vita. The major achievements for BioCrops in 2013 are summarized in Table 15

Table 15.Summary on achievements for BioCrops

Activity/Milestone	Targeted output	Target date	Baseline	Update	Status
A constant supply of clean vines maintained	40,000 virus free vines	31 December 2013	A screen house in place. Vine multiplication to be done to avail clean vines of OSP Ejumula, Kabode and Vita	40,000 vines have been delivered: Ejumula = 16,000 Kabode = 15,400 Vita = 9,000. The screenhouse has a stock of Ejumula, Kabode and Vita	100% delivery achieved
***in vitro* cultures of indexed sweetpotatoes established**	Have at least 100 in vitro cultures of Ejumula, Kabode and Vita and at least 2 other farmer preferred varieties	By end of July 2013	In vitro cultures of sweetpotato introduced from MAK	50 in vitro cultures of Ejumula, Kabode, Vita and one farmer preferred variety, Dimbuka maintained in vitro	The cooling system (AC) has been installed in the culture room for sweetpotato culturing. Electricity supply was upgraded to a commercial/ industrial level (3 phase).
BioCrops staff trained by MAK in tissue culture of sweetpotato	4 staff trained	First week August 2013	2 Staff trained in sweet potato tissue culture.	In house training in sweet potato T.C, hardening and nursery management conducted by MAK in 2013. Two screen house attendants and other BioCrops staff trained.	100% training accomplished.

Photos

A

B

C

D

E

F

G

H

I

J

K

L

M

N

A: farmers harvesting a trial of clean Vs farmer material
B: Farmers participate in planting on-farm trials in Buyende district
C: Farmers in Isingiro district holding roots of Kabode after harvesting one of the on-farm trials
D: Farmers in Isingiro district harvesting one of the on-farm trials
E: Ejumula(OP)2012/3, F: Ejumula(OP)2012/ 11
G: Farmers preparing roots for storage Triple S training in Gulu district
H: NASPOT 10 O, I: NASPOT 8 stored in sand for 60 days
J: Observations and experiences sharing on Triple S method
K: Identifying root shots in previous field
L: Root shoots destroyed by mole rats especially in previous fields due to dense bush around and weeds within the field
M: Kabode Triple S shoots, 45 days after planting
N: Kakamega Triple S shots, 45 days after planting

3.0 Summary of personnel commitments

Dr. Robert Mwanga and Mr. Gerald Kyalo have continued to serve as Principal Investigator and Field Crops Agronomist for the project, respectively. Our partners, NaCRRI, Makerere University and BioCrops also continued with their activities as stipulated in their contracts. At NaCRRI, one Scientist (10% time), 1 technician (50%) and 1 driver (30%) are involved in the project. At Makerere, Dr. Ssetumba Mukasa has 2 technicians who are committed to the project.

4.0 Major equipment acquired

None.

5.0 Description of significant travel

During the reporting period, CIP staff undertook travels to accomplish project objectives. Table 16 below summarizes the travels.

6.0 Delays, Problems, Suggestions

The planned project activities are on course. Planting 1st season OSP trials 2013 was delayed due to shortage of planting materials and prolonged drought in some areas. However, it was successfully done. Renewal of the contracts for project partners delayed, leading to late release of funds.

Table 16. Summary of significant travels

Date	Name	Institution	Locations	Travel objective	Output
14-25.012013	Gerald Kyalo Jowelia Namakula	CIP NaCRRI	Buyende, Oyam	Harvesting 2nd season OSP trials	17 OSP trials harvested, 3 palatability assessments done.
21-23. 02.2013	Gerald Kyalo Joweria Namakula	CIP NaCRRI	Rakai, Masaka	Selecting farmers to host curing, storage, harvesting 4 OSP trials	Two farmers identified per district, 4 OSP trials harvested, 1 palatability assessment done
11-21. 02.13	Gerald Kyalo Jowelia Namakula	CIP NaCRRI	Kabale, Isingiro	Assesemnt of SPVD, Alternaria blight, vigour and monitoring OSP trials	Diseases and vigour assessed, status of OSP trials established
18-20.02. 2013	Gerald Kyalo	CIP	NaCRRI	Participating in CloneSelector refresher training conducted by Luka Wanjohi and Robert Mwanga.	On-farm trial data was analyzed in CloneSelector
6.03. 2013	Robert Mwanga	CIP	FARM RADIO International (FRI), Kampala	To identify specific priorities related to OSP for consideration with FRI Uganda office, discuss the TOR for the OFSP National Advisory Group (NAG) and elect a chairperson of the group.	Priorities related to OSP consideration with FRI identified, Robert Mwanga elected chairperson NAG.
7-15.2.13	Sam Namanda	CIP	Lira, Gulu, Kole, Oyam	Trainings on 'Triple S' vine conservation and multiplication approach	A total of 37 females and 100 male participants trained, 30 demonstrations set up with farmers
23-29. 3.13	Sam Namanda	CIP	Lira, Oyam, Kole, Gulu	Follow up and monitoring Triple S activities	Status of Triple S demonstrations established, preparations for planting on beds started
28.3-2.4.13	Gerald Kyalo	CIP	Masaka, Rakai, Mukono	Preparing for planting of materials for post-harvest experiments.	Experiments set up.
8-13. 4. 13	Sam Namanda	CIP	Isingiro	Harvesting 2nd	7 trials harvested, 2

	Joweria Namakula	(NaCRRI)		season 2013 OSP trials	palatability tests conducted
9-20.4 13	Gerald Kyalo	CIP	Soroti, Masaka, Mukono, Rakai	Planting materials for post-harvest Experiments	2 farmers planted per district with 1.5 acres of gardens each
22.4-3.5.13	Gerald Kyalo Joweria Namakula	CIP (NaCRRI)	Rakai, Kabale	Harvesting 2nd season OSP trials	17 trials harvested, 3 palatability tests conducted.
24-26.04.2013	Sam Namanda	CIP	Mukono, Kamuli, Buyende	Planting trials of clean Vs farmers materials	2 trials planted per district
7-9.05.2013	Sam Namanda	CIP	Rakai	Planting trials of clean Vs farmers materials	3 trials planted
23-28.5.13	Gerald Kyalo	CIP	Rakai, Masaka, Soroti, Mukono	Monitoring materials for post-harvest experiments	2 gardens monitored per district. 1st weeding of all gardens done.
24.5-2.6.13	Namanda Sam	CIP	Gulu, Oyam, Lira, Kole	Collecting data on Triple S actvitites	Data collected, analysed and documented.
13-15. 6. 13	Sam Namanda	CIP	Mukono, Kamuli, Buyende	Pre-harvest assessment of trials	Data collected on establishment, vigor, SPVD, and Alternaria.
11-19.6.13	Gerald Kyalo Joweria Namakula	CIP (NaCRRI)	Isingiro, Kabale, Rakai, Buyende, Oyam	Planting 1st season OSP trials.	5 trials planted (1 per district)
02-7.7.2013	Gerald Kyalo	CIP	Rakai, Masaka, Soroti, Mukono	Monitoring materials for post-harvest experiments	Gardens monitored, planning for post-harvest experiments done
29.7-8.8.2013	Gerald Kyalo Joweria Namakula	CIP NaCRRI	Oyam Buyende, Rakai, Isingiro	Planting 2nd season OSP trials Monitoring 1st season trials	Ten trials planted in Oyam, Pre-harvest and establishment data collected.
09-14. 09.13	Gerald Kyalo	CIP	Mukono, Kamuli,	Harvesting 1st season clean vs farmer trials, planting 2nd season clean vs farmer materials	Four trials harvested, 6 trials planted.
17-21.09. 2013	Gerald Kyalo	CIP	Buyende	Planting 2nd season OSP trials, harvesting & planting clean vs farmer material trials	10 OSP trials planted in Buyende, 3 trials of clean vs farmer materials harvested, 3 trials of clean vs farmer material planted.
26-28.09. 2013	Gerald Kyalo	CIP	Rakai, Masaka	Planting 2nd season trials of clean vs farmer materials.	3 trials planted
02-05.9.13	Gerald Kyalo	CIP	Rakai, Masaka	Planting 2nd season OSP trials, setting up post-harvest experiments	8 trials planted, post-harvest trials set up in Bukakata sub-county.
8-14. 7.13	Sam Namanda	CIP	Masaka, Rakai	Monitoring 1st	Pre-harvest data taken,

				season clean vs farmer trials, planning for 2nd season trials	host farmers for 2nd season trials identified
15-23.8.13	Sam Namanda	CIP	Mukono, Kamuli, Buyende, Gulu, Oyam, Lira and Kole districts	Monitoring trials on clean vs farmer material, planning for 2nd season planting, follow up on Triple S technology.	Pre-harvest data taken, farmers to host trials for clean vs farmer material in 2nd season identified. A total of 5 seed root production fields planted each in Lira, Kole, Oyam and 2 in Gulu districts.
25-29.9.2013	Gerald Kyalo	CIP	Rakai, Masaka, Mukono	Harvesting and planting trials of clean Vs farmer material	Six trials planted Curing and storage experiments setup
13-17.10.2013	Gerald Kyalo Sam Namanda	CIP	Entebbe	Participate in 14th African Crop Science Society Conference	1 poster presented, 1 paper on curing and storage presented for the proceedings
22-27.10.2013	Gerald Kyalo Joweria Namakula	CIP NaCRRI	Masaka, Mukono, Kabale	Planting 2nd season trials, monitoring post-harvest experiments	10 on-farm trials planted
11-17.11.2013	Gerald Kyalo	CIP	Isingiro, Rakai, Masaka	Planting 2nd season trials, harvesting 1st season trial	10 on-farm trials planted, 1 on-farm trial harvested
27.11-02.12.2013	Gerald Kyalo Joweria Namakula	CIP NaCRRI	Kamuli, Oyam, Buyende	Monitoring trials of clean Vs Unclean, Harvesting 1st season trials	Six trials monitored, 1 on-farm trial harvested

Appendix 1. Progress on Objectives and Outcomes for CIP

Milestone	Targeted outputs	Baseline	Progress/ Status	Comments
Objective 1:	**Ensure disease-free supply of primary foundation seed**			
Provide training, and ensure that the private sector partner can produce quality primary material using plantlets from MAK, initially obtained from KEPHIS, Muguga, Kenya.	40,000 cuttings of primary material produced	Required pathogen-tested in vitro OSP varieties not available at MAK	The 40,000 vines have been delivered: Ejumula = 16,000 Kabode = 15,400 Vita = 9,000 Screen house with Ejumula, Kabode and Vita 100 % achieved	100% achieved
Asses the cost of tissue culture multiplication in Uganda.	Capacity of Biocrops to multiply clean foundation planting material established, 2 vine multipliers identified per district and trained on vine multiplication techniques	No experience of multiplying pathogen-tested OSP vines	Tracking of costs at BioCrops is on-going	
Objective 2:	**Transfer the Triple S technology at scale and build a cadre of trained extension personnel to monitor its adoption**			
Select key dry areas for testing this technology at scale.	Triple S technology validated and scaled up with farmers in key dry areas, 30% of target households in areas with prolonged dry seasons adopt the technology	Triple S technology not yet tested in HarvestPlus project areas	A total of 30 demonstrations were set up in Feb on Triple S in Gulu, Oyam, Kole and Lira districts. 100 % completed	Selected farmers have been trained and are hosting demonstrations.
Train extension personnel to effectively implement the technology.	At least one lead farmer from each county hosting OSP trials trained in OSP production	No extension personnel trained in OSP production	137 farmers, Field Extension workers/ Community Development Assistants trained in Gulu, Oyam, Kole and Lira districts 50 % completed	Training will continue as new sub counties are identified.
Monitor adoption of technology and make any needed changes in approach based on addressing any emergent constraints to adoption.	At least 30% of communities in project areas adopt Triple S.	OSP is not grown in the project areas	Not done	Activity planned for later years
Evaluate characteristics of adopters and non-adopters.	Percent adoption and characteristics of adopters	Technology absent in project area	Not done	Activity planned for later years
Objective 3:	**Accelerate evaluation of on-farm of promising OSP clones**			
Conduct on-farm trials with extensive farmer participation in key target areas.	New OSP clones evaluated with farmers and at least 2 clones selected for further evaluation	New OSP clones from NaCRRI have not been tested in HarvestPlus	1st and 2nd season OSP trials for 2013 have been planted with OSP clones Ejumula(OP) 2012/3,	1st season Planting was delayed due to shortage of planting material and unfavorable weather.

		project areas	Ejumula(OP)2012/11, Ejumula(OP)2012/9, Ejumula(OP)2012/10 and Resisto(OP)2012/1. A total of 55 trials were planted. Five 1st season trials were harvested Activity is on schedule	
Provide at least two new clones for cleanup for the seed system by year 4	Promising clones cleaned up before they are provided to vine multipliers and farmers	New clones from NaCRRI not yet cleaned	Promising clones SPK0042006/1136 and NAS7/2006/292 from the 2012 on-station and on-farm trials were officially released by the Variety Release Committee as NASPOT 12 O and NASPOT 13 O respectively.	Promising clones were sent to KEPHIS for cleanup
Objective 4:	**Improve curing techniques and investigate other ways to improve post-harvest quality and extend post-harvest shelf life of traded OSP**			
Design and conduct trials and curing demonstrations	Conditions for curing established	There is no curing of OSP in E. Africa	Curing trials were set up in Masaka, Rakai and Mukono with Kabode, NASPOT 8, NASPOT 1 and local variety SOCADIDO. 100 % completed.	Data collection is on-going
Evaluation of improved curing methods vs. current practice	Improved curing and storage techniques tested with farmers	Limited shelf life of sweetpotatoes	curing and storage trials were setup in September Curing 100% completed, storage 80% completed	
Work with implementation team to improve training on handling of roots during harvest and postharvest.			Trainings on post-harvest handling will be scheduled in 2014	
Objective 5:	**Backstop Implementation Team and Broader Dissemination Objectives**			
Respond to emergent problems concerning sweetpotato multiplication and production as requested by the implementation team.	Emerging problems solved	Issues among partners vary	CIP staff backstopped HarvestPlus team on training of farmers, extension personnel and vine multipliers	
Ensure that experience is documented and any relevant materials and finding are loaded on the Sweetpotato Knowledge Portal.	Documented experiences	No experiences on new OSP varieties and Triple S in HarvestPlus project areas	Quarterly and final 2013 technical reports have been written	

Appendix 2. Progress on Objectives and outcomes for NaCRRI

Milestone	Targeted out puts	Baseline	Progress
Objective:	**Accelerate evaluation on-farm of promising OFSP clones**		
Conduct on-farm trials with extensive farmer participation in key target areas.	New OFSP clones evaluated with farmers and at least two clones passed on to the farmers	New OFSP clones from NaCRRI have been tested on-station.	Promising clones SPK0042006/1136 and NAS7/2006/292 from the 2012 on-station and on-farm trials were officially released by the Variety Release Committee as NASPOT 12 O and NASPOT 13 O respectively. Also, 4 new promising clones (Ejumula OP/ 2012/9, Ejumula OP/2012/10, Ejumula OP/ 2012/11, Resisto OP/2012/2, have been planted in on-farm trials for evaluation.
Objective:	**Backstop Implementation Team and Broader Dissemination Objectives**		
Respond to emergent problems concerning sweetpotato multiplication and production as requested by the implementation team.	Provide solutions to urgent problems	No research institution ready to backstop partners consistently	NaCRRI team backstops partners as need arises
Ensure that experience is documented and any relevant materials and finding are loaded on the Sweetpotato Knowledge Portal.	Documented information is readily available	Information on OSP in target districts lacking	Quarterly and final 2012 technical reports have been written

Appendix 3. Progress on Objectives and Outcomes for MAK and BioCrops

Milestone	Targeted out puts	Baseline	Progress
Objective :	**Ensure disease-free supply of primary foundation seed**		
Provide training, and ensure that the private sector partner can produce quality primary material using plantlets from MAK, initially obtained from KEPHIS, Muguga, Kenya	40,000 cuttings of primary material produced by BioCrops	BioCrops has clean OSP from MAK	100 bottles (of 2-3 plantlets) of each variety are being maintained. Sub-culturing is done at least once every month. Plants have already been established in the screenhouse for further multiplication. MAK will continue delivery to BIOCROPS at a cost. 40,000 vines have been delivered by BIOCROPS: Ejumula = 16,000 Kabode = 15,400 Vita = 9,000 Activity 100 % complete
Asses the cost of tissue culture multiplication in Uganda	Capacity of Biocrops to multiply clean foundation planting material established	No experience with OSP multiplication	Tracking of costs at BioCrops is on-going

Appendix 4. list of participants from Gulu district sensitised and trained in Triple S method of producing sweetpotato planting material. CRPs = Community Resource Persons, FEWs-Field Extension Workers, CDAs-Community Development Assistants

#	Name of farmer	Sex	Sub county	Parish	Status of participant			
					CRP	CDA/FEW	Farmer	Demo Host
1	Betty Anek Otim	F	Bobi	Paidwe	1	0	0	1
2	Betty Oroma	F	Bobi	Paidwe	1	0	0	0
3	Stella Akajo	F	Bobi	Paidwe	1	0	0	0
4	Lilly Okulu	F	Bobi	Palwo	1	0	0	0
5	Romano Okello	M	Bobi	Palwo	1	0	0	0
6	Winfred Okot	M	Bobi	Paidwe	1	0	0	0
7	Charles Acaye	M	Bobi	Paidwe	1	0	0	0
8	Santo Okoya	M	Bobi	Paidwe	1	0	0	1
9	Gaudensio Okello	M	Bobi	Paidwe	1	0	0	1
10	Felix Otiti	M	Bobi	Paidwe	1	0	0	1
11	Tony Abic	M	Bobi	Paidwe	1	0	0	0
12	Mariano Ojok	M	Bobi	Paidwe	1	0	0	0
13	Marino Atim	M	Bobi	Palwo	1	0	0	0
14	Alfonse Woo	M	Bobi	Palwo	1	0	0	0
15	Alex Omara	M	Bobi	Paidwe	0	1	0	0
16	Richard Obura	M	Bobi	Paidwe	1	0	0	1
17	Geoffrey Okenya	M	Bobi	Palwo	1	0	0	0
18	Micheal Ocen	M	Bobi	Palwo	1	0	0	1
19	Walter Ocan	M	Koro	Acoyo	1	0	0	0
20	Agnes Auma	F	Koro	Acoyo	0	0	1	0
21	Harriet Akello	F	Koro	Acoyo	0	0	1	0
22	Franka Lakot	F	Koro	Acoyo	1	0	0	0
23	Haron Akello	F	Koro	Acoyo	0	0	1	0
24	Saritha Alanyo	F	Koro	Acoyo	1	0	0	1
25	Alice Oroma	F	Koro	Acoyo	0	0	1	1
26	Laker Kevine	F	Koro	Acoyo	0	0	1	0
27	Anna Ayol	F	Koro	Acoyo	0	0	1	0
28	Margaret Acaye	F	Koro	Acoyo	1	0	0	1
29	Beatrice Acen	F	Koro	Acoyo	0	0	1	0
30	Richard Odong	M	Koro	Acoyo	1	0	0	0
31	Lucy lakot	F	Koro	Acoyo	0	0	1	0
32	Beatrice Auma	F	Koro	Acoyo	0	0	1	0
33	Filda lanyero	F	Koro	Acoyo	0	0	1	0
34	Isaac Ojok	M	Koro	Ibakara	0	0	1	0
35	Susan Apiyo	F	Koro	Ibakara	0	0	1	0
36	Denisi okello	M	Koro	Ibakara	1	0	0	0

37	Jimmy Odongo	M	Koro	Ibakara	0	0	1	0
38	Richard Ojok	M	Koro	Ibakara	1	0	0	1
39	Jovin Okello	M	Koro	Ibakara	0	0	1	0
40	Simon Peter Opiyo	M	Koro	Ibakara	1	0	0	0
41	Everly Otika	M	Koro	Ibakara	1	0	0	1
42	Aber Stella	F			0	1	0	0
				Total	**26**	**2**	**14**	**11**

Appendix 5. list of participants from Oyam district sensitised and trained in Triple S method of producing sweetpotato planting material. CRPs = Community Resource Persons, FEWs-Field Extension Workers, CDAs-Community Development Assistants

#	Name of farmer	Sex	Sub county	Parish	Status of participant		
					CRP	CDA/FEW	Host
1	Richard Obong	M	Minakulu	Atek	1	0	1
2	Tonny Amai	M	Minakulu	Atek	1	0	1
3	Samuel Otodi	M	Minakulu	Atek	1	0	0
4	Bonny Omara	M	Minakulu	Atek	1	0	0
5	Richard Ogola	M	Minakulu	Atek	1	0	1
6	Lawrence Ongom	M	Minakulu	Opuk	1	0	0
7	Bosco Odongo	M	Minakulu	Opuk	1	0	0
8	Agnes Ongom	F	Minakulu	Opuk	1	0	1
9	Annet Opio	F	Minakulu	Atek	1	0	0
10	David Abor	M	Minakulu	Atek	1	0	0
11	Densh Apunyu	M	Ngai	Acut	1	0	0
12	Patrick Ayu	M	Ngai	Omac	1	0	1
13	Beatrice Ojuk	F	Ngai	Omac	1	0	0
14	Richard Akaki	M	Ngai	Omac	1	0	0
15	Calvin Odongo	M	Ngai	Omac	1	0	0
16	Maxwel Nam	M	Ngai	Acut	1	0	1
17	Patrick Oyile	M	Ngai	Acut	1	0	0
18	Lawrence Ocan	M	Ngai	Acut	1	0	0
19	Dicken Okello	M	Ngai	Acut	1	0	0
20	Robert okello	M	Ngai	Omac	1	0	1
21	Walter Ekuba	M	Ngai	Acut	1	0	0
22	Michael Opio	M	Ngai	Acut	1	0	0
23	Aldo Ocen	M	Ngai	Acut	1	0	0
24	Santo Okello	M	Ngai	Acut	1	0	1
25	Francis Opio	M	Ngai	Omac	1	0	0
26	Hahab Renuls	M	Ngai	Omac	1	0	**0**
27	Grace Ekanya	F	Ngai	Omac	1	0	0
28	Ray Okello	M	Ngai	Acut	1	0	0

29	Patrick Okello	M	Ngai	Omac	1	0	1
30	Patrick Aluku	M			0	1	0
31	Oyena Emmy	M			0	1	0
				Total	**29**	**2**	**9**

Appendix 6. list of participants from Lira district sensitised and trained in Triple S method of producing sweetpotato planting material. CRPs = Community Resource Persons, FEWs-Field Extension Workers, CDAs-Community Development Assistants

#	Name of farmer	Sex	Sub county	Status of participant			
				CRP	CDA/FEW	Farmer	Host
1	Stephen Odongo Leo	M	Aboke	0	1	0	0
2	Lamex Dongo	M	Barr	1	0	0	1
3	Geoffrey Otim	M	Barr	1	0	0	0
4	Tonny Amai	M	Barr	1	0	0	0
5	Alfred Otim	M	Barr	1	0	0	0
7	Alfred Olila	M	Barr	1	0	0	1
28	George Ogwang	M	Barr	0	0	1	0
29	Junira Ocen	M	Barr	0	0	1	0
30	Joe Olinga	M	Barr	1	0	0	0
31	Moses Ajula	M	Barr	1	0	0	0
32	Vincent Okeng	M	Barr	0	0	1	0
33	Moses ogwang	M	Barr	0	0	1	1
6	George Obong	M	Ngetta	1	0	0	0
8	William Opio	M	Ngetta	1	0	0	0
9	Patrick George Ojok	M	Ngetta	1	0	0	0
10	Tom Aguma	M	Ngetta	1	0	0	0
11	Tonny Omara	M	Ngetta	0	0	1	0
12	Bonifance Keny	M	Ngetta	0	0	1	0
13	Janan Okello	M	Ngetta	1	0	0	0
14	Tonny Okello	M	Ngetta	1	0	0	0
15	David Agoro	M	Ngetta	1	0	0	0
16	Patrick Opolo	M	Ngetta	0	0	1	0
17	Jasper Ayo	M	Ngetta	0	0	1	0
18	Monica Kibuka	F	Ngetta	1	0	0	0
19	Harriet Okaka	F	Ngetta	1	0	0	0
20	Teddy Opio	F	Ngetta	1	0	0	0
21	Grace Omara	F	Ngetta	1	0	0	0
22	Susan Okello	F	Ngetta	0	0	1	1
23	Milly Omara	F	Ngetta	1	0	0	0
24	Perpetua Okolo	F	Ngetta	0	0	1	0

25	Jasper okello	M	Ngetta	0	0	1	0
26	Betty Rose Aceru	F	Ngetta	**0**	0	**1**	0
27	David Odwar	M	Ngetta	0	1	1	0
34	Hellen Grace Akullu	F	Ngetta	0	1	1	1
35	Doreen Ayuru	F	Ngetta	0	0	1	0
			Total	**19**	**3**	**15**	**5**

Appendix 7. list of participants from Kole district sensitised and trained in Triple S method of producing sweetpotato planting material. CRPs = Community Resource Persons, FEWs-Field Extension Workers, CDAs-Community Development Assistants

#	Name of farmer	Sex	Status of participant			
			CRP	CDA/FEW	Farmer	Host
1	Mario Okullu	M	1	0	0	0
2	Fred Munu	M	1	0	0	0
3	Jimmy Awady	M	0	0	1	0
4	Denish Okello	M	0	0	1	1
5	George Apoka	M	0	0	1	0
6	Monica Alupu	F	1	0	0	0
7	Florance Omara	F	1	0	0	0
8	Miriam Oduca	F	0	0	1	0
9	Simpo Akullu	F	0	0	1	1
10	Silvia Awidi	F	0	0	1	0
11	Anna Ogwang	F	0	0	1	0
12	Kenneth Acuti	M	1	0	0	0
13	Lawrence Omony	M	1	0	0	0
14	Geoffrey Okabo	M	0	0	1	0
15	Tobia odongo	M	0	0	1	0
16	Vincent Alobo	M	1	0	0	1
17	George Akenya	M	0	0	1	0
18	Peter Silivesto Obong	M	0	0	1	0
19	Geoffrey Okello	M	0	0	1	0
20	Tom Opio	M	0	0	1	0
21	Alfred Ojok	M	0	0	1	0
22	Sam Okello	M	0	0	1	0
23	Samuel Ojok	M	0	0	1	0
24	Charles Oyar	M	0	0	1	0
25	Benard Oming	M	1	0	0	0
26	Milton Obong	M	0	0	1	0
27	Rose Akoi	F	1	0	0	0
28	Monica Akullu	F	0	0	1	0
29	Tom Ayo	M	1	0	0	0
30	Jacob Aripa	M	1	0	0	1

31	Fred Amot	M	0	0	1	0
32	Tonny Agulu	M	0	0	1	0
33	Cyprano Oyel	M	0	0	1	0
34	Denish Ayo	M	0	0	1	1
35	Charles Okidi	M	0	0	1	0
36	Robert Okello	M	0	1	0	0
37	Geoffrey Ocuku	M	0	1	0	0
		Total	**11**	**2**	**24**	**5**

Appendix 8. Farmers trained in sweetpotato production

No.	Name	Gender
1	Zzaake Lumumbah	Male
2	Mutebi Stuart	Male
3	Najjingo Rose	Female
4	Kiyingi Joseph	Male
5	Nantume Aida	Female
6	Kyolaba Mariam	Female
7	Mukwaya Kizito	Male
8	Kalule Vicent	Male
9	Gwokyalya Milly	Female
10	Babumba Lozio	Male
11	Nakayiza Jane	Female
12	Namusisi Jovia	Female
13	Nalwoga Rose	Female
14	Namutebi Doreen	Female
15	Nakiranda Imelda	Female
16	Mugerwa Yusuf	Male
17	Nalule Harriet	Female
18	Naddamba Imaculate	Female
19	Nannyombi Barbra	Female
20	Nansikombi Faridah	Female
21	Nalutaaya Joyce	Female
22	Kaggwa Godfrey	Male
23	Sennabulya Ben	Male
24	Musoke Godfrey	Male
25	Kasekende Robert	Male