PVC clothing lines (ensure no new holes are created); Manila/nylon strings (tie the two ends together) (Fig. 4); Zippers; or Velcro.

g) Harvesting

Cut apical (top) portions of vines (25–30 cm long), at least 10 cm above the soil level, leaving some nodes on the remaining stems to sprout. If some plants have dried up, use cuttings from the harvested material to fill the gaps. If plant vigor has reduced, uproot all the plants and replant using cuttings from the same material.

h) Replenishment of net tunnel material using tissue culture-derived material

With good management, material in the net tunnels can be used for two years after which new pre-basic cuttings should be planted.

i) Scheduling of production and bookkeeping

Multipliers should understand sweetpotato root production cycle and market demand for seed in their locality in order to plan seed multiplication to have planting material at the onset of rains, when there is high demand. Keep records of all inputs, farm activities, yield, and sales to judge whether the seed business is profitable or not.

j) Weevil control

Weevils are prevalent during dry conditions. Ensure that the vines in the net tunnel are well watered. Be careful to select a site for the net tunnel and open-field multiplication where sweetpotato has not grown for two crop cycles.

Conclusion

Multipliers are excited about the prospects of producing disease-free planting material using the net tunnel technology. However, reliable links should be established along the seed value chain, particularly with buyers.

Fig 4. Alternative closure for net tunnels was first used in Mozambique, shared through the community of practice and tested in Tanzania. (Credit B. Rakotoarisoa)

Currently, the net (OPTINET 50), sourced from Nairobi, Kenya, is expensive and takes time to deliver. Identifying local suppliers in the different countries is essential for the adoption of the technology. It is also important to identify alternative construction materials such as: PVC pipes to replace wooden sticks; zippers to replace binding wires for opening and closing; and PVC clothing lines to replace binding wires in attaching the insect proof net on the frame.

Though initially meant for virus control, net tunnels have proven to be good for vine conservation and promotion. Multipliers report that farmers ask particularly for material that originates from the net tunnels. This can help open up markets for clean planting material hence increasing incomes for multipliers.

The implementation of the proposed seed standards and inspection protocols, and its effect on availability, access and use of clean planting material should be monitored among different users. This will contribute toward understanding the institutional implications and benefits to farmers.

Fig 5. TOSCI-LZARDI consultation on Sweetpotato seed standards, March 2014

Keeping disease-free sweetpotato vines closer to farmers "Kinga Marando"

SASHA Sweetpotato Action for Security and Health in Africa

SEP 2016

The feasibility of using low cost net tunnels to produce disease-free sweetpotato planting material under farmer-multiplier management was assessed in Tanzania and Uganda. A total of 91 Decentralized Vine Multipliers (DVMs) were identified and supplied with 140 net tunnels. Over 3.6 million cuttings were produced over the three-year period. A virus degeneration study conducted under the project showed that with good agronomic practices multipliers should be able produce clean planting material using the net tunnels. Standards for production of quality planting material were developed in Tanzania and are awaiting ministerial assent.

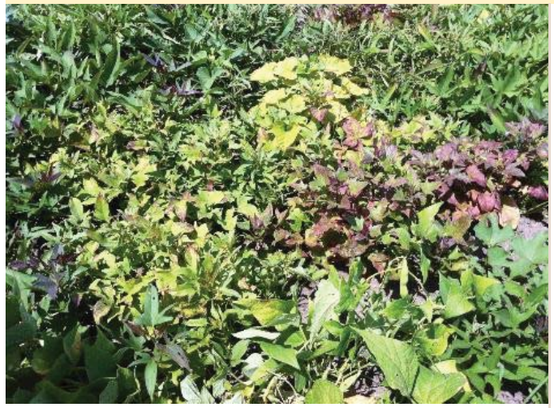

Fig 1. SPVD – infected material in a farmer's multiplication plot. Misungwi, Tanzania. (credit K. Ogero)

What was the problem?

Sweetpotato virus disease (SPVD) caused by synergistic interaction between Sweet potato feathery mottle virus (SPFMV) and Sweet potato chlorotic stunt virus (SPCSV) is a significant constraint to sweetpotato production in Tanzania and Uganda (Fig. 1). The disease can cause up to 98% yield losses. The situation is worsened by the prevalent farmer to farmer exchange of planting material.

What did we want to achieve?

The project sought to determine whether trained farmer multipliers could establish and cost-effectively maintain stocks of disease-free planting material and minimize the persistent recurrence of sweetpotato viruses using net tunnels, made of materials such as insect proof netting, flexible wooden sticks, and wires or sisal twine. The "Keeping disease-free vines closer to the farmers" ("Kinga Marando") project was implemented by the Lake Zone Agricultural Research and Development Institute, from 2013 to 2016. Collaborators included the Zanzibar Agricultural Research Institute, Uganda's National Crops Resources Research Institute, and the International Potato Center.

How did we make it happen?

We conducted adaptive research to assess the technical and economic feasibility of the net tunnel technology in controlling SPVD vectors under farmer management (Fig. 2). We tested the strategy in Sengerema, Misungwi, Misenyi, Bukoba and Unguja districts in Tanzania and Luwero and Rakai districts in Uganda. We conducted a virus degeneration study to determine how long the net tunnels could reliably produce virus-free planting material. Together with the Tanzania Official Seed Certification Institute (TOSCI), we held stakeholder meetings to develop standards for production of quality sweetpotato planting material.

CIP INTERNATIONAL POTATO CENTER
A CGIAR RESEARCH CENTER

KINGA MARANDO PROTECTING VINES

Partners

- Lake Zone Agricultural Research and Development Institute (LZARDI)
- International Potato Center (CIP)
- Zanzibar Agricultural Research Institute, Kizimbani (ZARI)
- Uganda National Crops Resources Research Institute (NaCCRI)
- Tanzanian Home Economics Association (TAHEA)
- Kolping Society of Tanzania (Kolping)
- Mikocheni Agricultural Research Institute (MARI)

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Fig 2. Net tunnel under construction in Sengerema district, Tanzania. (credit K. Ogero)

What did we achieve?

We built the human resource and infrastructure of one private sector laboratory and four research stations to produce and maintain disease-free foundation material. We conducted a survey to identify farmer-preferred varieties. In Tanzania *Isakalyabashihani, Umeme/Manigake, Gairo, Shangazi, Kilihona*, UKG2008/70, SP2001/05, NASPOT 1, *Njugu carot, Kigambilenyoko*, NASPOT 11, NASPOT 12, NASPOT 13 and *Ejumula* were identified. Six varieties were identified in Uganda: NASPOT 1, NASPOT 11, NASPOT 12, NASPOT 13, *Ejumula* and New *Dimbuka*. After virus-cleaning at the Kenya Plant Health Inspectorate Service, these varieties were multiplied through tissue culture at Crop Bioscience Solutions Ltd. in Arusha and then sent to national research institutions for distribution to 91 identified DVMs, along with 140 net tunnels (Table 1).

Table 1. Distribution of DVMs, net tunnels and varieties planted in the project areas

Country	Number of DVMs	Number of Net tunnels	Varieties multiplied by DVMs
Tanzania (Lake Zone)	54	76	Kabode, Polista and NASPOT 11
Tanzania (Zanzibar)	13	16	Mataya, Mayai and Kiegea
Uganda	24	48	NASPOT 9, Kabode and NASPOT 10
Total	**91**	**140**	

Source: Simon Jeremiah, 2016

Planting material maintained in net tunnels underwent one round of rapid multiplication in the open field before being sold to farmers for root production. A total of 3,603,500 cuttings were produced over the three-year project period (Table 2).

Table 2. Total number of cuttings produced through rapid multiplication

Country	Variety	Number of seedbeds	Estimated number of cuttings
Tanzania (Zanzibar)	Kabode	229	343,500
	Mataya	180	270,000
	Mayai	50	75,000
	Kiegea	36	46,500
Uganda	NASPOT 10	590	857,500
	NASPOT 9	41	64,800
	NASPOT 11	2	3,000
Tanzania (Lake Zone)	Kabode	1,327	1,688,700
	Polista	150	236,700
Total	NASPOT 11	20	16,800
		2625	**3,603,500**

Source: Simon Jeremiah, 2016

Building on earlier work conducted in the Lake Zone, Tanzania under the "Marando Bora" (quality vines) project, discussions continued with TOSCI at the national level to develop appropriate sweetpotato seed standards and inspection procedures (Fig. 5). Standards for Pre-basic, Basic, Certified 1 & 2 seed classes were included in the revised Seed Regulations Act (2015). A separate document on Rules for Quality Declared Seeds (QDS) 2015 covers the standards and inspection procedure for sweetpotato QDS. The documents were sent to the Ministry of Agriculture, Food Security and Co-operatives for approval in early 2016.

Fig 3. A farmer harvesting quality planting material from a net tunnel. Sengerema district, Mwanza, Tanzania. (credit K.Ogero)

What did we learn?

The virus degeneration study showed that with good agronomic practices multipliers should be able to produce clean planting material using net tunnels (Fig. 3). There was no virus infection in the net tunnels at the low virus pressure area over the 21-month period of the study whereas planting material in one net tunnel at the high virus pressure area experienced minimal infections in the last three generations.

A net tunnel management brief was prepared with key recommendations for production of quality planting material:

a) Site selection

A good site should meet the following conditions:

- Free from sweetpotato for the past two seasons.
- Year-round availability and easy access to water for irrigation.
- Safe from risk of theft, vandalism, or damage by livestock.
- Easily accessible for regular management and monitoring activities.
- Free from shade to allow maximum penetration of sunlight and rainwater.
- Site selected for open-field multiplication should be big enough to allow sufficient isolation distances between plots.

b) Fertilizer application

Well-decomposed organic manure should be added during bed preparation preferably two weeks before planting. Add three 20-liter (by volume) buckets of manure and mix with the soil. After every harvest add NPK (e.g., 17:17:17)[1] fertilizer to boost sprouting; application rate should be 200g/net tunnel. This is equivalent to one level teacupful of fertilizer.

c) Irrigation

Irrigation influences the quantity of vines produced in a net tunnel. A watering can is used for irrigating just one or two net tunnels.. Apply the water over the top of the net tunnel without opening. As the scale of production increases, more advanced methods such as drip irrigation can be installed. The frequency of irrigation depends on prevailing weather conditions.

d) Pesticide application

The net tunnels should be sprayed with a pesticide before closing, after planting and any other time they are opened to kill any insect that might have gained entry.

e) Weed management

Good site selection and removal of weeds during bed preparation reduces likelihood of heavy weed infestation later. After planting, use a mulch of rice husks or sawdust to suppress weeds. After each harvest, check and uproot all weeds and re-apply the mulch before spraying and closing the net tunnel. In case of a serious weed problem during the growing stage, the net tunnel may need to be opened to remove weeds; but spray with pesticide before closing. Remove weeds emerging around the net tunnels.

f) Opening and closing

The net tunnels should only be opened at harvest time. Open carefully to reduce wear and tear on the net. Binding wires can rust and break; or cause large holes on the nets. Alternative materials include:

1. Consult extension staff for locally available fertilizer formulation.