Assuring quality sweetpotato planting material
Does inspection make sense?

SASHA
Sweetpotato Action for Security and Health in Africa

In contrast to seed for grain crops, vegetatively propagated crops such as sweetpotato have bulky and perishable planting material. This presents technical and logistical challenges for an inspection and certification system. We are advocating for an integrated approach for quality assurance mechanisms for sweetpotato planting material based on: support for breeding for virus resistance and virus diagnostics; capacity strengthening of multipliers and farmers for pest and disease identification and management, including rouging (i.e. pulling out visibly affected plants), isolation from other plots, and crop rotation; together with appropriate inspection systems. To ensure sustainability in quality assurance mechanisms, it will be more cost effective for regulatory bodies to concentrate their inspection efforts at the up-stream sources which feed into the seed chain – i.e. pre-basic (foundation) and basic seed.

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Training farmer multipliers in sweetpotato quality planting material standards, Sengerema, Tanzania (credit M. McEwan)

What is the problem?

In the past sweetpotato has mainly been considered as a food security crop. The dominant practice in most areas is for farmers to source materials from their previous fields or their neighbours, typically without paying. Sweetpotato is now, however, being increasingly commercialised. Therefore farmers, particularly in production areas close to large urban markets, want to achieve high yields, to realise both increased food supply at home and higher incomes. Improved varieties can contribute to higher yields. However, as sweetpotato is a vegetatively propagated crop, pest and disease build up in the plant can be transferred through planting material to the next crop, leading to declining yields. A major contributor to this degeneration are sweetpotato viruses with reduction in root yield from the complex SPVD infection estimated at 50% or more (Loebenstein and Thottappilly 2009). Thus, a key objective for sweetpotato breeders is to screen for virus resistance in the selection process.

For grain crops, the genetic purity, phytosanitary, physical and physiological quality of seed is verified by regulatory bodies. The seed is then certified or quality declared and assigned to different seed classes. These are based on the number of generations from breeders' source, allowable tolerance levels for different diseases and pests, adherence to production standards, and responsibility for seed reproduction. There has also been considerable interest to introduce certification and inspection procedures for the vegetatively propagated crops including sweetpotato. The concerns of the regulatory bodies are to prevent the spread of plant borne diseases, and protect farmers from unscrupulous seed traders. However, are the needs of farmers for quality seed really being met, and what kind of inspection system is appropriate?

What have we done?

Working with the national research and extension systems and sweetpotato vine multipliers we piloted community based quality declared planting material (QDPM) inspection schemes in Lake Zone, Tanzania and in the Southern Nations, Nationalities and Peoples Region (SNNPR), Ethiopia. In Tanzania, this

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- Lake Zone Agricultural Research and Development Institute, Mwanza, Tanzania
- Regional Plant Health Office, Mwanza, Tanzania
- Tanzania Official Seed Certification Institute, Morogoro, Tanzania
- Southern Agricultural Research Institute, Hawassa, Ethiopia
- Ethiopian Agricultural Research Institute, Addis Ababa, Ethiopia
- Ministry of Agriculture, Addis Ababa, Ethiopia

involved using two different sets of tolerance levels – one set based on those proposed in the 2010 FAO Guidelines for vegetatively propagated crops; and a second set, which allowed higher or more relaxed tolerance levels based on the local context (McEwan et al., 2012).

We also tested the use of three different models for inspection: "self-inspection": which was based on existing farmer practice; "team inspection": which consisted of the multiplier, village extension officer and buyer (NGO); and "external inspection": which was the District Plant Protection Officer (DPPO), mandated by the Tanzania Official Seed Certification Institute (TOSCI) to conduct seed inspections. An independent inspection was conducted at the same time to be able to validate the results from the three models.

We wanted to compare the results of the different inspection models, and in addition to understand the process of how an inspection scheme is implemented. In Tanzania, two inspection visits were made (4-6 weeks after planting and 2 weeks prior to harvest) per season, and the pilot was conducted over two seasons, January to March and August to November 2012. The parameters for inspection were identified based on their importance for influencing yield. Box 1 shows the data which were collected. In Ethiopia, the pilot inspection was conducted by a *woreda* level committee comprised of researchers, extension providers and a representative of the multiplier.

Box 1: Data collection for inspection of sweetpotato planting material

1st visit: 4-6 weeks after planting

- History of previous crops and isolation distance observed
- Documented source of material (records)
- Beds labelled with name of variety and date of planting
- Evidence of roguing practice (removing plants with visible virus symptoms)
- Varietal purity in bed
- Presence of symptoms of serious diseases
- Incidence and severity of virus symptoms
- Presence of serious pests

2nd visit: 2 weeks prior to harvest

- Presence of serious pests and symptoms of serious diseases
- Physiological age of material and estimated quantity of material that can be harvested

Weevil damage in sweetpotato vines, Hawassa, Ethiopia
(credit M. McEwan)

Virus symptoms in sweetpotato planting material
(credit M. McEwan)

What were the results?

In Tanzania, for the first season, 64% of all plots inspected achieved the "acceptable" standard based on the locally negotiated tolerance levels, but this reduced to 55% of plots in the second season. If the FAO tolerance levels and standards are used, 25% and 14% of plots would have been scored as acceptable in each season respectively. In the FAO guidelines, the tolerance level for signs of weevils is zero, and this was the main reason why fewer plots were scored as acceptable. There were considerable variations across varieties and multipliers. The varieties Polista and Kabode consistently scored well (i.e. with 70%-100% and 67%-80% of plots acceptable in the first and second seasons, respectively). There was no pattern apparent in terms of performance in different agro-ecologies. In Ethiopia, the FAO set of tolerance levels were used for the pilot inspections at three sites. No site achieved the FAO standards due to high levels of virus, Alternaria, sweeetpotato butterfly and vectors (white flies and aphids).

In Tanzania, a comparison of the inspection results from each model with the independent validation showed a high level of convergence in results between the team model and the independent inspection and the external model and the independent inspection. There was also little difference in the percentage of inspection results confirmed by independent inspection between the team inspection and external inspection. Thus, with adequate training "local" inspectors can perform the inspections to the same level of confidence in results as "external" inspectors. In the second season the independent inspector visited five farmer multipliers who had a total of 11 plots used to source planting material. 64% were acceptable according to the locally negotiated standards. On this basis comparing the results from the multiplication plots managed by the trained DVMs with the plots of the farmer multipliers, the farmer multipliers performed better.

We also looked at the cost of implementing the inspections. The cost of inspecting one site is calculated to be $25.30 using the District Plant Protection Officer (DPPO) compared to $10 when using the Village Extension Officer (VEO). As two inspection visits are recommended (4-6 weeks after planting and 2 weeks before harvest); the total inspection cost per site is estimated at $50 and $20 for inspection by a DPPO and VEO, respectively. Our analysis showed that on small plots and using the "external" DPPO the cost of inspection is 375% of the value of the planting material. However, once the scale of multiplication increases to around 0.5 ha, then the cost of inspection as a percentage of the value of the planting material reduces to 0.5% and 0.2% for inspections conducted by the DPPO and VEO, respectively.

Therefore, it appears that from the perspective of the cost as a percentage of the total value implementing an inspection system is only reasonable for multiplication plots of at least 0.5 ha with a plant population of 250,000 cuttings.

As researchers we saw clear financial incentives to using clean seed with 25% and 43% yield increases translating into $255 and $831 net income benefit per hectare from using cleaned-up planting material of Polista and Kabode, respectively compared to farmer selected planting material of Polista. However, more studies are needed to understand farmers' perception of quality, and willingness to buy quality planting material in different contexts. Finally, there are technical and logistical challenges for implementing the inspections. These are shown in Box 2.

What have we learnt?

The characteristics of VPCs are different to grain crops – their planting material is bulky and perishable. So small scale decentralised multiplication is necessary to bring seed closer to farmers. This means that the inspection procedures used for grain crops cannot simply be cost-effectively transferred to VPCs. We should also discuss who could have the devolved responsibility to carry out inspections and certification functions at different stages of multiplication and who will cover the related costs. Our case shows that cost of inspection (calculated as a percentage of the value of the planting material) conducted by an external inspector for dispersed, small scale multiplication sites, is not financially sustainable. Quality starts at source, so we must consider the whole seed chain and it may be more cost effective to focus formal inspection and certification activities up-stream at pre-basic (foundation) and basic seed classes.

Knowledgeable and skilled farmers are critical to the functioning of any seed system –to appreciate varietal and quality seed characteristics and manage their own

Box 2: Technical and logistical challenges in implementing QDPM inspection at decentralised multiplication sites

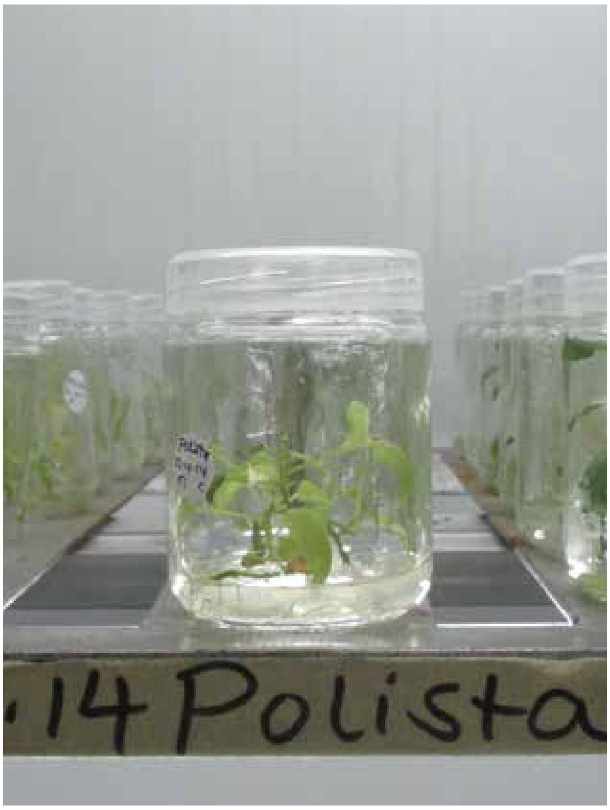
- Dispersed multipliers; limited number of multiplication beds at some sites; and fields at different stages does not make inspection visit cost effective
- Lack of records for source of planting material and date of planting; lack of labelling and non-standard beds make inspection visit longer
- Age of bed will influence inspection outcome

seed. Data from demonstration plots showed the financial advantages of using clean seed. However, from a farmer's perspective – what does this mean? What level of quality are farmers willing to pay for – and what is the real demand for clean seed of existing varieties, as opposed to seed of new varieties. Experience has shown that even when farmers understand the value of clean seed, the majority will only purchase small quantities to further multiply themselves. If the price is pushed too high, most farmers will just revert to material from neighbours or their own farms.

Farmer to farmer dissemination will continue to be the main channel through which vines are disseminated. Farmers practice various techniques to maintain or improve the quality of their planting material, e.g. rouging, which avoids plants with the complex SPVD. During the pilot, farmers commented on the usefulness of the inspections in that through them they learnt more about diseases and pests affecting vine multiplication and how specific management practices such as rouging, maintaining isolation distances and crop rotation can improve the quality of the planting material and subsequently sweetpotato production. Farmers appreciated having a standard against which to judge their own material. Thus using a participatory approach and an emphasis on learning rather than policing is critically important.

Our conclusion is that we should use multiple and simultaneous strategies: capacity building of famers to identify and manage pests and diseases; devolved authority to develop informal quality assurance systems to cover multiple, dispersed, small scale sites; together with

Post inspection feedback to multipliers, Geita, Tanzania (credit M. McEwan)



Quality starts at source. Crop Bioscience Solutions Tissue Culture Laboratory, Arusha, Tanzania (credit M. McEwan)

laboratory testing of the source material as it enters the seed value chain i.e. at a limited number of facilities.

What are the next steps?

With the completion of the pilot studies we have continued engagement with the regulatory bodies to feed these experiences from the field level into the national process. We need to continue to pilot different models for quality assurance of sweetpotato planting material with the regulatory bodies in different country contexts. This will include validating the correlation between a range of pest and disease parameters and reduction in yield; together with understanding the institutional issues related to implementation. We need to continue to generate and test with multipliers at farm level, technologies such as "net tunnels" to protect pre-basic (foundation) material from insect vectors. We also need to increase our understanding of farmers' real demand for clean seed. There are common concerns with other VPCs so a joint approach and dialogue with the national regulatory bodies would be more effective.

Conclusions

In our pursuit of quality we need to be cautious and ensure that over-regulation and bureaucracy do not stifle emerging seed entrepreneurs at birth. Increased yields are important, but only if farmers have access to output markets. A multi-pronged strategy is needed: breeding efforts are continuing to develop virus resistant varieties; but we also need to contribute to strengthening the efforts of farmers to maintain seed quality; while advocating for formal inspection processes to focus on the up-stream seed chain where pre-basic and basic planting material is produced.

Rouging out vines with virus symptoms, Sengerema, Tanzania. (credit M. McEwan)

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