Nurturing Innovations for Early Generation Seed Production

SASHA
Sweetpotato Action for Security and Health in Africa

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National Agricultural Research Institutes and private sector partners in 11 countries are exploring innovations to reduce cost and increase multiplication rates of early generation seed. Astute monitoring of the seed production environment can lead to incremental changes to the range of factors which influence costs and growth conditions.

Fig. 1. Participants at a workshop on Quality Declared Seed, Ethiopia (credit A. Frezer)

What is the problem?

Production of high quality early generation sweetpotato seed is expensive. The process requires micro-propagation of pathogen tested tissue culture plantlets, which are then acclimatized and hardened for normal plant growth under screen house conditions. We need to identify where costs can be reduced to ensure viable cost recovery.

What do we want to achieve?

We want to encourage measures to reduce costs without jeopardizing the quality of the seed. We aim to strengthen technical, financial and institutional capacities (Fig. 1) of National Agricultural Research Institutes (NARIs), and to ensure that they run cost effective and successful sweetpotato seed enterprises.

Where and with whom are we working?

We are currently working in 11 countries (Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Tanzania, Uganda and Zambia), with the NARIs, and with a private tissue culture laboratory in Uganda.

How are we making it happen?

Each NARI has a business plan with detailed cost structures for each stage in the production process for pre-basic and basic seed. The cost structures show that inputs and personnel for tissue culture (TC) production make it the costliest production stage. The number of TC plantlets required can be reduced and screen house production optimized. Colleagues in the sweetpotato seed systems community of practice have the opportunity to share and exchange experiences on how they are reducing costs and increasing the multiplication rate. This has happened through short-term training, on-line discussions and face to face meetings.

What have we achieved and learned so far?

Practices to reduce the costs of TC plantlet production are being evaluated and shared among countries e.g. the use of: table sugar in place of sucrose; locally available cling film in place of imported Para film to seal test tubes; stock solutions rather than the expensive MS premix for nutrient media; heat sensitive light timers to avoid overheating and reduce TC plantlet mortality. Colleagues at Crop Research Institute, Kumasi, Ghana are evaluating the effect of topophysis (i.e. distal, central, and proximal position on shoot) on *in vitro* multiplication rates. TC laboratories are used for multiple crops (e.g. potato, cassava, sugar cane) and so efficient cost sharing practices for personnel and equipment can be agreed upon.

Moreover, the number of TC plantlets required can be reduced through decreasing costs, increasing multiplication rates and optimizing screen house production practices. Colleagues at Tigray Agricultural Research Institute (TARI) in Ethiopia have limited the number of TC plantlets required by taking and rooting three cuttings from each hardened TC plantlet, rather than the conventional 1:1 ratio. The use of rooting hormone has improved the establishment at this stage. TARI has also reduced screen house costs by using recycled paint tins instead of new plastic pots; and by using solar energy for soil sterilization (Fig. 2) instead of diesel or electricity.

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Fig. 2. Solar sterilisation in TARI, Ethiopia. (credit M. McEwan)

Fig. 3. Staking plants in screen house, ZARI, Mansa, Zambia. (credit M. McEwan)

Fig. 4. Cutting, preparation and planting of two-node cuttings in coco peat plugs, Ethiopia. (credit B. Demtsu)

The National Crop Resources Research Institute (NaCRRI) in Uganda and others are testing the effect of different types and sizes of substrates (coco peat and sand) on multiplication rates. The Zambia Agricultural Research Institute (ZARI) has achieved more efficient vertical space utilization through using wires and strings to trellis the plants (Fig. 3) – so that they branch and produce up to five times more vines, than the conventional method. The National Root Crops Research Institute (NRCRI) at Umudike in Nigeria has found that use of the stem apex of the vine improves *in vivo* multiplication rate compared to the middle or the base portion. In Tanzania, the national program at the Sugar Cane Research Institute (SRI–Kibaha) are managing temperature fluctuations which slow down growth in the cooler months, by covering screen houses with additional plastic sheeting.

Different countries are trying out different fertilizers depending on local availability. These include foliar fertilizer (Rapid Grow), urea and organic manure by NaCRRI. NRCRI has found that application of poultry manure at 2-4tons/ha and top dressed with urea at 1.5kg/100m^2 after each pruning/ ratooning ensures high multiplication rates. TARI has experimented with the use of two-node cuttings in coco peat plugs (Fig. 4) for easier transport and faster establishment at open multiplication sites.

Quality is maintained by good maintenance of the screen house and sanitary practices: repairing netting, correct use of double doors, foot bath, protective clothing, regular insect scouting, use of low cost sticky cards for trapping white flies and aphids, and a regular spraying routine. Screen house plants are sourced from pathogen tested TC plantlets and currently it is recommended that virus testing using the indicator plant *I. Setosa* (Fig.5) and NCM ELISA analysis is conducted twice a year.

Fig. 5. Grafting of *I. Setosa* in preparation for virus indexing and cleaning at KEPHIS, Nairobi. (credit C. Bukania)

On-going (and systemic) challenges include:

1. Lengthy and high cost of government tendering processes for procurement. Early planning is critical and the business plans provide information on the items and quantities needed.
2. Lack of on-going preventative maintenance programmes for TC laboratory equipment. This should be scheduled when there is low demand for TC plantlets.
3. Lack of local service agents for imported equipment e.g. laminar flow and autoclave. NARIs are advised to check with universities and hospitals which may use similar equipment and plan joint service visits where possible.
4. Reducing costs and increasing the supply of pre-basic seed will only succeed if production is scheduled to coincide with the period of high market demand from basic multipliers i.e. "Late seed is lost seed".

What are the next steps?

On-going sensitization meetings with NARI senior research and financial management are building ownership and commitment to institutionalizing the use of business plans to guide the technical, financial and institutional innovations and actions required to make pre-basic seed production technically and financially sustainable.

Partners

- Kenya Plant Health Inspectorate Service, Plant Quarantine and Biosafety Station (KEPHIS-PQBS)
- National Crop Resources Research Institute (NaCRRI–Uganda)
- Rwanda Agricultural Bureau (RAB–Rwanda)
- Sugar Cane Research Institute (SRI–Kibaha) & Lake Zone Agricultural Research and Development Institute (LZARDI), Tanzania
- National Root Crops Research Institute (NRCRI), Nigeria
- Southern Agricultural Research Institute (SARI), Ethiopia
- Tigray Agricultural Research Institute (TARI), Ethiopia
- Crops Research Institute (CRI), Ghana
- Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso
- Instituto de Investigação Agrária de Moçambique (Agrarian Research Institute of Mozambique) IIAM, Mozambique
- Zambia Agricultural Research Institute (ZARI–Zambia)
- Department of Agricultural Research Services (DARS), Malawi
- BIOCROPS (U) Ltd Tissue Culture Laboratory, Uganda

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