Sweetpotato handbook for seed multiplication and inspection

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About this handbook
This handbook provides an easy-to-use reference on production of high quality sweetpotato planting material for seed (vines) that will contribute to efficient, profitable and sustainable sweetpotato productivity in Malawi. It is intended for use by extension staff, farmers, seed certification technicians, and other parties interested in sweetpotato seed systems and production. It is envisaged that users will find it useful and that researchers will continue to work for its improvement and applicability.

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Please send a copy to the Communications Department at the address below.
International Potato Center
P.O. Box 1558, Lima 12, Peru
cip@cgiar.org • www.cipotato.org

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## Contents

Acknowledgements .................................................................................................................................................................. 5

1. Introduction........................................................................................................................................................................... 6
   1.1. Importance of sweetpotato........................................................................................................................................... 6
   1.2. Sweetpotato seed systems........................................................................................................................................... 6
   1.3. Current status of sweetpotato seed certification...................................................................................................... 6

2. Sweetpotato seed multiplication........................................................................................................................................ 8
   2.1. Importance of quality seed........................................................................................................................................ 8
   2.2. Classes of seed............................................................................................................................................................ 8
   2.3. Stages and levels of seed multiplication..................................................................................................................... 8
   2.4. Seed multiplication methods..................................................................................................................................... 9

3. Recommended cultural practices for seed multiplication.................................................................................................. 10
   3.1. Site selection............................................................................................................................................................. 10
   3.2. Land preparation......................................................................................................................................................... 10
   3.3. Selection of varieties................................................................................................................................................ 10
   3.4. Guidelines for selection of vines................................................................................................................................ 10
   3.5. Planting.................................................................................................................................................................... 11
   3.6. Watering, weeding and fertilizer application ........................................................................................................... 11
   3.7. Roguing...................................................................................................................................................................... 11
   3.8. Pest and disease management.................................................................................................................................. 12
   3.9. Harvesting ............................................................................................................................................................... 15
   3.10. Post-harvest handling of vines ................................................................................................................................ 15
   3.11. Ratoon crop management.......................................................................................................................................... 16

4. Standards for inspecting and certifying sweetpotato planting materials ............................................................................. 17
   4.1. Procedures to produce sweetpotato planting material as a commercial venture .................................................... 17
   4.2. Factors to consider for seed material multiplication ............................................................................................... 17
   4.3. The pre-requisites for an entrepreneurial vine grower include.................................................................................... 17

References .............................................................................................................................................................................. 18

Appendix I.............................................................................................................................................................................. 19

Appendix II............................................................................................................................................................................. 29
**Acknowledgements**

The authors would like to thank the Department of Agricultural Research Services (DARS) through the Root and Tuber Crops Commodity and the International Potato Center for the technical expertise, description of sweetpotato varieties, and provision of photographs and illustrations used in this handbook.

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Felistent Chipungu, Obed Mwenye, Daniel VanVugt, John Kazembe, Patison Mamboya and Chifundo Kapalamula from CIP
1. Introduction

1.1. Importance of sweetpotato

Sweetpotato is one of the widely grown crops in Malawi and has the potential to contribute to improved food and nutrition security. The importance of sweetpotato as an alternative food and cash crop has steadily increased recently. This is attributed to the recurrent droughts and escalating prices of farm inputs, especially for maize which is the staple food crop.

Sweetpotato is considered as a low-risk crop that adapts readily to a wide range of agro-ecological conditions. It efficiently utilizes mineral reserves of marginal soils, can withstand unfavorable climatic conditions, and is highly efficient in the conversion of solar energy to carbohydrates.

Sweetpotato root yields differ greatly across the world, with Asia averaging 18.5 tons/ha, the USA 16.3 tons/ha, South America 12.2 tons/ha and Africa 4.7 tons/ha. Under excellent management and input use, such as can occur in South Africa, yields of 50-60 tons/ha can be obtained.

In Malawi, released varieties have yield potentials of over 20 tons/ha. The high yield gap between that obtained by researchers and farmers in Malawi is attributed to poor agronomic practices such as late planting in degraded soils, late or no weeding, wrong spacing, use of disease/pest infected planting materials and other poor cultural practices used by farmers.

1.2. Sweetpotato seed systems

The main constraint to sweetpotato production in Malawi is lack of high quality and disease-free planting vines. Instead, farmers use sprouts from previous fields as seed material. As these are informally exchanged between farmers they can escalate pest and disease incidences.

An effective and efficient seed system will provide farmers with high quality planting materials in a timely manner. A constraint to breeders being able to disseminate rapidly new varieties to farmers is the low multiplication rate for vines (15:1); this is low in comparison to most cereal crops (200-300:1). Fortunately, rapid multiplication techniques have been developed which can reach rates of 90:1 and are constantly being improved.

A successful seed system requires availability of improved seed (foundation seed, basic seed) with protocols for cleaning planting materials and rapid multiplication of disease-free vines, and also well trained personnel and stakeholders. The Malawi government Department of Agricultural Research Services (DARS) in collaboration with the International Potato Center (CIP) has developed a seed system for sweetpotato in Malawi that ensures production, dissemination, and access by farmers to high quality planting material of improved varieties.

1.3. Current status of sweetpotato seed certification

The sweetpotato seed system in Malawi is working to contribute to poverty alleviation through raising the crop’s productivity by availing quality seed of improved varieties. The seed system is intended to achieve:

- Dissemination of high quality and disease-free planting material which results in high yields.
- Timely provision of planting material to farmers of appropriate quality and quantity.
• Efficient dissemination of new improved varieties from breeding programs.
• Provision of replacement planting material following natural disasters or in times of crisis or unrest, as well as routinely replenishing farmers’ planting materials.

The seed system is also key in the implementation of the seed regulations of Malawi that ensure production and availability of high-quality seed in the country. The Seed Services Unit (SSU) in the DARS is therefore key in the process of ensuring availability of high-quality seed material of sweetpotato in Malawi.
2. Sweetpotato seed multiplication

2.1. Importance of quality seed

Although sweetpotato planting materials can be produced from true seeds, apart from specialist breeders, they are generally propagated vegetatively. The criteria used in determining quality of planting materials of sweetpotato are generally based on the threshold levels of infestation of diseases and pests. Crop fields which fall within the acceptable range of quality standards qualify as sources of good planting materials, while those outside the range are rejected.

In addition to incidence of diseases and pests, there are other difficulties associated with the production of sweetpotato planting materials. One of these is the bulkiness of the vines. The bulky and relatively fragile vines can easily be damaged when they are transported to production fields. This can result in poorly established crops.

2.2. Classes of seed

Just like cereals and legumes, the classes of sweetpotato planting materials are:

i. Breeder/Nucleus seed: This is seed of a released variety maintained by the breeder. This requires mother plantlets produced using tissue culture and in-vitro preservation.

ii. Pre-basic: This is the progeny of breeder seed produced under high level management in tissue culture and screen screenhouses. It is produced by mandated institutions and private entities with relevant facilities and structures.

iii. Basic/foundation seed (generations G1 to G3): This is the progeny of pre-basic seed sourced from screen houses and planted in open fields.

iv. Certified seed (G4 to G7): This is produced through the multiplication of basic/foundation seed (G3) in open fields.

2.3. Stages and levels of seed multiplication

There are three levels of seed multiplication outlined as follows:

i. Production at primary stage (G1 to G3):

At the primary stage, production is for early generation planting materials in open fields. The initial source of planting material is from screenhouses (pre-basic). The field is managed to a high-level and closely supervised by research scientists, extension staff or trained specialists. While the first open field planting is referred to as G1, the ratooned crop and the replants from the ratoons are classified subsequently by generations (G2 and above), and as approved by SSU between generations.

ii. Production at secondary stage

At the secondary multiplication stage, the source of planting material is from primary stage (G3) to produce G4. Seed multiplication is done by individual or commercial producers under technical supervision from researchers as well as extension workers from Ministry of Agriculture, NGOs, private institutions and other partners. These institutions/agencies should be backstopped by breeders/researchers through training about seed management. Seed can be classified from G5 to G7, depending on the assessment and approval by SSU.
iii. Production at the tertiary stage

To enhance dissemination and facilitate easy access to high quality planting materials by the farming communities, decentralized vine multipliers (DVMs) are recruited and trained. The planting material used by DVMs is the secondary stage (G5 to G7). Seed production is done by individuals, groups or commercial multipliers who are closely located to sweetpotato root producers. Supervision is done by extension workers and partners in communities. Inspection and registration with SSU is mandatory if the seed is to be sold.

2.4. Seed multiplication methods

i. Conventional multiplication

The conventional sweetpotato vine multiplication method is the easiest and most widely used. For this, vines are grown on ridges but at reduced within row spacing of 15 cm between planting stations (compared to 20 cm for root production). It is aimed at producing roots whilst also multiplying vines. However, it has the disadvantage of having a low vine multiplication rate (1:15) compared to the rapid multiplication technique (1:60-100).

ii. Rapid multiplication

The primary aim is to multiply vines at high plant density. Seed multiplication is done on nursery beds. The standard bed is 1 meter wide and any length. A 1-meter square bed requires 50 vine cuttings spaced at 10 cm x 20 cm (Figures 1 and 2).

Figure 1: Schematic presentation of rapid vine multiplication
Figure 2: Demonstration of planting on a nursery bed
3. Recommended cultural practices for seed multiplication

3.1. Site selection

Production of planting materials is done in nurseries and needs to be close to a reliable source of water. The land should be free from volunteer plants and therefore sites where the previous crop was sweetpotato should be avoided. The soil should be well drained, preferably a deep sandy loam. The site should be away from high pressure areas for sweetpotato virus. Ideally it should not be on steep slopes to avoid soil and water run-off. The nursery should be protected from livestock and wildlife damage as much as possible.

3.2. Land preparation

Beds for vine multiplication should be reasonably spaced to allow for easy working but generally about 1-1.5m soil to increase soil nutrients, improve soil structure and water holding capacity.

3.3. Selection of varieties

Sweetpotato varieties to be multiplied should be those demanded by local farmers and the market. These should be high yielding, early maturing, high in dry matter content (at least 30 %), with acceptable taste, low fiber content, good storability, and tolerant to pests and diseases. Details of released varieties in Malawi are provided in Appendix I.

3.4. Guidelines for selection of vines

i. Select vines that are healthy with vigorous and lush growth. (Figure 3).

Figure 3: High quality vine cuttings ready for planting

ii. Cuttings from the base of vines carry sweetpotato weevil and should be avoided (see Figure 9). Avoid plants with pests and diseases. Many sweetpotato pests and diseases are stem-borne and can be spread through distribution and planting of infested or diseased cuttings.

iii. Cuttings should be taken from the shoot tip because here the meristematic cells are still actively dividing. Avoid using basal and woody parts of the stem as sprouting will be poor.
iv. Two to three nodes per cuttings are recommended for rapid multiplication (Figure 4a).

**Figure 4a: A 3-node vine cutting**

3.5. Planting

Water the beds before planting. Plant the cuttings vertically, at a spacing of 20 cm by 10 cm (Figure 1 and 4b) with two nodes inserted into the soil (Figure 4c). Water the plants again after planting.

**Figure 4b: Between row (20 cm) and within row (10 cm) planting on beds 4c: Two nodes of the vine cutting inserted in the soil**

3.6. Watering, weeding and fertilizer application

Water seed bed regularly; never allow the seed bed to become dry. It is also important to keep sweetpotato nurseries weed-free, especially in the first 4-5 weeks of crop growth, before the canopy fully develops. Weeds rob plants of nutrients, water, light, and space, and can also act as alternative hosts for diseases and pests. Care should be taken not to damage roots when weeding. It may be necessary to apply nitrogen fertilizer to boost crop growth, but care must be taken to avoid excessive, soft growth which results in weak vines. Where fertilizer is required apply 200 kg per ha of 23:21:0+4S or CAN at planting or ratooning (1 match box per m² or 20g/m² of 23:21:0+4S).
3.7. Roguing

Good planting materials should be true to type with no admixtures. During field inspections, off-types must be identified, uprooted and destroyed by burying or burning to maintain seed purity. Similarly, all plants infected with viral diseases must be uprooted and destroyed by burning away from the field.

3.8. Pest and disease management

Regular routine field inspections to identify, uproot and destroy disease-infected plants is a must. The Regular inspections should start soon after sprouting and be repeated every two weeks. The uprooted plants should be destroyed away from the field by burning. In the early stages of growth, gaps resulting from uprooting must be filled with new cuttings to maintain a full stand. Care should be taken in identification of diseases to avoid confusing with nutrient deficiency/toxicity. Where in doubts, consult appropriate technical experts.

In Malawi, the major pests are sweetpotato weevil (*Cylas puncticollis*) and elegant grasshopper (*Zonocerus elegans*), while major diseases are sweetpotato virus disease (SPVD) and the fungal disease Alternaria blight.

i. Sweetpotato pests

Sweetpotato weevil

Sweetpotato weevil is the most destructive sweetpotato pest in Malawi. The adult weevil (Figure 5a) is an elongated, black, ant-like beetle. It lives on stems and leaves in early stages of the crop, where it feeds and lays eggs. Once the eggs hatch, the larvae enter and damage the tubers by making tunnels and depositing frass (excrement) (Figure 5b). In response, the tubers produce toxic chemicals called terpenes, which render the tubers inedible. Hot, dry weather favors the weevil because then the sweetpotato roots are easily reached through cracks in soil. The pest survives in infested roots and vines, residues from previous crop, and suitable alternate host plants such as morning glory (*Ipomoea indica*). It cannot be controlled through use of insecticides as the weevils live in stems or roots and may not be reached by insecticides. The major control measure for sweetpotato weevil include:

a. Use of tolerant varieties.

b. Appropriate cultural practices, such as early planting, selection of clean planting materials, and removal of volunteer plants.

c. Field hygiene (removal of infested crop residues).

d. Preventing or filling cracks in the soil by hilling up.

e. Crop rotation.

Figure 5a. Adult weevil and 5b: Root damage by larva
Elegant grasshopper

The elegant grasshopper is one the most destructive sweetpotato pest in Malawi. It feeds on leaves causing irregular holes and sometimes leaving ragged edges (Figures 6a and 6b). The major control measure for elegant grasshopper include:

a. Use of chemicals as advised by extension workers or experts
b. Use traditional chemicals such as botanical extract obtained from the plant *Tephrosia vogelli*.

**Figure 6a: Elegant grasshopper and 6b: Damaged leaves**

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ii. Sweetpotato diseases

**Sweetpotato virus disease (SPVD)**

SPVD is caused by a combination of Sweetpotato Feathery Mottle Virus (SPFMV), transmitted by aphids, and Sweetpotato Chlorotic Stunt Virus (SPCSV), transmitted by whitefly. SPVD is widespread and regarded as a serious problem in Africa including Malawi. It can cause yield reduction of 56 - 98%. Infected plants appear puckered, with slight yellowing of the veins and mottling of the leaves (Figure 7). The mottling is often pale so that the whole plant may appear chlorotic. Control measures include:

a. Use of resistant/tolerant varieties.
b. Avoiding use of infected plants as the source for planting material.
c. Uprooting and burning infected plants.
d. Field sanitation such as removal of debris and uprooting and destruction by burning of volunteer plants.
e. Crop rotation.
**Figure 7**: Sweetpotato virus disease symptoms

g. SPFMV: vein clearing, creating a net effect  
h. SPFMV: fine vein clearing, giving the appearance of a net: sometimes the leaf appears silverish  
i. SPCaLV: chlorotic spots  
j. SPCaLV with begomovirus: small chlorotic areas along veinlets and leaf cupping  
k. SPFMV and other viruses: severe leaf distortion and vein clearing  
l. Begomovirus complex: leaf cupping and other distortions at the leaf margin  
m. SPCaLV and begomovirus: necrosis due to multiple infection  
n. Sweetpotato little leaf phytoplasma: fine vein clearing throughout the leaf  
- SPFMV-Sweetpotato feathery mottle virus; SPCaLV – sweetpotato caulimo-like virus

**Alternaria blight (A. bataticola)**

Alternaria blight, also called Alternaria leaf and stem blight, is a fungal disease. Symptoms of the disease include brown lesions with concentric rings on leaves, petioles, and stems. Blackened leaf debris appears underneath affected plants (Figure 8). Vine tips are less affected. Severe attacks may kill plants.

The disease is prevalent in mid to high altitude areas and is favored by humid conditions. The fungus survives in debris and is spread by infected vines, wind, and splashing rain and water. Control measures include:

a. Use of resistant/tolerant varieties  
b. Field sanitation Field sanitation such as removal of debris and uprooting and destruction by burning of volunteer plants  
c. Selection of disease-free planting material

**Figure 8**: Sweetpotato plant infected by Alternaria blight showing blackened leaves
3.9. Harvesting

Harvesting should start when the vines are at least 45 cm long (usually two to three months after planting, depending on prevailing conditions). Harvesting should be done for either further vine multiplication or root production. Harvesting is done by cutting at 10 to 15 centimeters above the ground (Figure 9). With good management, two to three vine harvests from ratoons can be obtained within a rainy season, as long as the plants are healthy and free from viral diseases and sweetpotato weevil (see 3.11, Ratoon crop management).

Figure 9: a demonstration of 10-15 cm vine base after cutting

3.10. Post-harvest handling of vines

Packaging

Different vine packaging methods are used in Malawi depending on the buyer’s specifications. Commonly used options include sacks and 100 cuttings bundles.

- When sacks are used, a 50 kg maize sack accommodates about 8 kg of vines. It is advisable to make holes in the sacks to increase air flow and also to avoid overfilling the sacks.
- Vines can also be tied in bundles of 100 cuttings, each 30 cm long, with or without leaves on (Figure 10a, 10b).
- During a mass multiplication and dissemination activity, it is useful to have a rough estimate of the number of cuttings per kilogram, which varies for different varieties.

Figure 10a: a bundle of vines with leaves and 10b: without leaves
Labelling

Make sure that each vine package is clearly labelled. The label needs to give information on: variety, date of harvest, name and contact details of the multiplier (Figures 10a, 10b). Details of the characteristics of the variety should also be provided on the back of the label.

Figure 11a: A well labeled vine bundle 11b: Label with detailed information

Vine storage

Planting of sweetpotato vine cuttings should be done soon after harvesting. The optimum storage period for sweetpotato vines is one to three days, although cuttings can be kept for up to seven days. The vines should be kept in a cool and shady place. During storage, roots may develop at the base of the cuttings. This is called pre-sprouting. If this happens, the cuttings should then be carefully planted with the roots.

Transportation

Transport sweetpotato vines in open trucks, ox-carts or wheelbarrows, depending on distances. Take care when loading to avoid squashing and damaging the vines; especially when large trucks are used the vines can get squashed and overheat. Transport sweetpotato vines during the cool part of the day to minimize rotting or drying out.

3.11. Ratoon crop management

When the vines are being harvested care should be taken to avoid bruising the remaining buds. Bruised buds may not sprout. After ratooning, apply urea fertilizer as a source of nitrogen at the rate of 13g/m² to boost growth. Keep the field weed free. Another set of vines can be harvested two to three months after ratooning. Ratooning is not recommended, where disease pressure is high. Ratooned field should be certified by SSU.
4. Standards for inspecting and certifying sweetpotato planting materials

4.1 Procedures to produce sweetpotato planting material as a commercial venture

i. In Malawi, the seed certification agency is the SSU which comes under the DARS, Ministry of Agriculture. Register with SSU before producing any sweetpotato planting material for sale.

ii. Source of planting material for multiplication should be approved by the SSU before planting of the nursery.

4.2 Factors to consider for seed material multiplication

- Adequate land to permit crop rotation
- Water availability for irrigation
- Technical expertise
- Willingness

4.3 The pre-requisites for an entrepreneurial vine grower include:

- Access to land that is in close proximity to a reliable source of water for periodic irrigation (avoid water sources that are fed by drainage and also alleys between beds).
- Soils should be fertile and well drained.
- The field should be adequately isolated from fields that are currently or have recently been used to grow sweetpotato.
- The farmer should have a basic practical knowledge and skills for production of high-quality planting material and have a genuine interest in producing sweetpotato planting material as a business.

In deciding to produce sweetpotato planting materials as a commercial venture, answering the following questions may aid quick decision making:

a) Have you got access to a market for vines?

b) Have you got land available that has not recently been used to grow sweetpotato? This will avoid problems due to volunteer crops and the associated pest and disease risk.

c) Is your land accessible to enable effective management?

d) Can the site be protected from damage caused by livestock or wildlife?

e) Do you have fertile and well-drained soil?

f) Is the site free from sweetpotato diseases and pests?

g) Can you implement the 10 meter isolation distance as stipulated in the certification standards? (Appendix II).
References


# Appendix I. Characteristics of Released Varieties

<table>
<thead>
<tr>
<th>Pictures</th>
<th>Variety, growth characteristics</th>
<th>Agronomic aspects</th>
</tr>
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| ![Anaakwanire](image1) | **Anaakwanire**  
**Canopy or plant type:** Very spreading and twinning; flowering ability and habits: Late and sparse  
Light green leaves when mature and young; 3 moderate lobes; green vines both upper and under side of the leaf  
Green mature vines and apical ends. Short (2.5-4cm) internodes; intermediate (5-6mm) diameter  
Roots have cream skin color, long irregular shape, 29% dry matter, orange fleshe (29A:28D)-CIP color chart; beta carotene: 5500µg/100g FWB  
Takes 6 Months to mature.  
Specifically adapted for high rainfall areas.  
Moderate tolerance to sweetpotato weevil to sweetpotato virus diseases.  
Potential yield is 25t/ha | |
| ![Chipika](image2) | **Chipika**  
**Canopy or plant type:** Erect, flowering ability and habits: Late and sparse  
Dark green leaves when mature, no lobes  
Dark green vines when mature; Short (3-5cm) internodes; Intermediate (5-6mm) diameter  
Roots are, long elliptic shape, tan skin color  
30% Dry matter, Beta carotene: 3500µg/100g FWB  
Takes 5 Months to mature  
Well adapted to warm and hot areas, mid to low altitudes of Malawi  
Moderate resistance to weevil attack  
Succumbs to Alternaria and cold seasons  
Potential yield 35t/ha | |
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<tr>
<th><strong>Pictures</strong></th>
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<th><strong>Agronomic aspects</strong></th>
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</table>
| ![Image](image1.png) | **Kadyaubwerere**  
**Canopy or plant type:** Spreading, flowering ability and habits: Late and sparse flowering  
Green leaves when young and mature; 5 deep lobes  
Green vines when young and mature. Intermediate (5.0-7.5cm) internodes; intermediate (5-6mm) diameter  
Ovate root shape, purple red skin colour, 31% Dry matter; Deep orange flesh colour.  
(28A:29D)-CIP color chart, Beta carotene: 8900µg/100gfwb | Takes 5 Months to mature  
Widely adapted  
Tolerant to sweetpotato weevil and sweetpotato virus disease  
Potential yield is 35t/ha |
| ![Image](image2.png) | **Kaphulira**  
**Canopy or plant type:** Spreading. Flowering ability and habit: Late and moderately profuse  
Green leaves when young and mature; heart shaped single lobe. purple veins underside leaf  
Green vines with purple nodes when mature. Intermediate (4-6cm) internodes, Intermediate (6-7mm) diameter  
Round elliptic root shape, Cream skin colour, 30.0% dry matter. Intermediate orange flesh colour. (29A:26D)-CIP color chart. Beta carotene: 3200µg/100gfwb | Takes 3.5 Months to mature  
Widely adapted  
Moderate resistance to sweetpotato weevil and virus disease  
Potential yield is 35t/ha |
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<th>Pictures</th>
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<th>Agronomic aspects</th>
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<td><img src="Image1" alt="Picture" /></td>
<td><strong>Mathuthu</strong>&lt;br&gt;&lt;b&gt;Canopy or plant type:&lt;/b&gt; Semi-erect. flowering ability and habit: Late and sparse&lt;br&gt;Leaves are green when young and mature; with prominent purple veins under surface of the leaf; 5 Moderate lobes&lt;br&gt;Green vines with purple spots when young and mature, Intermediate (5-6cm) internodes Intermediate (5-6mm) diameter&lt;br&gt;Obovate root shape, light purple skin colour, 29.0% Dry matter. Intermediate orange flesh colour. (28D:28C)-CIP color chart. Beta carotene: 900µg/100gfw&lt;br&gt;<strong>Takes 5 Months to mature</strong>&lt;br&gt;Well adapted to mid-altitude areas&lt;br&gt;Moderate to sweetpotato weevil attack and SPVD&lt;br&gt;<strong>Potential yield is 25t/ha</strong></td>
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<td><img src="Image2" alt="Picture" /></td>
<td><strong>Zondeni</strong>&lt;br&gt;&lt;b&gt;Canopy or plant type:&lt;/b&gt; Spreading.&lt;br&gt;Flowering ability and habit: Late and sparse&lt;br&gt;Leaves are light green when mature, purple margins on young leaves, 3-4 moderate lobes&lt;br&gt;Vines are light green when young, short 3.5-5cm) internodes, intermediate diameter (5-6mm)&lt;br&gt;Long irregular root shape, light orange skin colour&lt;br&gt;30.0 - 32.0% Dry matter Deep orange flesh colour. (30D:29B)-CIP color chart, Beta carotene: 9000µg/100gfw&lt;br&gt;<strong>Takes 6 Months to mature</strong>&lt;br&gt;Less stable among and across agro-ecologies&lt;br&gt;Moderate to sweetpotato weevil attack and SPVD&lt;br&gt;<strong>Potential yield of 8-16t/ha</strong></td>
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<td><img src="image1" alt="Royal choice" /></td>
<td><strong>Royal choice</strong>&lt;br&gt;<strong>Canopy or plant type:</strong> It has a spreading growth habit&lt;br&gt;Green when young and mature; with prominent purple veins under surface of the mature leaves. 5 Moderate lobes&lt;br&gt;Light green when young and mature, intermediate (5.0-7.5cm) internodes, intermediate (5-6mm) diameter&lt;br&gt;Long oblong root shape, red skin colour, 31% Dry matter, orange flesh colour.</td>
<td>Takes 3-4 Months to mature.&lt;br&gt;Big root size, widely adapted to agro-ecological zones and moderate tolerance to SPVD&lt;br&gt;Potential yield of 35 t/Ha</td>
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<td><img src="image2" alt="Royal choice" /></td>
<td><strong>Mthetsanjala</strong>&lt;br&gt;<strong>Canopy or plant type:</strong> It has a semi-erect growth habit&lt;br&gt;Light green leaves with one triangular lobe&lt;br&gt;Light green vines, intermediate (5.0-7.5cm) internodes, intermediate (5-6mm) diameter&lt;br&gt;Long oblong root shape, red skin colour, 32% Dry matter, deep orange flesh colour.</td>
<td>Takes 4-5 Months to mature.&lt;br&gt;Big root size, and widely adaptable&lt;br&gt;Potential yield of 30 t/Ha</td>
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<tr>
<td><img src="MSUNGABANJA.jpg" alt="Picture 1" /></td>
<td><strong>Msungabanja</strong>&lt;br&gt;<strong>Canopy or plant type:</strong> It has a spreading growth habit&lt;br&gt;Green leaves, one triangular lobe, with prominent purple veins under surface of the mature leaves.&lt;br&gt;Light green vines, intermediate (5.0-7.5cm) internodes, intermediate (5-6mm) diameter&lt;br&gt;Ovate root shape, red skin colour&lt;br&gt;31% Dry matter, deep orange flesh colour</td>
<td>Takes 4-5 Months to mature.&lt;br&gt;Big root size, and widely adaptable&lt;br&gt;Potential yield of 30 t/ Ha</td>
</tr>
<tr>
<td><img src="SAKANANTHAKA.jpg" alt="Picture 2" /></td>
<td><strong>Sakananthaka</strong>&lt;br&gt;<strong>Canopy or plant type:</strong> Has vigorous growth and spreading growth habit&lt;br&gt;Green leaves when young and mature; heart shaped single lobe.&lt;br&gt;Light green vines when young and mature&lt;br&gt;Short (3.5-5.0cm) internodes; Intermediate (5-6mm) diameter&lt;br&gt;Long irregular root shape, cream colour, 30% Dry matter, White flesh colour.</td>
<td>Takes 5 months to mature. Well adapted to mid-altitude areas&lt;br&gt;Moderate to weevil attack and SPVD&lt;br&gt;Potential yield of 20 to 30t/ha</td>
</tr>
<tr>
<td>Pictures</td>
<td>Variety, growth characteristics</td>
<td>Agronomic aspects</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Semusa</td>
<td><strong>Canopy or plant type</strong>: Spreading growth habit</td>
<td>Takes 5 Months to mature, widely adapted. Moderate resistance to sweetpotato weevil damage and SPVD. Potential yield of 20-35t/ Ha.</td>
</tr>
<tr>
<td>Sungani</td>
<td><strong>Canopy or plant type</strong>: Spreading growth habit</td>
<td>Takes 5 Months to mature, widely adapted; moderate to sweetpotato weevil damage and virus disease. Potential yield of 23-35t/ Ha.</td>
</tr>
<tr>
<td></td>
<td>Green mature and immature leaves with 3 and 5 lobes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Green vines and light green when young, short (3.5-5.0cm) internodes, intermediate (5-6mm) diameter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long root shape, cream skin and flesh colour, 32% Dry matter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Takes 5 Months to mature, widely adapted; moderate to sweetpotato weevil damage and virus disease. Potential yield of 23-35t/ Ha.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light green leaves when mature, purple margins on young leaves, have 5 deep lobes. Mature leaves are green</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light green vines when young and mature.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intermediate (5.0-7.5cm) internodes, Intermediate (5-6mm) diameter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Round root shape, cream skin and flesh colour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>33% Dry matter.</td>
<td></td>
</tr>
<tr>
<td><strong>Pictures</strong></td>
<td><strong>Variety, growth characteristics</strong></td>
<td><strong>Agronomic aspects</strong></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td><img src="image1" alt="Kajiyani" /></td>
<td><strong>Kajiyani</strong>&lt;br&gt;<strong>Canopy or plant type:</strong> It has an extremely spreading growth habit&lt;br&gt;Green leaves and petioles with purple veins under leaf. 5 lobes&lt;br&gt;Light green vines when young and mature, intermediate (5.0-7.5cm) internodes, intermediate (5-6mm) diameter&lt;br&gt;Cream skin and white fleshed, long roots, 32% dry matter</td>
<td>Takes 5 Months to mature, widely adapted&lt;br&gt;Moderate resistance to sweetpotato weevil damage and SPVD&lt;br&gt;Potential yield of 30t/Ha</td>
</tr>
<tr>
<td><img src="image2" alt="Lunyangwa" /></td>
<td><strong>Lunyangwa</strong>&lt;br&gt;<strong>Canopy or plant type:</strong> Spreading growth habit&lt;br&gt;5 very deep lobes, purple young leaves which turn green when mature, purple and hairy petioles&lt;br&gt;Has purple vines, intermediate (5.0-7.5cm) internodes and intermediate (5-6mm) diameter&lt;br&gt;Long irregular root shape, white skin and flesh colour 30% Dry matter.</td>
<td>Takes 5 Months to mature, widely adapted&lt;br&gt;Moderate resistance to sweetpotato weevil damage and SPVD&lt;br&gt;Potential yield of 20t/Ha</td>
</tr>
<tr>
<td>Pictures</td>
<td>Variety, growth characteristics</td>
<td>Agronomic aspects</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------</td>
<td>------------------</td>
</tr>
</tbody>
</table>
| ![Picture](https://via.placeholder.com/150) | **Nyamoyo**  
**Canopy or plant type:** Spreading growth habit  
Green mature and immature leaves, with purple veins underside of the leaves. Has 5 lobes  
Light green vines, short (3.5-5.0cm) internodes; Intermediate (5-6mm) diameter  
Long root shape, cream skin and flesh colour  
33% Dry matter | Takes 5 Months to mature, widely adapted  
Moderate resistance to sweetpotato weevil damage and SPVD  
Potential yield of 20-35t/ Ha |
| ![Picture](https://via.placeholder.com/150) | **Mugamba**  
**Canopy or plant type:** Semi-erect in growth habit  
The leaves are green and have one triangular lobe  
Thick vines, light green when mature, short (3-5cm) internodes, intermediate (5-6mm) diameter  
Root skin colour is cream, and flesh colour is also cream with orange patches when mature, 35% Dry matter | Takes 5 Months to mature, widely adapted  
Moderate resistance to sweetpotato weevil damage and SPVD  
Potential yield of 40 t/Ha |
<table>
<thead>
<tr>
<th>Pictures</th>
<th>Variety, growth characteristics</th>
<th>Agronomic aspects</th>
</tr>
</thead>
</table>
| ![Kenya](image1) | **Kenya**  
**Canopy or plant type:** It has vigorous growth and semi-erect in growth habit  
Leaves are green with very deep lobes  
Green mature and apical ends. Short (2.5 -4cm) internodes. Intermediate (5-6mm) diameter  
The skin colour is cream, the flesh colour is pale - yellow to yellow in colour when mature, 38% Dry matter | Takes 4-5 Months to mature, widely adapted  
Moderate resistance to sweetpotato weevil damage and SPVD  
Potential yield of 30 t/ Ha |
| ![Salera](image2) | **Salera**  
**Canopy or plant type:** It has an extremely spreading growth habit  
Leaves (young and mature) and petioles are green in colour. 3 deep lobes  
Light green when young and mature, intermediate (5.0-7.5cm) internodes, intermediate (5-6mm) diameter  
The skin and flesh colour is white, 32% Dry matter | Takes 5 Months to mature, widely adapted  
Moderate resistance to sweetpotato weevil damage and SPVD  
Potential yield of 35 t/ Ha |
<table>
<thead>
<tr>
<th>Pictures</th>
<th>Variety, growth characteristics</th>
<th>Agronomic aspects</th>
</tr>
</thead>
</table>
| ![Image](image1.jpg) | **Kakoma**  
**Canopy or plant type**: Semi-erect in growth habit  
The leaves are green with prominent purple petioles and veins under leaf, have one triangular lobe  
Purple vines medium short (3-5cm) internodes, intermediate (5-6mm) diameter  
Purple root skin and white flesh colour, 35% Dry matter | Takes 5 Months to mature, widely adapted  
Moderate resistance to sweetpotato weevil damage and SPVD |
| | | Potential yield of 20 t/Ha |
## APPENDIX II. CERTIFICATION STANDARDS FOR SWEETPOTATO PLANTING MATERIAL

<table>
<thead>
<tr>
<th>Activity</th>
<th>Nucleus (Pre-basic)</th>
<th>Early generation (G1-G3) basic seed</th>
<th>Basic G4-G5</th>
<th>Certified seed G6-G7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>Tissue culture (TC) &amp; Screen house-Maximum of 6 sub-culturing cycles in TC; and screen house (SH) cuttings; and SH replant at least once in 2 seasons Notify SSU</td>
<td>-Register with the SSU before or at planting for the first open field production from pre-basic seed</td>
<td>-Register with the SSU before or at planting for the first seed material sourced from G1 to G4</td>
<td>-Register with the SSU before or at planting for the first crop from G4 to G5</td>
</tr>
<tr>
<td>Land history</td>
<td>2 seasons</td>
<td>2 seasons</td>
<td>1 season</td>
<td></td>
</tr>
<tr>
<td>Isolation Distance</td>
<td>10 m</td>
<td>10 m</td>
<td>10 m</td>
<td></td>
</tr>
<tr>
<td>Number of inspections</td>
<td>2 (during vegetative phase and at harvest)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off types (%)</td>
<td>0.5%</td>
<td>0.5%</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Inspection procedure</td>
<td>-Sample 100 plants per bed of 1m x 20m and sample 10 beds per hectare. Sample 200 plants per hectare if planted on ridges</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sweetpotato Virus Complex Disease

<table>
<thead>
<tr>
<th></th>
<th>During the growing period</th>
<th>At harvest</th>
<th>Weevils during growing period</th>
<th>At harvest</th>
<th>Weevils at harvest</th>
<th>Alternaria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5%</td>
<td>0%</td>
<td>≤1% (if old vines leave 10-15cm from the base)</td>
<td>≤1%</td>
<td>≤1%</td>
<td>≤5%</td>
</tr>
</tbody>
</table>

### Alternaria

<table>
<thead>
<tr>
<th></th>
<th>During the growing period</th>
<th>At harvest</th>
<th>Weevils at harvest</th>
<th>Alternaria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5%</td>
<td>0%</td>
<td>≤1%</td>
<td>≤5%</td>
</tr>
</tbody>
</table>

### Packaging and labelling

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
<th>Bundle tying material</th>
<th>Labeling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 vine cuttings of 30cm each and/or 4 or 8 kg bundle by weight</td>
<td>Use durable materials i.e. luzi, linya, twine, cotton threads, sacks, dried and soaked zilambe or sisal.</td>
<td>Variety, grower, year/season, evidence of inspection report like serial number per bundle</td>
</tr>
</tbody>
</table>
CIP is a research-for-development organization with a focus on potato, sweetpotato and Andean roots and tubers. It delivers innovative science-based solutions to enhance access to affordable nutritious food, foster inclusive sustainable business and employment growth, and drive the climate resilience of root and tuber agri-food systems. Headquartered in Lima, Peru, CIP has a research presence in more than 20 countries in Africa, Asia and Latin America.

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For more information, please contact CIP Headquarters. Av. La Molina 1895, La Molina. Apartado 1558. Lima 12, Peru.

+51 1 3496017  cip-cpad@cgiar.org  www.cipotato.org  @cipotato  @Cipotato  @cip_cipotato