Technical Guidelines for Sweetpotato Seed

Citation:

Mukasa S.B., Namanda S., Musoke C., Magezi S., Kyalo G., Mwanga R.O.M., Ssemakula G., Ball A-M., Kasharu, Kyamanywa S. and Tumuboine E. 2016. Technical guidelines for inspection and certification of sweetpotato planting material in Uganda: recommended practices.

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ISSN: 2518-248X

ACKNOWLEDGEMENT

The authors acknowledge the contributions of different stakeholders in the development of these guidelines. The contributions from the plant inspectors from MAAIF headquarters and from selected districts helped make the guidelines have practical dimensions that will be useful during inspection. Inputs from partner institutions like Makerere University (under the Cassava-Potato-Sweetpotato project of the BioInnovate Programme), National Crops Resources Research Institute (NaCRRI, NARO), Ministry of Agriculture Animal Industry and Fisheries (MAAIF), International Potato Center – Kampala (CIP – Uganda), SENAI Farm Supplies Ltd, and Bio-Crops (U) Ltd were vital in conceptualizing the idea of developing the guidelines. Special thanks go to HarvestPlus/IFPRI for financially supporting the consultative meetings and preparation of the first draft.

ACRONYMS

AOSCA Association of Official Seed Certifying Agencies. AOSCA is an association of certification agencies in North America, Argentina, Chile, South Australia and New Zealand.

CIP International Potato Center

FAO Food and Agriculture Organisation

IFPRI International Food Policy Research Institute

MAAIF Ministry of Agriculture Animal Industry and Fisheries

MAK Makerere University

NARO National Agricultural Research Organisation

NGO Non-Governmental Organisation

NPPO National Plant Protection Organisation

NSCS National Seed Certification Service

OECD The Organisation for Economic Cooperation and Development seed certification schemes

QDPM Quality Declared Planting Material,

QDS Quality Declared Seed, also referred to as Quality Declared Planting Material (QDPM)

SASHA Sweetpotato Action for Security and Health in Africa

SPVD Sweetpotato virus disease.

SSA Sub-Saharan Africa

VRC Variety Release Committee

ABOUT THE GUIDELINES

The International Plant Protection Convention 1951, overseen by the Food and Agriculture Organization (FAO), aims to prevent and to control the introduction and spread of pests of plants and plant products. It sets the standards for the issue of International Phytosanitary Certificates under the authority of the National Plant Protection Organisation (NPPO) of the member states. The Department of Crop Protection of the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) is the Uganda's designated NPPO. In 2014, MAAIF finalised the drafting of the National Seed Policy (NSP) with a mission to create a well-regulated seed sector that ensures availability of and access to safe and high quality seed and planting materials under pluralistic seed systems.

MAAIF crop protection and certification program in collaboration with Makerere University College of Agricultural and Environmental Sciences, HarvestPlus DDBC programme of International Food Policy Research Institute (IFPRI), and the International Potato Center (CIP) engaged in developing protocols for sweetpotato planting material (seed) as part of the comprehensive strategy to pluralistic seed sector including vegetatively propagated planting materials. The protocols are presented here as technical guidelines for field inspection and certification of sweetpotato planting material in Uganda.

Apart from developing certification guidelines for sweetpotato planting material, the team has developed inspection instructional materials for sensitizing, training and technically empowering the plant inspectors, seed producers, laboratory operators, screenhouse operators (net protected nursery multipliers). Sweetpotato vines under certification must meet the requirements of the Seeds Regulations for vegetatively propagated crops seed crop eligibility. MAAIF certification program is primarily based on tolerances levels for visual disease readings, pest incidence varietal mixtures in the seed crop, land use history, source of planting material for the seed crop and laboratory testing in case of referral cases. Therefore, these guidelines contain standards and protocols for inspection and certification for sweetpotato planting material (seed) for all seed classes. It explains the methodology for sampling seed multiplication fields, how to calculate the incidence of diseases and pests which affect the seed quality, and how to report the results. These guidelines ensure that inspections are carried out in accurate and objective ways.

In order for farmers to realize the yield potential of sweetpotato, they should be able to access adequate quantities of quality and disease free seed in time for planting. Provision of quality planting material can be guaranteed by appropriate standards and protocols that could be used during inspection and certification. The available information at national, regional and international levels has been processed together to come up with a holistic set of standards and protocols for sweetpotato planting material for Uganda.

DEFINITION OF KEY TERMS

Contaminant: A plant that is considered undesirable in a seed production field, including off types, other varieties, other crops, weeds and plants with disease symptoms.

Crop age: The time from planting to the date of assessment, inspection or any other key activity.

Crop rotation: The practice of growing a series of different types of crops in the same area in sequenced seasons or years. In these guidelines, rotation refers to a specified years immediately preceding the seed crop.

Field count: A count of contaminating factors as specified in the field production standards for seed

Field inspection: An inspection of a seed field for carrying out checks to ascertain correct crop rotation, isolation, rouging, weeding or compliance to seed quality standards

Generation: The number of times or seasons a seed crop has been exposed to the natural crop growing environment; where G0 is the crop grown under protected environment, G1 is the crop that has been grown one season under natural condition with any protection.

Inspector: Person authorized by the regulatory body to perform the field inspection - designated by law, and responsible to, the government for carrying out inspection and certification schemes.

Isolation: A minimum separation distance required in a seed multiplication field in order to prevent contamination by physical mixtures or disease vectors.

Micropropagation: The practice of rapidly multiplying stock plant material to produce a large number of progeny plants using plant tissue culture techniques.

Off-type: A plant which does not display the recognized characters of growth, morphological formation either in leaf or flower, a shape or colour or is in any way obviously different from accepted characters of the variety being grown.

Parental material: the smallest unit of seed or planting material used by the grower to maintain the variety from which all subsequent seed of the variety is derived through one or more generations.

Protected environment: in the context of these guidelines, this is where sweetpotato seed is maintained or multiplied in an insect proof containment e.g. glasshouse, screenhouse, polyhouse and net tunnels.

Ratoon crop: A sprout or shoot from the root, stem or vine of a plant after it has been cut back.

Rouging: Removal of plants which are diseased or not of the desired type contaminants to purify and clean the stock,

Sampling area/unit: One of the small areas in the field in which plants are examined in detail.

Seed (Sweetpotato Seed): In the context of these guidelines, seed refers to quality sweetpotato vine cuttings intended for use as planting material.

Seed class: The categorization of seed according to genetic purity and quality standards. The seed classes adopted in these guidelines are Nuclear stock, Basic seed, Certified 1, Certified 2 and QDS.

Volunteer plant: A plant, which usually comes up from seed (root or cutting) left on/in the ground from a previous crop.

1.0 INTRODUCTION

1.1 Sweetpotato production and constraints to its seed system

Sweetpotato is commonly vegetatively propagated where each cropping cycle is started by planting the apical 20-30 cm vine cuttings. This allows accumulation of pests and diseases, particularly viruses, through each successive generation leading to significant decline in yield. Most farmers source planting material from their own fields or purchase from neighbors. This does not allow a check on the quality of vines planted. Sweetpotato virus disease (SPVD) is the most important disease of sweetpotato. SPVD can cause 50-98% yield loss in susceptible varieties and has been associated with the extinction of elite varieties. Other pests and diseases have been reported, and they also raise phytosanitary concerns. A more feasible and sustainable intervention would be to promote a combination of using moderately tolerant varieties and use of good quality planting material.

1.2 Purpose of seed certification

The purpose of seed certification is to ensure farmers realize the potential yield of sweetpotato through timely access to adequate quantities of quality seed. This can be guaranteed by use of appropriate standards and protocols during inspection and certification. These guidelines cover all the seed classes of Nuclear (Pre-basic), Basic, Certified 1 (first generation), Certified 2 (second generation) and Quality declared seed (QDS). The main objectives of field inspections for sweetpotato seed are to check that:

- The cropping history and location of the planned multiplication field meet the criteria for appropriate seed class,
- The seed source and identity of the varieties grown are in conformity with the Seed Regulations and Standards,
- Appropriate agronomic practices have been used in the multiplication field including the removal of weeds, off-types and diseased plants,
- The incidence of diseases and pests in the multiplication field is within the tolerance levels laid out in the standards for sweetpotato seed, and
- Harvesting is done in such a way to avoid mechanical mixing of varieties
- Only seed harvested from certified fields is approved for distribution.

1.3 Seed classes

There are a number of seed classification systems. Whatever system is used, standards and guidelines are set by the government. And, the four classes of seed recognized for the purpose of seed certification are:

i) Breeder/Pre-basic/Nuclear/
i) Foundation/Basic,
i) Registered/Certified 1, and
i) Certified 2 seed.

In these guidelines, we have adopted the naming of seed classes as proposed in the National Seed Policy (2014) draft. Therefore, under these guidelines, sweetpotato seed is categorized into 5 classes, including the QDS, following harmonization between the OECD and the National Seed Policy 2014 draft with respect to seed class names and label colours (Table 1). The proposed classification for sweetpotato seed classes should put into consideration that sweetpotato is vegetatively propagated and that the future of the crop will be based largely on tissue culture, especially the nuclear stock seed (Figure 1).

Table 1: Description of proposed sweetpotato seed classes including the QDS

S/N	Harmonised sweetpotato seed class	Description for sweetpotato seed stage	Labels
1	Nuclear stock seed	Tissue culture plantlets (Laboratory produced)	Violet stripe on white
2	Basic seed	Screenhouse vines (net-protected production)	White
3	Certified seed 1	Isolated field vines (net-protected production)	Blue stripe on white
4	Certified seed 2	Isolated field vines (net-protected production)	Red stripe on white
5	Quality declared seed	Farmer or community field produced vines	Green

Production of seed of the different seed classes could follow mostly a linear flow of events as stages, starting with on with most stringent tolerance levels – the nuclear stock stage (Figure 1). Here, we propose a model for sweetpotato seed scheme as shown in Figure 1. Details of tolerance levels for the different classes are shown in Table 6.

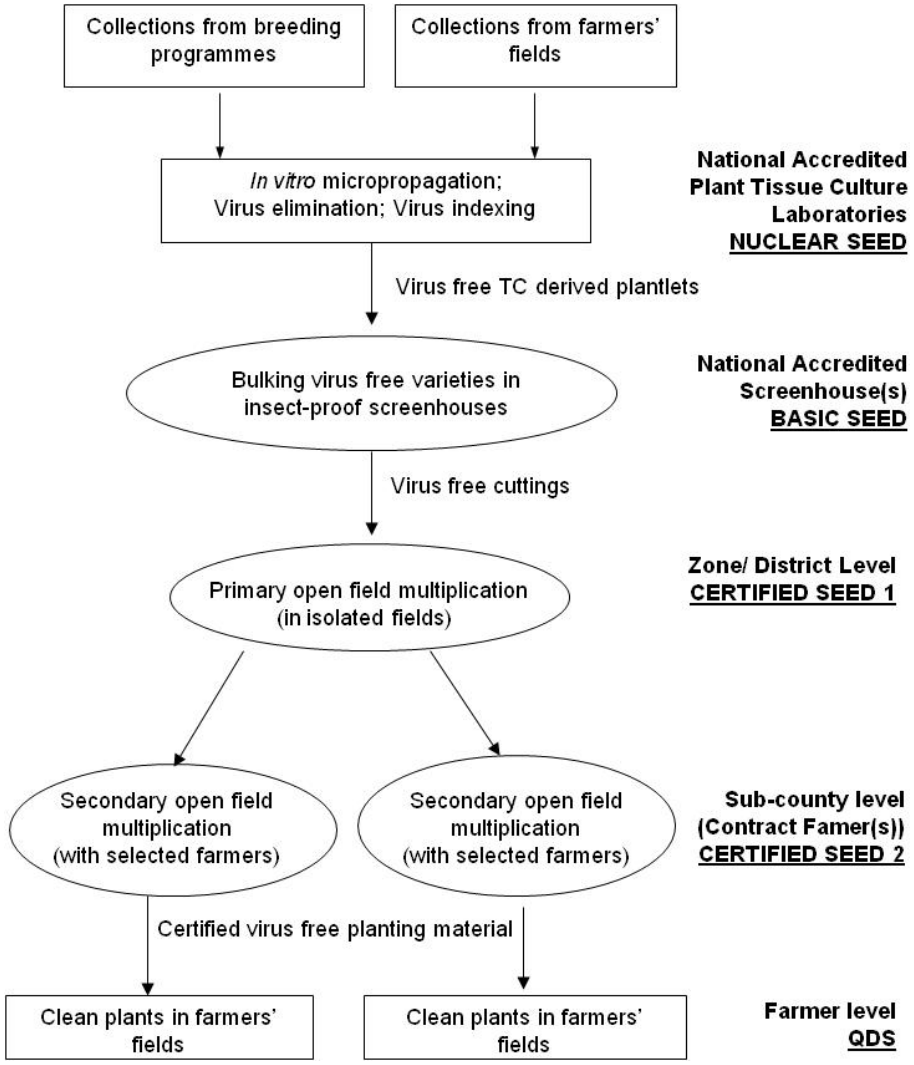


Figure 1. Diagrammatic scheme of sweetpotato seed for Uganda.

1.4 Scope of the plant inspectors guidelines

These guidelines are intended to assist MAAIF inspectors in the inspection of the growing sweetpotato crop to determine whether the crop meets the standards outlined in the *Seeds Regulations*. The objectives of conducting crop inspections are to:

- Determine the farm unit production eligibility for crop inspection through review of the Application for Sweetpotato Crop Inspection Growers' Declaration and confirmation of the grower's declaration.
- Assess and record the disease levels, varietal purity, crop rotation, cultivation practices, isolation distances and overall health of the sweetpotato crop.
- Determine seed eligibility status of the inspected crop and if appropriate, assign a seed class and a crop unique certification number.

1.5 Qualification of plant inspectors

In order to qualify to perform sweetpotato seed crop inspection, the inspector must have completed the appropriate training which includes but is not limited to the following:

- BSc from a recognized institution is mandatory
- Become familiar with the Seeds Regulations, sweetpotato planting material, and the plant inspection procedures.
- Have participated in sweetpotato seed inspection and certification training sessions
- .
- The first year of sweetpotato crop inspection must be done accompanied by an experienced inspector.
- The inspectors should undergo refresher training sessions every after 5 years.

1.6 Responsibility of the national regulatory body

The regulatory body, National Seed Certification Service¸ has the following responsibilities:

- Review applications and eligibility of varieties for production of quality declared seed; and maintain an up-to-date list of those varieties accepted as eligible
- Review applications for registration as a seed producer and maintain an up-to-date register of those which are approved
- Ensure that inspections are made on at least 10 per cent of the seed fields for the production of sweetpotato seed.
- Authorize seed inspectors carry out the seed inspection on a minimum of 10 per cent of the multipliers fields used for production of seed.
- Authorize seed inspectors to certify seed classes designated as Nuclear stock, Basic seed, Certified 1 seed, Certified 2 seed or Quality declared seed (QDS)

2.0 SWEETPOTATO SEED PRODUCTION

Production of sweetpotato has special requirements that make the plants arising from the crop suitable for use a good seed. The issues to consider include history of the area of production and crop husbandry. The area chosen for sweetpotato seed should also be amenable to inspection for eventual certification.

2.1 Land requirements

Land intended for sweetpotato seed production should be prepared in a timely manner and in such a way that clean land is obtained. The plot for sweetpotato seed crop should not have any contamination (including water runoff) or build-up of soil-borne diseases from sweetpotato or alternate hosts grown in previous seasons.

2.2 Isolation

The sweetpotato seed crop should be planted in isolation from other crops to minimize contaminations. The isolation areas or distance could be used to grow crops that are alternate hosts for sweetpotato pests and diseases. The objective of maintaining an isolation distance is to avoid transmission of sweetpotato viruses by vectors such as aphids and white-flies. The isolation distance with a suitable barrier crop (e.g. maize, sorghum) are indicated for each seed class under these guidelines (Table 6), but without suitable barrier the isolation distance should be twice.

2.3 Source of seed

The seed grower should use seed of a class above the one he/she is targeting to produce. Seed production should use seed of Nuclear stock, Basic, Certified 1 or Certified 2 seed classes. QDS seed production should use source seed of any of the above classes. Tubers may also be used as a source of planting material, and quality standards or tolerance levels must be observed.

2.4 Method of planting

The method of planting will be influenced by whether sweetpotato is grown for a sole purpose of seed or multi-purpose where a farm intends to use the tubers as food. Where sweetpotato is grown only for seed, a close spacing of 20 X 20 cm could be used when planting. Planting may be done on flat bed, ridges or mounds. Whichever method used for planting, the grower should record the plant density.

2.5 Crop rotation

Crop rotation is very important to prevent soil borne diseases and pests contaminating the seed. It also minimizes contamination from sprouts from tubers or vines of the previous crop. Sweetpotato should only be re-planted on the same plot after the respective rotation years (Table 6). If there is high weevil incidence the number of seasons the field should be free of sweetpotato should be extended by one season (six months).

2.6 Off-types and other varieties

Farmers should be assured of the genetic purity and variety that they are receiving. Multiplication plots should consist of only one variety and off-types should be removed. The maximum percentage of other varieties or off-types (variety purity) in the sweetpotato seed field is as shown in Table 6. The list of some sweetpotato varieties released and their descriptors is shown in Annex 9.

2.7 Pests and diseases

Many insect species attack sweetpotato and the importance of different species varies between agro-ecological zones, season and varieties. Many insect pests (e.g. sweetpotato weevils) are a problem mainly in dry periods. Pests of sweetpotato cause damage on leaves (through defoliation), stems, or roots. Defoliation reduces yield depending on the severity of infestation and the growth stage of the sweetpotato crop in which it occurs. Defoliation affects the quality of vines for planting and the vines from affected field can spread the pest to new areas. In addition to feeding, certain insects, such as aphids and whiteflies, transmit viruses. Extensive stem damage can result in wilting or even in death of the plant. Damage to the vascular system caused by insect feeding and tunneling and pathogen invasion of the injured tissue can reduce the size and number of storage roots. Some key pests of sweetpotato in Uganda are listed in Annex 4.

2.8 Diseases of sweetpotato

A number of pathogenic organisms affect sweetpotato leading to a range of symptoms. The disease causing organisms include viruses, fungi, and bacteria, as well as nematodes. Pathogenic bacteria, although not very common, are responsible for important economic losses. They affect vascular tissue as well as storage and fibrous roots, thus causing vine wilting and rots. Fungal pathogens are classified according to the type of disease they cause, such as foliar, stem, storage root, and postharvest diseases. Plant parasitic nematodes are included as the cause of serious damage to storage roots both in the field and during storage. More information of key sweetpotato diseases is given in Annex 5. Although the symptoms of virus diseases appear in the foliage, these have been accorded a separate Annex 6 because of their importance. Of all the sweetpotato pathogens, viruses appear to contribute the most to yield losses. Several single virus infect sweetpotato with no or mild symptoms. However, dual infections involving Sweet potato chlorotic stunt virus and another virus (mostly Sweetpotato feathery mottle virus) results into very severe symptoms, a phenomenon described as sweetpotato virus disease (SPVD). Diseased plants become severely stunted and the leaves become small and narrow, often with a distorted edge. Puckering, vein-clearing, and mottling may occur. The mottling is often pale so that the whole plant may appear chlorotic.

In some cases plant appear sick when they lack nutrients. Plant nutrients are chemical elements that are essential to plant tissue. For healthy growth, plants require an adequate supply of each of these elements. The most abundant elements in plants are carbon, oxygen, and hydrogen, and are obtained from the air and water. The others are referred to as mineral nutrients, and are supplied by the mineral and organic components of the soil. A deficiency of any particular nutrient results in reduced growth rate and yield. It can only be corrected by increasing the supply of that nutrient; therefore, accurate diagnosis of nutritional disorders is essential for efficient corrective treatment. Supplying a nutrient in excess of crop requirements is costly and of no benefit. Many mineral nutrients (such as boron, manganese, and copper) are toxic to plants if present at high concentrations. Other elements, which are not essential nutrients, may also cause toxicity, such as aluminum, in acid soils, and sodium. Care should be taken not to confuse nutrient deficiencies or toxicity with diseases associates with pests and diseases. Some common nutrient deficiencies are provided in Ames et al. (1996).

3.0 SWEETPOTATO SEED INSPECTION

All classes of seed are produced by a registered seed producer that conforms to the minimum standards. In order to be eligible for seed certification, seed must be of a registered variety, produced by a holder of a valid certificate of competence from the designated authority, and the producer must have in place an internal quality control system. Therefore, any person who wishes to become a seed producer must submit an application for registration to the regulatory body, the national Seed Certification Service. Laboratories and screenhouses that are involved in the upstream production of seed, particularly nuclear stock and basic seed, should also be registered. The following diagram (Figure 2) provides an overview of the field inspection process.

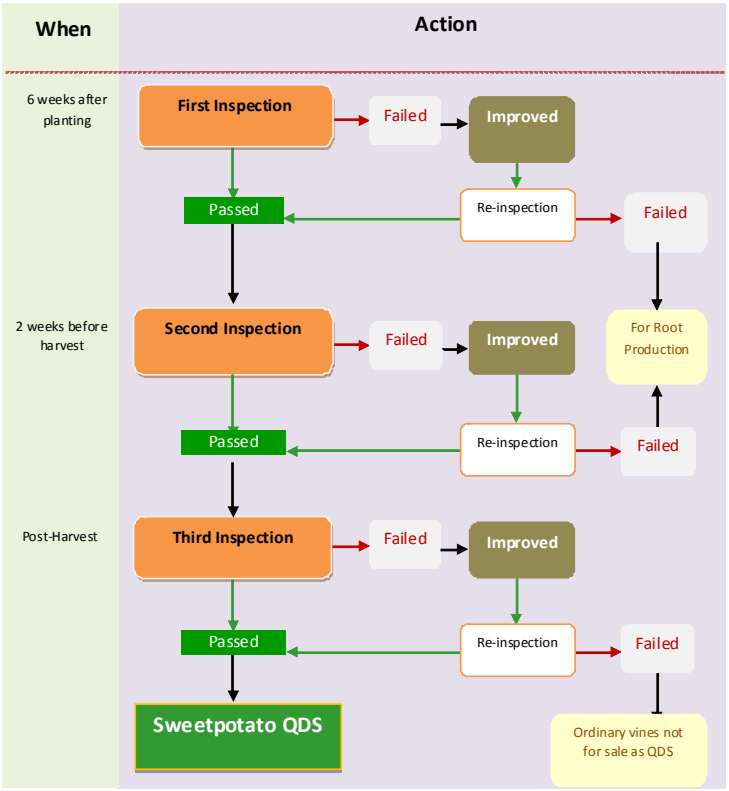


Figure 2: Inspection scheme for sweetpotato seed

3.1 Information and Tools for seed inspections

The inspector should visit the farm (pre-inspection visits) to familiarize with the farm location and history. The farmer lodges in an application to become a seed grower while indicating the seed class to be grown, source of seed, and size of seed bed (≥ 1.0 Acre or 0.4 Ha). A seed inspector should be provided with the following information in order to carry out a satisfactory job:

- Address of the seed producer
- Variety name and description of varieties to be inspected
- Identification manual for sweetpotato pests and diseases
- The prescribed field standards for sweetpotato seed
- Information on source of seed used

An inspector should possess the following materials or tools when conducting a crop inspection:

- A signed grower's Application for Seed Crop Inspection Declaration
- Sweetpotato Seed Inspection Manual and applicable directives
- A map locating the seed field
- Inspector's designation card and badge
- Pen/pencil,
- A pocket magnifying lens
- Labels for seed classes
- Calculator, Knife, Handheld counter
- Plastic bags for plant samples
- Appropriate footwear, and protective clothing (e.g. rain gear, hat, chaps and gaiters)

Note: the first inspection could be preceded by a pre-inspection visit by the inspector upon submission of an application to become a seed grower.

3.2 Timing and number of inspections

Field inspections must be carried out at all critical crop stages because the different factors affecting seed quality may not be apparent or occur at the same time, or a factor affects seed quality at one particular stage of crop growth. Two field inspection visits and a post-harvest (after cutting) inspection are recommended for sweetpotato seed. The first field visit should be made about 4 weeks after planting and the second visit at 1-2 weeks before harvesting of vines.

First inspection: 4 weeks after planting

The factors which will be assessed during the first visit (4 weeks after planting) include:

- Verify the original source of seed: Source of starter material for multiplication should be documented. Is this source known to be free from pests and diseases?
- Verify isolation distance: Isolation from other sweetpotato plots and whether there is a suitable barrier crop (e.g. at least 5 m of maize).
- Verify cropping history (rotation practice): Sweetpotato should not have been grown for more than three years on the same plot. An alternative crop to sweetpotato should have been planted in rotation.
- The site should appear free from visible pests and diseases which may infect the current sweetpotato crop.
- Soil fertility status should be able to support lush growth.
- Multiplication beds should be labelled with variety, date of planting and spacing, and source of material used.
- Verify that only one crop and variety is grown on the field or multiplication block;
- Verify the area planted is the same size as the area designated in the application form;
- Conduct field count to verify the occurrence of contaminants in the field; this is the best time to identify off-types and other varieties, plants with symptoms of specified diseases.
- Advise the grower on how to identify and rogue out diseased plants and off-types and any other remedial measures, such as spraying with approved pesticides.

Second inspection visit: 1-2 weeks before harvest

- Verify all factors listed for inspection in earlier growth stages;
- Confirm observations made in previous inspection. Conduct field count to verify the occurrence of contaminants in the field;
- Explain to the grower how to remove certain contaminants and set a date for the re-inspection if requested.
- Estimate the quantity of material (number of vines) that can be harvested for each variety and multiplication plot. This estimate will be used to issue the seed labels. See Annex 10 for estimation of quantity of planting material to be harvested.
- For ratoon crop, inspection should be done 1-2 weeks before harvesting the vines.

Third inspection: post-harvest

The inspector visually inspects the quality of vines after they have been harvested, packed and labeled for sale, according to the criteria in Table 6. As it is logistically impossible to inspect all harvesting operations, this should be done through random surprise checks of at least 10% of sweetpotato seed offered for sale.

Re-inspection

If the contaminant present in the field has not already extensively contaminated the seed crop, it may be rouged out or other remedial action taken and the field re-inspected. This recommendation should be explained to the grower so that action can be taken. If the grower agrees to remove the contaminant, the field must be re-inspected to determine that it meets the standards. Re-inspection is carried out only if the grower requests it. When the grower requests re-inspection and it is permitted, note on the first inspection report form “Re-inspection requested and authorized”. After making the re-inspection, the report is marked “Re-inspected”.

3.3 Social and biosafety aspects of inspection

Farm biosecurity is a set of measures designed to protect a farm or farm facilities from the entry and spread of pests and diseases. Farm biosecurity is the responsibility inspector, and that of every person visiting or working on the farm or seed production facility. It is essential that no transmission of disease can be attributed to careless behaviour on the part of staff involved in farm inspections. Every official must carry out effective biosecurity measures. Inspector must be familiar with the biosecurity programs of the farms to be inspected and be fully prepared to enter and leave an establishment without posing a biosecurity risk. Personal social and health security should also be taken seriously. When conducting inspections concerning seed vines, the inspector must:

- The inspection visit must be planned with the seed multiplier, and if possible with announced with the local area office and local council office. In the majority of cases, contact will be made with the farmer or person in charge before the inspection takes place. The inspector should do the inspection with the farmer or his representative.
- Inspectors should wear footwear that will allow cleaning and disinfection. Appropriate footwear should be to ensure protection of the inspector from an expected health hazards or injuries.
- Encourage adherence to and implementation of biosecurity best practices within inspected farms.
- Records of all visits should be kept at all times.

3.4 Conducting the inspection

On arrival at the farm, the inspector should contact the farmer, farm manager or his/her representative. The purpose of the visit should be explained, together with the procedures and standards of the field inspection. The farm manager or his representative should go with the inspector to be sure the proper field is inspected and to observe the inspections. The inspector should:

- Physically verify the number of seed production fields against the number stated in the application form.
- Examine the grower's records in order to verify the original source of material for the seed crop
- Verify that each sweetpotato variety is grown in separate beds or plots of 0.5 Acres (0.2 Ha). The plots should be separated by open bands of at least 3 meters.
- Randomly select ten per cent of the fields (samples) for subsequent inspection or referral testing if deemed necessary.
- Show the multiplier the contaminating factors and how to rogue out or other remedial actions.

3.5 Field shape, walking pattern, and field overview

It is essential to get a general view of the condition of the seed field before starting the field inspection. At this point, the inspector should make observations on isolation distance, varietal identity, crop uniformity, presence of diseases, pests and weeds, and cultural practices used. Special attention should be paid to other.

The inspector should verify the field size and observes its shape before making the inspection. Rectangular fields (at least 0.5 acres) are recommended. If the field is approximately rectangular in shape; the suggested pattern of walking the field overview is shown in Figure 2.

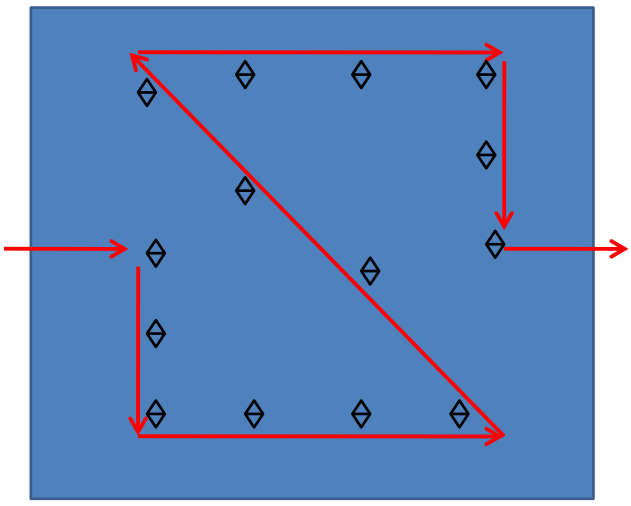


Figure 2: Suggested walking patterns for field inspection

3.6 Harvesting and handling vines

Harvest sweetpotato vines for seed using a sharp knife. The harvested part should be juvenile with apical and/or auxiliary buds that will sprout. For ease of counting, harvesting could be done in bundles of 100 vines while mixing physical damage. The minimum vine standards are indicated in Table 2. Vine quality criteria and tolerance levels to be verified during the post-harvest inspection by inspector are shown in Table 6. After packaging, the vines should be labeled.

Table 2: Minimum post-harvest requirements for sweetpotato seed

Post-harvest inspection criteria	Standards or tolerance levels
Harvesting age: new crop	2-3 months
Minimum harvesting age: ratoon crop	1-2 months after first cutting
Minimum length of cutting for root production	25 to 30 cm long (with 3-5 nodes)
Minimum length of cutting for rapid multiplication	20 cm
Off types and other varieties (Max %)	0%
Diseases and pests observable (Maximum %)	0%
Packaging (well ventilated material e.g. jute, polythene with perforations)	Vertical 100 L sacks
Number of labels	A label for every 1,000 cuttings in a pack

The number of labels issued should be in strict accordance with the estimated number of vines which have been inspected and fulfil the seed standards. Seed class labels with the following information should be provided:

- Name of the multiplier and contact details (cell phone number, village and district)
- Crop name, variety name and seed class (e.g. pre-basic, basic, certified),
- Original source:
- Number of cuttings
- Year of production
- Date of packing
- Name of certifying authority
- Lot reference number per harvest/batch
- Untreated or treated with a specified chemical
- Variety Information (e.g. flesh colour, skin colour, yield, maturity period, dry matter; susceptibility to diseases and pests):

3.7 Fees

The MAAIF charges fees in accordance with the Uganda Seed Inspection Agency Fees Notice. The Ugandan Seed Inspection and Certification Agency (USICA) Fees Notice stipulates an application fee and an inspection fee per hectare. The fees and applicable taxes must be payable to the Uganda Revenue Authority (URA). Additional fees for phytosanitary certification and laboratory testing activities are covered separately. Once an inspector has begun an inspection of any crop, no fees or portion of that fee is refundable. For more information on these fees consult the MAAIF Inspection Agency Fees Notice.

3.8 Suspension of Crop Inspection

The inspector can suspend the inspection if, he/she determines there is a problem that can be corrected by the grower. Following any suspension of a crop inspection, the inspector must inform the grower for which reason he/she has suspended crop inspection. The objective of the suspension is to give to the grower the opportunity to apply corrective measures. The inspector needs to make sure that the grower understands the situation, and if, plants have to be rouged out because of excessive levels of u, or mixture, and the grower is capable to do so. The inspector may choose to review the problematic areas in the field with the grower and allow them time to correct the problem prior to continuing inspections.

3.9 Termination of crop inspection

During the inspection process, or upon arrival at the farm unit, conditions can be encountered which will warrant immediate termination of inspection of a specific crop, or termination of all crop inspections on the farm unit. Inspection may be terminated under any of the following conditions:

- Inspection counts show excessive levels of disease or varietal mixture whereby the crop is clearly ineligible for certified class.
- No blank row (3 metres minimum) separating two crops of different varieties (a grower may be given an opportunity, time line of one week from initial finding, to remove a row between the two varieties).
- There is no clear marking or separation (10 metres of blank row at both ends of the field) separating the specific crop from different classes of the same variety, and it is not possible to assign a lower class as per guidelines.
- Excessive presence of weeds, leaf injury, pesticide or fertilizer injury.
- When it is not possible to determine by visual inspection the variety purity or disease incidence.
- The seed source used to plant the crop was infected or non-certified
- Evidence of lack of adequate rotations.

3.10 Rejection

When a crop does not meet the standards applied for, the inspector must inform the grower of the inspection results. Following a crop evaluation, the Inspector may decide, at the time of inspection, to reject or downgrade the crop, without previous recommendation of corrective action.

If the crop does not meet the standards for certified class seed vines on the first or during subsequent or final inspection, the crop must be rejected as seed. The inspector must indicate the reason for the rejection on the Report of Field Inspection (Annex 3). Rejected crops require no further inspection in regards to seed vine certification.

3.11 Sample collection and submission

Sample collection and laboratory diagnosis may be required under various circumstances. A laboratory test can help to distinguish a disease versus a physiological condition, or to confirm field observations. The inspector, who wants to get confirmation of his /her diagnosis, in particular cases, may consult his supervisor for help or complementary information.

There are other circumstances which could warrant sampling for laboratory analysis including, but not limited to, importing countries phytosanitary certification requirements for sweetpotato, suspecting the presence of a new pest or disease, investigative testing, surveys, or where there is suspicion of a zero tolerance regulated pest, or a quarantine pest.

Samples should be taken according to relevant protocols and detailed instructions and the submission form must contain the following information:

- Grower's name/ Farm unit;
- Crop year;
- Grower number/ Identifier number (may use certificate number of the field);
- Variety;
- Sample type and size;
- Reason for submission (specific suspect diseases or virus strains);
- Date collected;
- Local sample ID;
- Individual collecting the sample;
- Inspector submitting the sample.

Samples must be labelled, packaged and shipped to the appropriate laboratory depending on the analysis to be conducted. Results will be released to the inspector who has submitted the sample and any other identified supervisor or program officer. All results must be approved and released in accordance with standard operating procedures in place in the appropriate labs and results will be only distributed internally within.

3.12 Official reporting of crop inspection results

Once the inspector has returned to the office (after final crop inspection), the Report of Field Inspection is produced from the Inspector's Field Notes and becomes the finished copy of the crop inspection (see Annex 2; Annex 3). All corrections to the pre-printed information on the report must be initialed and dated by the inspector. All areas on the report requiring an inspector's name and date must be filled in. Upon completion of all crop inspections on a farm unit for the season, the original copy of the Report of Field Inspection are to be filed in the local inspection office. A copy of each Report of Field Inspection must be provided to the grower along with the Growing Crop Certificate as soon as they are ready. All field reports and growing crop certificates should be checked for accuracy and proper completion, by another inspector, prior to sending them to the grower.

4.0 REQUIREMENTS FOR REGISTERING VINE MULTIPLIER

4.1 Application to become a seed vine multiplier

The grower, signs the application, declaring that:

- All sweetpotato varieties grown on the farm unit are listed on the application;
- All the sweetpotato varieties listed are planted from nuclear stock or basic seed class;
- All required inspection fees in accordance with The Seeds Regulations Act are met;
- Provide a map showing the location of the field/farm.

A hard copy file should be created (if not already in place) for each and every grower applying for sweetpotato seed vine crop inspection. All related documents should be kept in these files for further review if and when necessary. The minimum retention period for seed vines documents is 5 years. Documents should include:

- A copy of the Application for Seed Potato Crop Inspection Grower's Declaration ,
- Proof of seed purchased,
- Inspector's Field Notes,
- Copy of Reports of Field Inspection,
- Copy of Growing Crop Certificate,
- Copy of Revocation of Certification if used,
- Any other relevant information such as clean up records, field map, etc.

4.2 Procedure for registering new seed sweetpotato growers

A new seed vine grower must send a request to enter the seed vine certification program to a MAAIF inspector before the receipt of any seed vines intended for planting on their farm. The MAAIF inspector then ensures that a new grower is aware of the Seeds Regulations Part II and relevant directives (see the reference section) regarding certification requirements and should provide copies to the prospective seed grower prior to the completion of the Application for Seed Crop Inspection Grower's Declaration. The inspector should review the application with the grower, clarify all entries and answer any questions.

For a new grower, once the application is approved, an identification number (or a grower number) is issued. A new sweetpotato vine grower is one that has never been a seed vine grower. A grower who submitted an application and was approved for crop inspection in the previous year can be considered an existing seed grower as long as:

- All fees have been paid in accordance with the provisions,
- The application for inspection has been completed in accordance with section 49 of the Seeds Regulations Part II;
- The inspector was able to review the grower's declaration on the application prior to first inspection and confirm its accuracy;

Existing seed growers maintain their identification numbers from year to year. Each field entered for certification is given a unique identification number which is used for tracking purposes throughout the certification process.

4.3 Application for field inspection and issuance of certificate number

The application for field inspection should be made to the regulatory body as early as possible before the field is planted so that the suitability of the site can be verified. An official application form should be completed with the contact details of the registered seed grower, the location of the field, crop variety, source of planting material, and area to be planted.

A certification number is made up of 14 digits representing specific crop year, region, district, farm unit and field. The number is assigned to a seed vine lot which, at the completion of the crop inspection process has been determined to meet all regulatory requirements. For example, if a certification number was 2015-3041187-001, it would represent the following information:

Crop year - 2015

Region - 3 (Central)

District - 04

Farm unit - 1187

Field – 001

In this case, 3041187 is the grower (farm unit) number for this farm unit.

Note: Regions are designated as follows; 0 – Northern and Eastern, 1- Western, 2 - Southern, 3 - Central.

5.0 CERTIFICATION STANDARDS FOR SWEETPOTATO SEED

5.1 Certification standards for sweetpotato seed under protected environment

Sweetpotato planting material can be produced and multiplied under protected environment, where it is maintained or multiplied in an insect proof or contamination proof containment e.g. tissue culture laboratory, glasshouse, screenhouse, polyhouse and net tunnels. This protected environment is most cases limited to production of nuclear and basic classes of seed because of cost implications.

5.1.1 Certification standards for nuclear stock seed

Parameters and tolerance levels for sweetpotato mass in-vitro propagation of nuclear stock are indicated below (Table 4). Mass propagation should be started from virus indexed material. Tolerance levels for nuclear stock maintained or multiplied under field conditions are indicated in Table 6.

Table 4: Parameters and tolerance levels for sweetpotato nuclear stock seed

Parameter	Tolerance level	Comments
Tissue culture sub culturing	Maximum of 4 cycles	Not more than 6 cycles of sub culturing to maintain purity (depending on variety)
Fungal and bacterial infection	0%	Visual observation
Varietal impurity %: sample	0 %	Proper record of varieties, sources of varieties and track records of ex-plants
SPVD causing viruses (SPCSV, SPFMV, SPMMV, or SPLCV etc.)	0%	Lab test on first sub-culture 1-2 months after sub-culturing. External and independent, testing lab to comply with MAAIF standards
Minimum number of nodes	1	For materials going for sub culturing should have at least one node
Compliance to SOP for standard TC laboratories	At least one visit/year	Once a year by a biotech inspection committee of MAAIF.
Packaging of TC plantlets	Sealed containers	Glass or plastic. Should be sterilised to prevent contamination. Firmer media should be used if plantlets to be transported.
Labelling requirements	Culture vessel label	Label should indicate date sub-cultured, variety name, and technician's initials. To help in-vitro multipliers know the variety and next date to sub-culture.

5.1.2 Certification standards for basic seed

The basic seed class is mostly multiplied in screenhouses with insect proof features. The screenhouse or net tunnels are also used as facilities for hardening and bulking tissue culture derived planting material. Parameters and tolerance levels for sweetpotato hardened planting material (Basic) are show in the Table 5.

Table 5: Tolerance levels for basic seed or tissue culture derived planting material

Parameter	Tolerance level	Comments
Viruses, SPVD and other diseases		
SPVD causing viruses (see Annex 6)	0%	Laboratory testing; remove and destroy infected plants
SPVD symptoms*	0%	Visual observation at each harvest
Fungal infections e.g. black rot	0%	Visual observation (rogue affected plants)
Pests		
Insect pests (e.g. aphids, whiteflies)	1%	These are common pests and vectors for viruses
Mites or thrips	5%	Are common in screen houses but do not transmit viruses
Caterpillars	5%	They may not affect the plants adversely but indicate poor management
Weevils	1%	They indicate poor management and are transferable to next generation as adults or eggs.
Snails	1%	They may not affect the plants adversely but indicate poor management
Root knot nematodes	0%	Currently not serious
Wire worm	1 %	Currently not serious
Variety purity, harvesting and packaging		
Varietal impurity %: sample	0%	Visual observation. Discard off-types.
Maximum permitted ratoons	16	For three years under net tunnels
Harvesting age: new crop*	2-3 months	Months after planting
Harvesting age: ratoon crop*	1-2 months	Months after previous harvest
Minimum length of cutting	15-25 cm	Depending on variety.
Min. number of nodes/cutting	3	Depending on variety
Labelling requirements	1 label	Label should indicate details (section 3.6)
Packing conditions	Bundles of 100 vines	This is a high value product to be bought largely by primary field multipliers.
Inspection and certification		
Validity of certification	3 years	To maintain standard condition in the net tunnel
Minimum number of inspections	1 per harvest	Visual observation at each harves
Validity of certification	Per batch	By MAAIF and its agency.
Minimum number of inspections	1	Lab test: sample of each batch to test for sweetpotato viruses

* **SPVD symptoms include chlorosis, mottling, mosaic, purpling, stunting, leaf curl**

** **Depends on variety, climatic conditions and management**

5.2 Field standards and tolerance levels for sweetpotato seed

Seed classes namely Certified 1 (C1), Certified 2 (C2) and Quality declared seed (QDS) are mostly grown and multiplied in open fields following set guidelines. However, it is possible to produce all classes of seed, including Nuclear and Basic seed, under open field conditions as long as the seed can meet the standards as indicated in Table 6. The inspector should visually check at least 10 per cent of seed post-harvest. The inspector should also verify the packing and labeling of the seed are according to the criteria listed in Table 6. Sweetpotato planting materials that fulfill the criteria are declared as sweetpotato nuclear stock through to QDS. A declaration is completed and one label for every 1,000 cuttings is provided in strict accordance with the quantity of seed approved. The seed labels are attached to the bags, or packaging material. The criteria for rejection or acceptance of application for a seed class are based on standards or tolerance levels below (Table 6).

Table 6: Field standards for sweetpotato seed certification tolerance levels

Parameters	Seed classes				
	Nuclear	Basic	C 1	C 2	QDS
Variety purity and agronomy					
Varietal purity (%)	100	100	99	99	98
Field isolation distance (m) (with suitable barrier crop) (Minimum)*	100	70	50	50	30
Crop rotation or furrow (Min. years)	2	2	1.5	1.5	1
Maximum permitted ratoons	5	3	2	2	1
Recommended method of planting	Lab	Screen-house	Flatbeds/ Ridges	Flatbeds/ Ridges	Ridges/ Mounds
Diseases of sweetpotato					
SPVD symptoms (Max. %)#	0	0	2	3	5
SPVD causing viruses (Annex 6) – lab test is required (Max. %)##	0	0	2	3	5
Fungal infections e.g. black rot, Alternaria blight (Max %)	0	0	1	2	3
Pests of sweetpotato					
Nematodes (affected plants) (Max. %)	-	1	1	2	3
Sweetpotato butterfly/ caterpillars, counts per 100 plants (Max. %)	-	2	5	5	10
Sweetpotato weevil (Max %)	0	2	3	5	10
Mites/thrips (Maximum %)	2	3	5	5	5

Mites/thrips (Maximum %)	2	3	5	5	5
Aphids/Whiteflies (adults per 100 plants) (Max %)	0	5	5	5	5
Harvesting and packaging					
Length of cutting (cm) (Min.)	15	15	20	20	25
Number of nodes/cutting (Min.)	3	3	5	5	5
Harvesting age of new crop (months)**	2-3	2-3	2-3	2-3	2-3
Harvesting age of ratoon crop (months)**	1-3	1-3	1-3	1-3	1-3
Inspection and certification					
Number of inspections/ crop (Min.)	1	1	2	2	2
Maximum permitted ratoons	5	3	2	2	1
Validity of certification (Months)	12	12	6	6	6
Labelling requirements	Plant	Bed	Field	Field	Field

N.B. Pests/diseases such as wireworms, scurf, bacterial wilt and SSR-Pox have been reported elsewhere (and in the FAO QDPM manual) but not in Uganda.

* The isolation distances for Nuclear and Basic seed are applicable of the seed grown in open field without protection as in screenhouses or laboratories.

** Depending on variety, edaphic and climatic conditions

SPVD symptoms: refer observance of any SPVD related symptoms (i.e. vein chlorosis, mottling, mosaic, purpling, stunting, leaf curl) by visual inspection.

SPVD causing viruses: percentage should be determined following some diagnostic assay like plant infectivity assay (using Ipomoea setosa), ELISA or molecular assays as determined by the inspector. This should be done if the SPVD score are unclear or on suspicion of latent infections.

6.0 SAMPLING PROCEDURE FOR FIELD INSPECTIONS

6.1 Taking the field count and number of counts to be taken

Inspections are made in the field on the standing seed crop, but examining all plants in the field is not possible. Therefore, observations are made on representative samples. It is, however, essential that the required numbers of counts or samples be taken properly to get a realistic assessment of occurrence of contaminants or estimates in the field. The numbers of counts for each field is dependent on the size of the land and plant density. The number of counts should then be converted into percentages and employ tolerance levels in Table 6 for decision making.

Field size of two hectares or less

A total of 10 counts should be selected randomly and in each count 100 sweetpotato plants are visually checked for the contaminant factors indicated in Table 6. In the absence of rows, 10 randomly selected plots of 5x4 m (20 m^{-2}) should be checked. The mean value of the inspected plants provides the single score for the field.

Field size of greater than two hectares

For every one additional hectare of field, a total of five counts will be randomly selected with 100 plants per count and inspected. In the absence of rows, for every additional hectare of field, five randomly selected plots of 5x4 m (20 m^{-2}) should be checked. The mean value of the inspected plants provides the single score for the field.

6.2 Assessment of sweetpotato seed production field

For the first count: enter the seed field at a randomly selected place and start moving in the direction of the rows, and then proceed to:

- Randomly select a row, and then randomly select a plant and start counting twenty consecutive plants. Count the number of: off-type plants, and diseased plants and in their respective categories and incidence.
- Crossover to another row and again start counting 20 consecutive plants from a point approximately parallel to the last plant counted in the previous row.
- Repeat the process until 100 sweet potato plants have been counted, and the number of off-types and diseased plants calculated for that count.
- Repeat the entire process for the next count until the number of counts required for the field size is completed.

6.3 Assessment for tolerance levels

The following parameters should be assessed during the assessment for tolerance levels:

- Evidence of rouging: count the number of plants which have been rouged out in each row. Fill the form with the number (percentage) of the remaining plants.
- Plants dried up or died: count the number of plants which have dried up or died. Fill the form with the number (percentage) of the remaining plants.
- Evidence of varietal purity: in each selected row, count the number of plants which are of a different variety or off-type to that specified on the label for the bed. Fill in the form with the number of plants of other varieties in each selected row, and calculate the total number of plants of other varieties.
- Incidence and severity of virus symptoms (e.g. SPVD): in each selected row, count the number of plants with mosaic and stunting virus symptoms. Then assess incidence based on visual observation of symptoms (stunting, distorted leaves with a chlorotic mottle vein clearing, or purpling) and express the incidence as the percentage of symptomatic plants over the total number of plants examined. Fill in the form with the number of plants with mosaic and stunting symptoms in each selected row, and calculate the total number of plants with symptoms.
- Incidence of virus infections: plants showing positive signals after plant infectivity assays, ELISA or PCR detection. Count the number of positive plants in each selected row. Fill in the form with the number of plants with positive results in each row, and calculate the total number of plants.
- Weevil infestation: signs include malformation, thickening or swelling, and cracking of the stems of the vines at the base close to the soil surface. Count the number of affected plants in each selected row. Fill in the form with the number of plants showing signs of weevil infestation in each row, and calculate the total number of plants with signs of weevils.
- Sweetpotato butterfly caterpillars: Count the number of plants showing signs of caterpillars in each selected row. Fill in the form with the number of plants showing signs of caterpillars in each row, and calculate the total number of plants with signs of caterpillars.
- Other pests (Aphids, whiteflies, mites): Count the number of adult pests in each selected row. Fill in the form with the number of plants with the respective pest in each row, and calculate the total number of plants with the pest(s).
- Alternaria blight: Count the number of plants showing signs of alternaria in each selected row. Fill in the form with the number of plants showing signs of alternaria in each row, and calculate the total number of plants with signs of alternaria.
- Plant vigour: the plants should be 2 - 3 months old at harvest time for new crop and 1-2 months at the first ratoon. Rate the overall vigour of the plants in the selected rows. Score as below: 1 = very good plant vigour; 2 good plant vigour; and 3 = poor plant vigour. Add all the scores together and get the average score. The overall score should be “good” for an acceptable standard.

6.4 Sampling for laboratory based testing procedures

In some instances, it may require laboratory test to confirm certain contaminant e.g. virus infections. In this case sampling and sample size should be considered data reliability. For tissue culture plantlets, randomly select between five plantlets per 100. Collect one leaf situated among the five top leaves for subsequent laboratory analysis that may include plant infectivity assays, ELISA or PCR based techniques. Plant infectivity assays using, *Ipomoea setosa*, is cheap and can detected virus infection at very low titers within 7 days (Mukasa *et al*., 2003). Laboratory analysis should be carried out by technical and competent staff, and using approved laboratories.

Enzyme linked immunosorbent assay (ELISA) is a routinely used method suitable for large scale detection of plant viruses. The advantages of using ELISA are that it is simple, quick (8 hours), sensitive - 0.01 to 1 ug/ml, cost-effective (many samples can be tested at once), and it can be used with IC-RT-PCR. Samples can be tested serologically for up to ten viruses (Annex 6). For testing a large number of samples within a short time ELISA is suitable, but for very sensitive results PCR is better. The disadvantage is that the method is not very sensitive especially for low virus concentration.

Polymerase chain reaction (PCR) based diagnosis has some advantages over plant infectivity and ELISA assays. PCR is widely used, analysis requires one day, it uses less reagents and time. It can differentiate between virus species and it allows the in-vitro amplification of specific DNA sequences in the presence of primers. There are several PCR formats, some of which are not very applicable given the costs (e.g. qPCR). Samples for RT-PCR and QPCR can be preserved in silica gel, between papers. The disadvantages are higher likelihood of contamination, reaction inhibition, cost and requirement for more developed laboratories and specialised equipment.

6.5 Comparing the field observations with the standards

After the inspection is completed, sum up the total number of plants of each contaminant factor found in all field counts made. Compare these with the number of plants allowed of each contaminating factors in Table 6. If the contaminant found in the total field inspection samples is less than the tolerance level, the field is accepted. However, if the contaminants are above the tolerance level, the field is rejected. Fields within the tolerance levels can be given an appropriate seed class label and the cuttings can be sold as seed.

6.6 Reporting inspection results

The inspector should record the data whilst in the field or during the post-harvest inspection, then perform the analysis, summarize the results and produce the report. Feedback should be given to the seed grower and the report should be submitted to the regulatory body and filed there. The following points require special attention in the compilation of the report for the first and second inspection visits:

- General condition of the crop, and record of contaminants for each count inspected
- Expected date of harvesting and estimated quantity of cuttings which can be harvested
- Signature of the seed grower or his representative present at the time of inspection should be taken
- One copy of the report goes to the grower, a copy is also sent to the regulatory body for taking follow up action on the report and the third copy is retained by the inspector.

ANNEXES

ANNEX 1: Application Form for Field Inspection of Sweetpotato Seed

Crop _____

Variety _____

Grower Number _____

Address and Phone No _____

Detailed information:

Field		Previous Crops	Seed used						Date of Harvest
Field No.	Hectare		Lot Ref No.	Amount	Origin	Kind of Seed treatment	Planting Date	Seed Rate	
		1 2 3							
		1 2 3							
		1 2 3							
		1 2 3							

ANNEX 2: Field Inspection Notes

MINISTRY OF AGRICULTURE INSPECTION AGENCY: INSPECTOR'S FIELD NOTES					
Inspectors Name:		Contact:		E-mail:	

NAME AND ADDRESS OF GROWER	Varieties		Hectares	Origin of vines	Seed class	Country	
	1					Region	
	2					Sub county	
	3					Location	
File Number:	4					Certi. Number	

Inspection Visit: 1st 2nd 3rd	QUALITY, DISEASE AND PEST SCORE PER 100 PLANTS	Scores: A= Excellent, B = Good, C= Fair, D = Poor

		Variety purity	SPVD / Viruses	Fungal diseases	Weevils	Other pests	Isolation distance	Others	Score	Inspector remarks
	1							Cultivation		
	2									
	3							Stand		
	4									
	5							Vigour		Signature:
Average %										Date:
	1							Cultivation		
	2									
	3							Stand		
	4									
	5							Vigour		Signature:
Average %										Date:
	1							Cultivation		
	2									
	3							Stand		
	4									
	5							Vigour		Signature:
Average %										Date:

Class issued		Reason for rejection	
Observations:			

ANNEX 3: Summary Report of Sweetpotato Seed Inspection

Name and position of inspector:

……

Address and contact number of Inspector:……

Date of inspection visit: ……

First inspection visit: (2-3 weeks after planting) y/n. Second inspection visit: (2 weeks before harvest) y/n

Name of multiplier: ……

Location of multiplication site (District, Village): ……..

……

INSPECTION REPORT

Isolation from other SP plots: (at least 100 m from other sweetpotato plots) ……

……

Site history: (rotation has been practiced and the site is visibly free from pests and diseases) ……

……

Source of material is documented: what was the source of the current material used for multiplication. Is this source documented? Is this source known to be free from pests and diseases? ……

……

Labelling of multiplication beds: are all the beds labelled with variety and date of planting? ……

……

Varieties inspected: ……

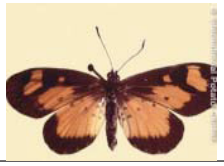
OVERALL RECOMMENDATION:……

SIGNED:……..

DATE:……..

PLACE:……..

ANNEX 4: Some pest of economic importance on sweetpotato in Uganda

Pest Name	Damage	Picture
Aphids: *Aphis gossypii* and others (Homoptera: Aphididae)	Aphids damage plants by sucking sap from growing shoots. Symptoms of aphid attack are wrinkling, cupping, and downward curling of young leaves. During heavy infestation, plant vigour is greatly reduced. As aphids feed and move from plant to plant in the field, they transmit viruses. The most important aphid transmitted virus is SPFMV. Winged forms may travel long distances and introduce viruses into new areas. *A. gossypii* has a wide host range.	
Sweetpotato Butterfly: *Acraea acerata* (Lepidoptera: Nymphalidae)	The caterpillars feed on the leaves. Young caterpillars feed on the upper leaf surface, whereas older larvae eat the whole leaf except for the primary midribs. Complete defoliation may result from severe attacks	 
Sweetpotato Weevils: *Cylas* spp.	Three species of the genus Cylas are pests of sweetpotato and are found in Africa. Adult sweetpotato weevils feed on the epidermis of vines and leaves. The developing larvae of the weevil tunnel in the vines and storage roots, causing significant damage. In response to damage, storage roots produce toxic terpenes, which render storage roots inedible even at low concentrations and low levels of physical damage. Feeding inside the vines causes malformation, thickening, and cracking of the affected vine.	
Whiteflies: *Bemisia tabaci* (Homoptera: Aleyrodidae)	High whitefly populations may cause yellowing and necrosis of infested leaves. The pest is more important as a transmitter of viruses, especially SPCSV and SPMMV. *B. tabaci* has a wide host range, including cotton, tomato, tobacco, and cassava.	

ANNEX 5: Diseases of Sweetpotato (Bacterial, Fungal and Nematodes)

Disease name	Damage/ Symptoms and Control
Bacterial Stem and Root Rot: *Erwinia chrysanthemi*	Aerial symptoms are water-soaked brown to black lesions on stems and petioles. One or two branches may wilt, and eventually the entire plant collapses. Localized lesions on fibrous roots may also be present. On fleshy roots, localized lesions with black margins can be observed on the surface, but more frequently the rotting is internal, with no evidence outside. Cuttings for transplanting should be taken above the soil line. Using less-susceptible cultivars and taking care to avoid wounding can reduce disease incidence.
Alternia blackspot: *Alternaria bataticola*	Brown lesions with a typical bull's-eye appearance of concentric rings occur on leaves, especially older leaves. Black lesions appear on petioles and stems. Bases and middle sections are more affected than the vine terminals. Death of vines can occur. The ground under affected vines is often carpeted with blackened leaf debris. Susceptibility to the pathogen varies among varieties. Pathogen-free planting material of the more resistant varieties and good sanitation practices will help control the disease.
Phomopsis Leaf Spot: *Phomopsis ipomoea-batatas*	Whitish to tan to brown lesions, usually less than 10 mm in diameter, form on the upper and lower surfaces of leaves. The lesions usually have a dark brown or purple margin. Pycnidia are visible in the centre of the lesions. No control measures are known. Control is not normally necessary.
Soft Rot: *Rhizopus stolonifer, Mucor* sp.	Soft rotting occurs after harvest. Storage roots become soft, wet, and stringy, often starting at one end. A strong alcohol-like odour is produced. These fungi are commonly seen sporulating on the surface of rotting storage roots. Washing storage roots is especially conducive to rot. Care in handling and proper curing can reduce disease incidence. So far, no resistance has been found, but some varieties rot faster than others because they are more susceptible. Curing is accomplished by storing after harvest at 29–32°C and 95–100% relative humidity for 5–7 days with adequate ventilation. Subsequent storage is best at around 13°C and 95% relative humidity.
Root-Knot Nematode: *Meloidogyne spp*.	Affected plants become stunted, foliage turns yellow and flagging, and flower production is abnormal. On fibrous roots, round to spindle-shaped swellings (galls) are produced together with egg masses on the surface. Large portions of the root system can become necrotic. The storage roots of some varieties react with longitudinal cracking, whereas in others, blister-like protuberances emerge through the epidermis. Resistance, crop rotation, and selected nematode-free planting material can help to control this disease. In East Africa, nematodes are rarely associated with sweetpotato and no control measures are needed.

ANNEX 6: Sweetpotato Viruses and Sweetpotato Virus Disease

Sweetpotato-infecting viruses

Advances in microscopy, serology and molecular biology techniques have resulted in better methods for virus detection and identification. Worldwide, up to 20 different viruses have been described to infect sweetpotato (Loebenstein *et al*., 2003), but only 11 of them are currently recognized by the International Committee of Taxonomy for Viruses. With the emerging sequence data for virus isolates from different parts of the world, it will be possible to more clearly distinguish the different viruses and virus strains that infect sweetpotato. Sequences for viruses isolated from sweetpotato are available the viruses shown below.

Sweetpotato virus complexes and diseases

Sweet potato virus disease (SPVD) is the name used to describe a range of severe symptoms in different sweetpotato cultivars comprising **overall plant stunting, leaf narrowing and distortion, chlorosis, purpling, mottling, mosaic or vein-clearing**. Mixed infections of SPFMV and SPCSV are the usual cause of SPVD. In fact, single virus infections commonly cause mild or no symptoms in many sweetpotato cultivars. In Uganda, SPFMV and SPCSV have been detected in the major sweetpotato growing districts (Mukasa et al., 2003). In general, co-infection of sweetpotatoes with SPCSV and a potyvirus (or another unrelated virus) results in viral synergism leading to development of severe symptoms and significant yield losses.

Some viruses that have been reported in sweetpotato

Virus genus	Virus species a	**Natural vector**
Potyvirus	Sweet potato vein mosaic virus (SPVMV)	Aphid
Potyvirus	*Sweet potato feathery mottle virus* (SPFMV)	Aphid
Potyvirus	*Sweet potato latent virus* (SwPLV)	Aphid
Potyvirus	*Sweet potato mild speckling virus* (SPMSV)	Aphid
Potyvirus	*Sweet potato virus C* (SPVC)	Aphid
Potyvirus	*Sweet potato virus 2* (SPV2)	Aphid
Potyvirus	*Sweet potato virus G* (SPVG)	Aphid
Nepovirus	Sweet potato ringspots virus (SPRSV)	Unknown
Luteovirus	Sweet potato leaf speckling virus (SPLSV)	Unknown
Ipomovirus	Sweet potato yellow dwarf virus (SPYDV)	Whitefly
Ipomovirus	*Sweet potato mild mottle virus* (SPMMV)	Whitefly
Cucumovirus	*Cucumber mosaic virus* (CMV)	Aphis
Crinivirus	*Sweet potato chlorotic stunt virus* (SPCSV)	Whitefly
Caulimovirus	Sweet potato caulimolike virus (SPCaLV)	Unknown
Carlavirus	*Sweet potato chlorotic fleck virus* (SPCFV)	Unknown
Begomovirus	*Sweet potato leaf curl virus* (SPLCV) 3	Whitefly
Begomovirus	*Sweet potato leaf curl Georgia virus* (SPLCGV)	Whitefly
Begomovirus	*Sweet potato leaf curl Uganda virus* (SPLCUV)	Whitefly
Begomovirus	*Ipomoea yellow vein virus* (IYVV)	Whitefly

ANNEX 7: Estimation of Quantity Of Planting Material

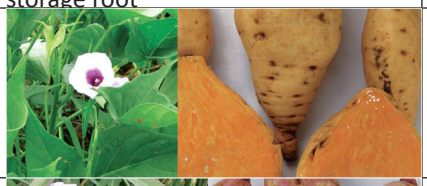
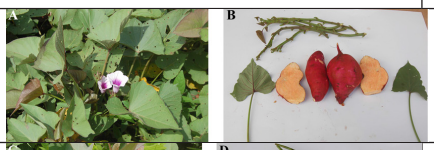
Estimated quantity of material available by variety (by inspector)

Name of Inspector: . . . . . .

Variety	Date of planting	Age of Crop	No. of beds (Specify size or plant population)	Estimated date of 1st harvest of quality vines	Estimated No. of vines (1st harvest)#	Estimated date of 2nd vine harvest (6 weeks after 1st harvest)	Estimated No. of vines (2nd harvest)

= Estimation = number of beds x average plant population x average # of 30 cm cuttings per plant

ANNEX 8: List of Some Sweetpotato Varieties Released in Uganda

Variety Name	Morphological characters shoot and flower, shoot tip, leaf, and storage root	Yield (Ton/Ha)	Year of release	Reaction to SPVD	Reaction to Alternaria
EJUMULA					
KAKAMEGA					
NASPOT 1					
NASPOT 9 O					
NASPOT 8 O					
NASPOT 10 O					
NASPOT 11					
NAPOST 12O					
NASPOST 13O					
New Kawogo					
New Dimbuka					
Semanda					

ANNEX 9: Payment Documentation for Sweetpotato Seed Inspection

MINISTRY OF AGRICULTURE INSPECTION AGENCY					
PAYMENT DOCUMENTATION FOR SWEETPOTATO PLANTING MATERIAL					
SEED VINE MULTIPLIER INFORMATION					
Name of grower			Contact number		
Grower number			Mailing address		
CROP INSPECTION SERVICE INFORMATION					
Number of Hectares inspected		Region		Date of service	
Commodity code	Description	Quantity	Unit cost	Tax	Total
2755	Application fees		50		
2754	Fees per hectare		20		
				Grand Total	
PAYMENT INFORMATION					
Method of payment	Cash		Cheque		Cheque number:
Date of payment		Receipt number			
Payee signature		Official signature and stamp			

ANNEX 10: Revocation of Certificate

MINISTRY OF AGRICULTURE INSPECTION AGENCY				
REVOCATION OF CERTIFICATE				
YOU ARE ADVISED THAT PURSUANT TO SECTION 52 OF THE SEEDS REGULATIONS, THE CERTIFICATION OF THE FOLLOWING SEED VINE LOTS HAVE BEEN REVOKED				
Certificate No.	Variety	Hectares	Field identification	Remarks

Name of program officer		Signature		Date:	

REFERENCES

Ames, T., Smit, N.E.J.M., Braun, A.R., O'Sullivan, J.N. and Skoglund, L.G. 1996. Sweetpotato: Major Pests, Diseases, and Nutritional Disorders. International Potato Center (CIP). Lima, Peru. 152 p.

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Urage, E., Gorfu, D., (2012) Production of Quality Declared Planting Material (QDPM) of Sweetpotato, Ethiopia: Reference Book for an Informal Seed Inspection System for Sweetpotato Vines. Hawassa, Ethiopia: Hawassa Agricultural Research Center, Southern Agricultural Research Institute.

ANNEXES

ANNEX 1: Application Form for Field Inspection of Sweetpotato Seed

Crop _____

Variety _____

Grower Number _____

Address and Phone No _____

Detailed information:

Field		Previous Crops	Seed used						Date of Harvest
Field No.	Hectare		Lot Ref No.	Amount	Origin	Kind of Seed treatment	Planting Date	Seed Rate	
		1 2 3							
		1 2 3							
		1 2 3							
		1 2 3							

ANNEX 2: Field Inspection Notes

MINISTRY OF AGRICULTURE INSPECTION AGENCY: INSPECTOR'S FIELD NOTES					
Inspectors Name:		Contact:		E-mail:	

NAME AND ADDRESS OF GROWER	Varieties		Hectares	Origin of vines	Seed class	Country	
	1					Region	
	2					Sub county	
	3					Location	
File Number:	4					Certi. Number	

Inspection Visit: 1st 2nd 3rd	QUALITY, DISEASE AND PEST SCORE PER 100 PLANTS	Scores: A= Excellent, B = Good, C= Fair, D = Poor

		Variety purity	SPVD / Viruses	Fungal diseases	Weevils	Other pests	Isolation distance	Others	Score	Inspector remarks
	1							Cultivation		
	2									
	3							Stand		
	4									
	5							Vigour		Signature:
Average %										Date:
	1							Cultivation		
	2									
	3							Stand		
	4									
	5							Vigour		Signature:
Average %										Date:
	1							Cultivation		
	2									
	3							Stand		
	4									
	5							Vigour		Signature:
Average %										Date:

Class issued		Reason for rejection	
Observations:			

ANNEX 3: Summary Report of Sweetpotato Seed Inspection

Name and position of inspector:

……

Address and contact number of Inspector:……

Date of inspection visit: ……

First inspection visit: (2-3 weeks after planting) y/n. Second inspection visit: (2 weeks before harvest) y/n

Name of multiplier: ……

Location of multiplication site (District, Village): ……..

……

INSPECTION REPORT

Isolation from other SP plots: (at least 100 m from other sweetpotato plots) ……

……

Site history: (rotation has been practiced and the site is visibly free from pests and diseases) ……

……

Source of material is documented: what was the source of the current material used for multiplication. Is this source documented? Is this source known to be free from pests and diseases? ……

……

Labelling of multiplication beds: are all the beds labelled with variety and date of planting? ……

……

Varieties inspected: ……

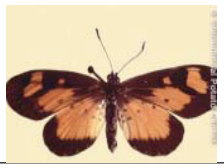
OVERALL RECOMMENDATION:……

SIGNED:……..

DATE:……..

PLACE:……..

ANNEX 4: Some pest of economic importance on sweetpotato in Uganda

Pest Name	Damage	Picture
Aphids: *Aphis gossypii* and others (Homoptera: Aphididae)	Aphids damage plants by sucking sap from growing shoots. Symptoms of aphid attack are wrinkling, cupping, and downward curling of young leaves. During heavy infestation, plant vigour is greatly reduced. As aphids feed and move from plant to plant in the field, they transmit viruses. The most important aphid transmitted virus is SPFMV. Winged forms may travel long distances and introduce viruses into new areas. *A. gossypii* has a wide host range.	
Sweetpotato Butterfly: *Acraea acerata* (Lepidoptera: Nymphalidae)	The caterpillars feed on the leaves. Young caterpillars feed on the upper leaf surface, whereas older larvae eat the whole leaf except for the primary midribs. Complete defoliation may result from severe attacks	 
Sweetpotato Weevils: *Cylas* spp.	Three species of the genus Cylas are pests of sweetpotato and are found in Africa. Adult sweetpotato weevils feed on the epidermis of vines and leaves. The developing larvae of the weevil tunnel in the vines and storage roots, causing significant damage. In response to damage, storage roots produce toxic terpenes, which render storage roots inedible even at low concentrations and low levels of physical damage. Feeding inside the vines causes malformation, thickening, and cracking of the affected vine.	
Whiteflies: *Bemisia tabaci* (Homoptera: Aleyrodidae)	High whitefly populations may cause yellowing and necrosis of infested leaves. The pest is more important as a transmitter of viruses, especially SPCSV and SPMMV. *B. tabaci* has a wide host range, including cotton, tomato, tobacco, and cassava.	

ANNEX 5: Diseases of Sweetpotato (Bacterial, Fungal and Nematodes)

Disease name	Damage/ Symptoms and Control
Bacterial Stem and Root Rot: *Erwinia chrysanthemi*	Aerial symptoms are water-soaked brown to black lesions on stems and petioles. One or two branches may wilt, and eventually the entire plant collapses. Localized lesions on fibrous roots may also be present. On fleshy roots, localized lesions with black margins can be observed on the surface, but more frequently the rotting is internal, with no evidence outside. Cuttings for transplanting should be taken above the soil line. Using less-susceptible cultivars and taking care to avoid wounding can reduce disease incidence.
Alternia blackspot: *Alternaria bataticola*	Brown lesions with a typical bull's-eye appearance of concentric rings occur on leaves, especially older leaves. Black lesions appear on petioles and stems. Bases and middle sections are more affected than the vine terminals. Death of vines can occur. The ground under affected vines is often carpeted with blackened leaf debris. Susceptibility to the pathogen varies among varieties. Pathogen-free planting material of the more resistant varieties and good sanitation practices will help control the disease.
Phomopsis Leaf Spot: *Phomopsis ipomoea-batatas*	Whitish to tan to brown lesions, usually less than 10 mm in diameter, form on the upper and lower surfaces of leaves. The lesions usually have a dark brown or purple margin. Pycnidia are visible in the centre of the lesions. No control measures are known. Control is not normally necessary.
Soft Rot: *Rhizopus stolonifer, Mucor* sp.	Soft rotting occurs after harvest. Storage roots become soft, wet, and stringy, often starting at one end. A strong alcohol-like odour is produced. These fungi are commonly seen sporulating on the surface of rotting storage roots. Washing storage roots is especially conducive to rot. Care in handling and proper curing can reduce disease incidence. So far, no resistance has been found, but some varieties rot faster than others because they are more susceptible. Curing is accomplished by storing after harvest at 29–32°C and 95–100% relative humidity for 5–7 days with adequate ventilation. Subsequent storage is best at around 13°C and 95% relative humidity.
Root-Knot Nematode: *Meloidogyne spp*.	Affected plants become stunted, foliage turns yellow and flagging, and flower production is abnormal. On fibrous roots, round to spindle-shaped swellings (galls) are produced together with egg masses on the surface. Large portions of the root system can become necrotic. The storage roots of some varieties react with longitudinal cracking, whereas in others, blister-like protuberances emerge through the epidermis. Resistance, crop rotation, and selected nematode-free planting material can help to control this disease. In East Africa, nematodes are rarely associated with sweetpotato and no control measures are needed.

ANNEX 6: Sweetpotato Viruses and Sweetpotato Virus Disease

Sweetpotato-infecting viruses

Advances in microscopy, serology and molecular biology techniques have resulted in better methods for virus detection and identification. Worldwide, up to 20 different viruses have been described to infect sweetpotato (Loebenstein *et al*., 2003), but only 11 of them are currently recognized by the International Committee of Taxonomy for Viruses. With the emerging sequence data for virus isolates from different parts of the world, it will be possible to more clearly distinguish the different viruses and virus strains that infect sweetpotato. Sequences for viruses isolated from sweetpotato are available the viruses shown below.

Sweetpotato virus complexes and diseases

Sweet potato virus disease (SPVD) is the name used to describe a range of severe symptoms in different sweetpotato cultivars comprising **overall plant stunting, leaf narrowing and distortion, chlorosis, purpling, mottling, mosaic or vein-clearing**. Mixed infections of SPFMV and SPCSV are the usual cause of SPVD. In fact, single virus infections commonly cause mild or no symptoms in many sweetpotato cultivars. In Uganda, SPFMV and SPCSV have been detected in the major sweetpotato growing districts (Mukasa et al., 2003). In general, co-infection of sweetpotatoes with SPCSV and a potyvirus (or another unrelated virus) results in viral synergism leading to development of severe symptoms and significant yield losses.

Some viruses that have been reported in sweetpotato

Virus genus	Virus species a	**Natural vector**
Potyvirus	Sweet potato vein mosaic virus (SPVMV)	Aphid
Potyvirus	*Sweet potato feathery mottle virus* (SPFMV)	Aphid
Potyvirus	*Sweet potato latent virus* (SwPLV)	Aphid
Potyvirus	*Sweet potato mild speckling virus* (SPMSV)	Aphid
Potyvirus	*Sweet potato virus C* (SPVC)	Aphid
Potyvirus	*Sweet potato virus 2* (SPV2)	Aphid
Potyvirus	*Sweet potato virus G* (SPVG)	Aphid
Nepovirus	Sweet potato ringspots virus (SPRSV)	Unknown
Luteovirus	Sweet potato leaf speckling virus (SPLSV)	Unknown
Ipomovirus	Sweet potato yellow dwarf virus (SPYDV)	Whitefly
Ipomovirus	*Sweet potato mild mottle virus* (SPMMV)	Whitefly
Cucumovirus	*Cucumber mosaic virus* (CMV)	Aphis
Crinivirus	*Sweet potato chlorotic stunt virus* (SPCSV)	Whitefly
Caulimovirus	Sweet potato caulimolike virus (SPCaLV)	Unknown

Carlavirus	*Sweet potato chlorotic fleck virus* (SPCFV)	Unknown
Begomovirus	*Sweet potato leaf curl virus* (SPLCV) 3	Whitefly
Begomovirus	*Sweet potato leaf curl Georgia virus* (SPLCGV)	Whitefly
Begomovirus	*Sweet potato leaf curl Uganda virus* (SPLCUV)	Whitefly
Begomovirus	*Ipomoea yellow vein virus* (IYVV)	Whitefly

ANNEX 7: Estimation of Quantity Of Planting Material

Estimated quantity of material available by variety (by inspector)

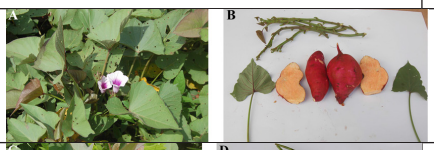
Name of Inspector: . . . . . .

Variety	Date of planting	Age of Crop	No. of beds (Specify size or plant population)	Estimated date of 1st harvest of quality vines	Estimated No. of vines (1st harvest)#	Estimated date of 2nd vine harvest (6 weeks after 1st harvest)	Estimated No. of vines (2nd harvest)

= Estimation = number of beds x average plant population x average # of 30 cm cuttings per plant

ANNEX 8: List of Some Sweetpotato Varieties Released in Uganda

Variety Name	Morphological characters shoot and flower, shoot tip, leaf, and storage root	Yield (Ton/Ha)	Year of release	Reaction to SPVD	Reaction to Alternaria
EJUMULA					
KAKAMEGA					
NASPOT 1					
NASPOT 8 O					

NASPOT 9 O					
NASPOT 10 O					
NASPOT 11					
NAPOST 12O					
NASPOST 13O					
New Kawogo					
New Dimbuka					
Semanda					

ANNEX 9: Payment Documentation for Sweetpotato Seed Inspection

MINISTRY OF AGRICULTURE INSPECTION AGENCY					
PAYMENT DOCUMENTATION FOR SWEETPOTATO PLANTING MATERIAL					
SEED VINE MULTIPLIER INFORMATION					
Name of grower			Contact number		
Grower number			Mailing address		
CROP INSPECTION SERVICE INFORMATION					
Number of Hectares inspected		Region		Date of service	
Commodity code	Description	Quantity	Unit cost	Tax	Total

2755	Application fees		50		
2754	Fees per hectare		20		
				Grand Total	

PAYMENT INFORMATION					
Method of payment	Cash		Cheque		Cheque number:
Date of payment		Receipt number			
Payee signature		Official signature and stamp			

ANNEX 10: Revocation of Certificate

MINISTRY OF AGRICULTURE INSPECTION AGENCY				
REVOCATION OF CERTIFICATE				
YOU ARE ADVISED THAT PURSUANT TO SECTION 52 OF THE SEEDS REGULATIONS, THE CERTIFICATION OF THE FOLLOWING SEED VINE LOTS HAVE BEEN REVOKED				
Certificate No.	Variety	Hectares	Field identification	Remarks

Name of program officer		Signature		Date:	

REFERENCES

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