THE REPUBLIC OF UGANDA

SEED POTATO INSPECTION AND CERTIFICATION PROTOCOL

MINISTRY OF AGRICULTURE, ANIMAL INDUSTRY AND FISHERIES

DEPARTMENT OF CROP INSPECTION AND CERTIFICATION

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Terms and Definitions

For the purposes of this protocol, the following terms and definitions apply.

Authorized person: A competent private or public persons authorized by the National Designated Authority to perform specified functions in accordance with the Seed Act**.**

Basic seed: Progeny of breeder seed or pre-basic seed produced under conditions that ensure maintaining genetic purity and identity. This can be produced by an individual or organization other than the breeder.

Breeder seed: Progeny of parental stock. Breeder seed is produced by or under the direction of the plant breeder who selected the variety. During breeder seed production, individual plants are harvested, based on plant characteristics, under the highest level of control to ensure genetic purity of the variety.

Black leg: Commonly used name of a bacterial disease of potatoes, caused by *Erwinia carotovora subsp. atroseptica.* Similar symptoms may, however, be caused by *E. carotovora subsp. carotovora, E. chrysanthemi.*and bacteria of the genus Dickeya and Pectobacteria.

Certification: An official control procedure which aims at ensuring the production and supply of seed potato which satisfy the requirements of this standard.

Certified seed: Progeny of basic seed or pre-basic seed produced under conditions that ensure maintaining genetic purity and identity of the variety and that meet minimum standards and certified by the designated seed certification agency.

Compulsory certification: Mandatory certification for varieties of crops that have been tested in National performance trials, officially released, and listed on the National variety list

Consignment: A quantity of seed potato consisting of one or more lots destined to a party and covered by one set of documents.

Contaminated field: A field whose history and regulatory action indicates presence of a specific pathogenic organism in the soil.

Disease: Any disturbance of a plant caused by pathogenic organisms which interferes with its normal structure, physiological function or economic value.

Field: A defined area of land used for cultivation of seed potato.

Field inspection: Examination of a seed crop field including checking for effective isolation distance, hectarage of the seed field, off-types, foreign cultivars and diseased plants as part of the seed certification programme.

Generation: The number of growing cycles since the first introduction in the field**.**

Inspection: Examination of plants, tubers, units of presentation, equipment or facilities by National Designated Authority, to determine compliance with regulatory requirements.

Isolation: Required distance or time between two crops of the same species or between two crops of too closely related species to prevent contamination either mechanically, by pollination or pest infestation.

Lot: A quantity of seed potato bearing the same reference number, and being of the same variety, category, class, size and origin, and covered by one sets of documents.

National Designated Authority (NDA): Organization, or agency empowered by national legislation to administer the certification of seed potato under this protocol.

Off-type plant: Plant which does not exhibit the recognized and prescribed growth habits and characteristics of the variety being grown.

Parental material: Propagating material from which the breeder's seed is raised.

Plant variety: Plant grouping within a single botanical taxon of the lowest known rank, defined by the expression of the characteristics resulting from a given genotype or combination of genotypes distinguished from any other plant grouping by the expression of at least one of the said characteristics and considered as a unit with regard to its suitability for being propagated unchanged.

Pest: Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products.

Post control: Growing of plants from seed lots which have been tested or certified to further determine and confirm varietal purity and freedom from disease infestation.

Pre-basic: Progeny of breeder's seed. Pre-basic seed is a step of seed multiplication between breeder and basic seed that is used to produce sufficient quantities of seed for basic seed production, a responsibility of the breeder.

Purity: Percentage by weight of pure seeds as determined by purity analysis in the seed laboratory.

Quality: The sum of all characteristics that determine the acceptance of seed potatoes in relation to the specifications of this protocol.

Quarantine pest: A pest of potential national economic importance to the country endangered thereby and not yet present there, or present but not widely distributed and being officially controlled.

Sampling: The procedure of drawing at random a number of tubers, plants or parts of plants, which may be taken as representative of the lot or the field.

Seed potato: Tubers of Solanum tuberosum L which are certified by the NDA.

Sealing: Stage in processing whereby a seed container is sealed to prevent any tampering.

Seed class: Stage in a seed multiplication system well defined in respect of parental seed standards and seed quality.

Seed health: Level of freedom of either the seed or the seed crop from seed-borne diseases and pests.

Seed inspector: A person appointed under the Seed Act.

Seed lot: A specified quantity of seed which measures to prescribed maximum weight and which is represented by one sample in laboratory seed testing or in post control plots and is homogeneous and physically identifiable by a unique reference number.

Seed quality: A seed that have met the minimum standards and hence are of high varietal, genetic and physical purity, are free from noxious weeds, seed borne diseases and pests and have high germination capacity.

Seed testing: Examination of a sample of seed with a view to determining its quality.

Seed testing laboratory: A laboratory for the testing of seed, declared by notice in the Gazette to be a seed testing laboratory.

Sprout inhibitor: Chemical substance, applied either to the plants during the growing season or to the tubers after harvest which suppresses the normal development of sprouts

Standard: Level of quality achieved during field inspection or a laboratory test as defined in these protocols.

Storage: A stage of seed processing in which seed is maintained in a condition such that minimum deterioration of seed lots occur.

1. Introduction

Certification of seed potato in Uganda is designed to facilitate the production of top-quality seed potato tubers through application of the seed regulations and the seed potato certification standards 'the seed potato specifications. Failure to comply with these conditions and regulations shall be cause for refusal or cancellation of any application for or certification of any seed as certified seed potatoes.

1.1 Purpose of the seed potato certification protocols

The purpose of the MAAIF seed potato certification protocol is to provide the procedure to be followed in Uganda for seed potato certification, define the requirements and standards for inspection and certification of seed potato production. The requirements are derived from the Seeds and Plant Act, 2006, the Plant Protection and Health Act, 2015, and the Uganda standards Seed Potato specifications. The requirements cover all steps involved from tissue culture plantlets production, mother plant multiplication, production of rooted cuttings and mini tubers in the screen house, to field certification of seed tubers.

1.2 Variety eligibility and entry of propagating material into certification

For a variety to enter in the seed potato certification scheme, it must have been officially released by the variety release committee and entered on the national variety list or on a regional variety catalogue or list to which Uganda is party, or subscribes to.

In potato seed multiplication, several sources of propagating material and various methods are used to increase initial stock of propagating materials. Certification protocol purposes to identify and assimilate these sources and methods into the certification program. Propagating materials from local or international public or private agencies may be accepted at whichever generation level if the material can meet the requirements and standards. Documentation on source of propagating materials must be supplied to the national designated authority (NDA), including identity of clone, number of generations, and results of testing.

1.3 What constitutes certified seed potato?

To qualify as MAAIF certified seed potatoes, the seed potato must be grown in accordance with the seed certification rules of MAAIF. In addition, the potato must pass the final field inspection, potato laboratory disease testing and grading requirements of the seed regulations and this protocol and must be accompanied by an official MAAIF certified seed potato label.

Certification confirms that the seed potatoes have been subjected to field inspections and laboratory tests pursuant to this protocol and meet the requirements for certification. Official

labels shall be issued by the Department of crop inspection and certification, MAAIF or its authorized person and shall have the words “MAAIF Certified Seed Potatoes”. The label shall have the producer's name, address, variety, seed class, and date for which the label was issued.

1.4 Role of Department of crop Inspection and Certification

Certification of seed potatoes in Uganda is conducted under the authority of MAAIF through the Department of Crop Inspection and Certification. The role of the department is to establish and administer the conditions of the seed potato certification protocol to produce certified seed potatoes.

2. Application for seed potato Certification

- Any person applying for registration as a seed potato grower shall be required to have access to ample facilities for sorting, grading and storage of certified seed as maybe approved by MAAIF or its authorised agent, before approval of the application is granted.
- All applications will be accompanied by the prescribed fee, or proof of payment of the prescribed fee
- Any grower intending to produce certified seed potato must be registered with the Department of crop inspection and certification of MAAIF.
- Any seed potato grower desiring to have seed potatoes certified by MAAIF under the MAAIF certified seed potato scheme shall apply to the Department of crop inspection and certification within 3 weeks of planting. Applications made after 4 weeks will be rejected for late application.
- All fields intended for seed potato production shall have been tested and found to be free of potato cyst nematode (*Globodera rostochiensis* or *G. pallida)* and bacterial wilt (*Ralstonia solanacearum*) by MAAIF or its approved laboratory. The report shall accompany the application for seed potato certification.
- A field map with clear designations of each seed lot, all documentation relating to the seed-source and any other information requested on the application form (including variety name, generation, tonnes planted and crop rotation history), must be attached to the application.
- Applications must be submitted for any seed lots, fields or varieties for which certification are sought. Failure of any grower to apply for certification of any seed

lot, field or variety will result in that grower's field or variety being ineligible for certification.

- All new growers without experience must serve a probationary period of 12 months. During this period, they will grow a plot/s of Basic, Certified I, Certified II, or Certified III seed, to assess their capacity and must attain field inspection pass with a field rating of 1 or 2 (**Annex 1**).

3. General requirements of seed potato

- Seed potato shall be free from pests of quarantine importance and meet the thresholds stated in this protocol and standard in regard to the regulated non-quarantine pests, injurious diseases and pests and from any defects likely that impair their quality as seed.
- Seed potato shall be substantially dry outside and, in general, of normal shape and size as per descriptor for the particular variety.
- Seed potato or growing crops of potato shall not be treated with sprout inhibitors without permission from the NDA.

4. Seed classes

In seed potato certification an eligible variety must be officially released, after which the breeder is allowed to multiply the seed through several cycles, (due to its low multiplication factor) to reach substantial quantities for farmers use to grow ware potato. The starting material for this multiplication is either mini tubers or healthy mother plants. From this material pre-basic seed is produced followed by basic seed and certified seed in the subsequent multiplications. The key stages of multiplications based on propagation generations are classified as classes. Each seed class has specific level of regulatory control, quality standards and tolerances for diseases and pests

There are four main classes of seed potato:

- **Breeder Seed** (stock seed) – is the last stage of clonal selection produced (by the breeder) in one of three ways:

I. Mini tubers – In mini tuber production (either by aeroponics, hydroponics or sand hydroponics) tissue culture plantlets are raised to produce mini-tubers and released as clone A. These will then be planted in soil as clone B.

II. Apical cuttings – Apical cuttings obtained from tissue culture plantlets are grown in a greenhouse and multiplied in the field to produce clone A.

III. Clonal tubers - In clonal selection, single mother plants are selected from maintenance plots and planted as clone A in individual rows. Conforming clone A rows are planted in subsequent generation as clone B in plots. Conforming Clone B are then planted as clone C which is finally approved as breeder seed.

- **Pre-Basic seed** is the progeny of breeder seed (stock seed) produced in the field, under the control of the breeder and is a step to bulk breeder seed.
- **Basic seed** is the progeny of pre- basic/breeder seed produced in the field by the breeder or qualified seed producers.
- **Certified seed** is the progeny of basic seed/certified seed produced in the field by seed producers under certification by the Department of Crop Inspection and Certification, as G1, or further propagated to G2 or G3, which is sold to farmers for ware potato production.

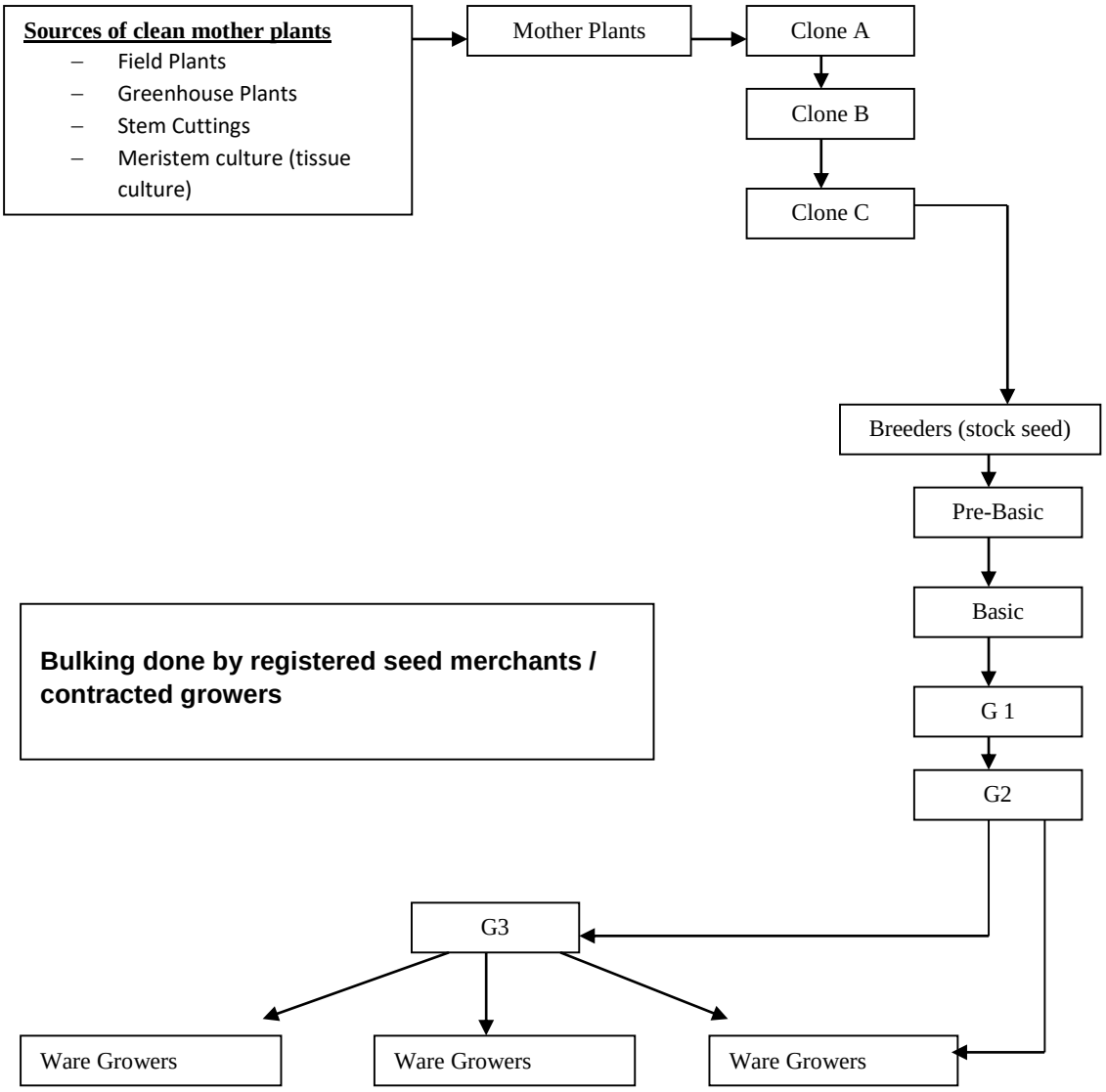

Figure 1. Seed potato multiplication chart in Uganda. The generations from mother plants through Clone A, B, C, and breeder stock represent the breeder seed, while pre-basic and basic represent the basic class while G1, G2 and G2 represent the certified seed classes. Breeder seed is the responsibility of the breeder to ensure maintenance and genetic integrity. Pre basic and basic can either be bulked by the breeder or qualified institution while the certified classes are multiplied by seed producers.

5. Inspection of breeder (stock) seed

- The crop (i.e. each individual variety grown) should be thoroughly inspected for both regulated and non- regulated disease symptoms and the presence of insect vectors (aphids). Number of flowers and young leaves towards the top of the canopy, should be scrutinized for presence of aphids. Yellow sticky traps must be present, and these should also be inspected to gauge insect activity in the environment. It is recommended that a yellow sticky trap also be present within the double door entrance, between the inner and outer doors. This will help monitor possible aphid incursions at this point and can also intercept aphids before they enter the growth area (for this reason, they should be recommended strongly to the seed grower).
- Where there is any doubt over disease symptoms expressed by a potato variety grown as breeder seed potatoes, the inspector should collect leaf samples and submit them at a MAAIF approved diagnostic laboratory.
- There should be no other potato varieties or any other *Solanaceous* plant material present in the facility, except for potato plants under application for certification as breeder seed. If there is a connection between protected environments, a secure pest-resistant physical separation must be present between breeder seed potatoes and all other plants being grown in a different protected environment on the same farm unit.
- Breeder seed propagative material must be grown in soilless media or planted in medium or soil which has not been previously used to produce any potato crop.
- If containers are used, they must be new or must have been thoroughly cleaned and disinfected with an appropriate disinfectant before each use.
- All varieties must be physically separated from one another by means of physical barriers to maintain varietal integrity and purity. This could be achieved by, for example, using dividers in beds, or the growing of individual varieties in individual containers or in different parts of the greenhouse.
- During the inspection, the floor plan should be compared, and its accuracy verified in relation to all varieties present.
- Facility must be aphid-proof at all possible entry points (i.e. screen mesh of size smaller than 70 microns at all air intakes, exhausts, vents including louvered vents). The structure should be inspected for holes or tears that allow entry of aphids/insect vectors.

6. Certification of Pre-basic or mini-tuber production

6.1 Inspection of production facilities for mini-tuber

- Greenhouse/polyhouse facilities must be insect-proof and approved by MAAIF prior to planting.
- Greenhouse/polyhouse must be a substantial, properly constructed, insect-proof glasshouse, polyhouse, or approved tunnel house with an insect-proof door entrance, porch, or 'lock'. The entrance porch or lock must be of sufficient area to permit the entry of people, plants, trolleys into the lock, to ensure that only one door may be open at any one time.
- All openings (including evaporative cooling systems) in the facility must be covered with permanently fixed insect proof gauze with a maximum aperture of 0.5 mm or 500 microns. Whilst metal gauze is preferred, synthetic meshes may be used. Synthetic meshes can be approved by MAAIF Inspectors, provided they retain the minimum aperture dimensions when fixed in place. For this reason, welded mesh is preferred to woven mesh types.
- Premises must be securely locked when unattended and after hour access to the premises must be limited to authorized persons only.
- It is the responsibility of the operator to ensure that the premises and all operations comply with all local and national laws & regulations.

6.2 Pathogen-testing of breeder stock seed

- All potato stocks (existing and new cultivars) from all acceptable sources must be disease free and tested for the pathogens listed in **Table 1**, for use as starter material in the certification scheme. The tests may be done at the official quarantine facility, or by any other testing facility approved by Department of crop inspection and certification.
- A plant health certificate or equivalent declaring the results of the pathogen testing conducted for a given stock or multiplication material must be submitted to Department of crop inspection and certification to enable entry into the certification scheme.
- Only pathogen free stock will be allowed for further multiplication. However, additional pathogens/pests maybe included as need arises.

Table 1. List of pathogens which tissue culture stocks must be tested for before inclusion in seed certification.

Pathogen	Disease
Bacteria	
Pectobacteria (formerly *Erwinia* spp.) and *Dickeya* spp.	Blackleg and related soft rots
Ralstonia solanacearum (formerly *Pseudomonas solanacearum*)	Bacterial wilt
Clavibacter michiganense pv *sepodonicum*	Ring rot
Streptomyces spp.	Common scab
Fungi	
Spongospora subterranea	Powdery scab
Rhizoctonia solani	Black scurf
Helminthosporium solani	Silver scurf
Phoma exigua	Gangrene
Fusarium spp.	Wilt, dry rot
Verticillium spp	Wilt, early dying
Colletotrichum coccodes	Black dot
Phytophthora infestans	Late blight
Virus	
Potato leaf roll virus (PLRV)	Leaf roll
Potato virus A (PVA),	Mosaic
Potato virus M (PVM),	Mosaic
Potato virus S (PVS),	Mosaic
Potato virus Y (PVY)	Mosaic
Tomato spotted wilt virus (TSWV)	
Potato spindle tuber viroid. (PSTVd)	
Potato virus X (PVX)	Mosaic
Other	
Candidatus Liberibacter solanacearum	Zebra chip disease complex

6.3 True to type quality assurance for cuttings.

- True to type testing for cuttings will be conducted for the first cuttings made from the initial mother plant.
- The cuttings will be grown and allowed to flower and form tubers, to ensure true to type by conforming to the characteristics and features of the variety. The conforming mother plants will

consequently be used for cuttings for further multiplication.

6.4 Conditions for tuber seed production

- Seed source must be tissue culture plantlets or micro tubers produced by a MAAIF approved source or laboratory.
- New growth media shall be used for each planting.
- Application for inspection should be made immediately after planting.
- Two field inspections by MAAIF inspectors are required.

    i) The first inspection will be performed during flowering/canopy cover for non-flowering varieties/tuber initiation stage of plant growth

    ii) The second inspection will be performed just before dehaulming while the plants are still green and prior to onset of senescence. Sampling tubers for bacteria wilt testing shall be done at this stage. It is the responsibility of the grower to schedule the inspections with MAAIF inspectors

- Leaf testing for viruses - Plantlet populations or mini-tubers produced in an approved facility shall be randomly tested for all diseases of concern. A minimum of 2.5% of plants in the greenhouse/polyhouse shall be leaf sampled prior to harvest and tested for the five viruses (**Table 2**).
- Diagnostic tests shall be done at MAAIF or MAAIF authorized laboratory.
- Leaf samples shall be collected in groups of 10 leaves and sealed in plastic bags.
- Inspector may request additional tests and sampling based on observations and circumstances.
- Copies of diagnostic testing results must be forwarded to the Department of crop inspection and certification to the Inspector in charge of certification within 10 days of the completion of testing.

Table 2. Five viruses to be tested on leaf samples collected from greenhouse

Virus	Symptoms
Potato leaf roll virus (PLRV)	Leaf roll
Potato virus S (PVS),	Mosaic
Potato virus Y (PVY)	Mosaic
Tomato spotted wilt virus (TSWV)	
Potato virus X (PVX)	Mosaic

7. Requirements for production of certified seed potato

7.1. Field crop history requirements

A field for growing seed potato should not have had a potato crop for the period as indicated for the corresponding seed class to be produced as indicated in **Table 3**.

Table 3. Required period for a field to have been out of potato for various seed classes

Class to be produced	**Years out of potatoes[1, 2]**
Breeder Seed (G1)	Six years (new ground preferred)
Pre basic seed (G2)	Four years
Basic seed (G3)	Three years
Certified I seed (G4)	Two years
Certified II seed (G5)	Two years
Certified III seed (G6)	Two years

[1]Potatoes of a lower class of the same variety may be grown for a second consecutive year on the same field.
[2]A field will not be eligible for certified seed production of any generation until the fifth year following identification of bacterial ring rot in the field.

7.2 Separation and Isolation

A seed crop shall be separated from neighbouring commercial potato crops by distances as shown in **Table 4**.

Table 4. Isolation distance in metres (minimum) from commercial potato crop

Class to be produced	Isolation distance (meters)
Breeders seed	100
Pre basic seed	100
Basic seed	100
Certified I seed	10
Certified II seed	10
Certified III seed	10

A seed crop shall be separated from neighbouring seed potato crops by a space of at least 5 metres for basic seed and at least 2 metres for certified seed. In case of sloppy areas, appropriate measures should be put in place to avoid contamination from runoff storm water.

8. Seed potato inspection requirements

Seed potatoes are inspected during the growing season with special attention given to a) tuber-borne diseases b) general appearance and development - trueness to variety and c) varietal purity.

- At least one visual inspection of propagating materials in laboratory and/or greenhouse facilities will be made by MAIFF before such material is sold and/or planted for the next generation increase. Samples for testing will be taken as outlined in 6.2 above.

- At least two field inspections shall be made during the growing season, the first inspection at flowering/canopy cover for non-flowering varieties/tuber initiation stage while the second inspection at tuber development stage before de-haulming to confirm compliance with field standards.

- Rouging to remove weak plants, varietal mixtures, diseased plants, and objectionable weeds from the field should commence as soon as they become apparent and continue through the growing season. Rouging may be delayed until after the first field inspection and determination is made of potential problems. Plants infected with virus or bacterial diseases should be removed from the field along with the seed pieces and new tubers.

- If ring rot is found in any potato field on a farm (or it is determined that any seed lot planted on the farm is contaminated with ring rot or was stored in a space with potatoes that were contaminated with ring rot), all fields on that farm may be downgraded to Certified II or III or for own use as seed by the farmer. However, it may be ineligible for certification depending upon individual circumstances and level of contamination.

- Field inspection technique**:** starting from a random position in the field count 100 plants (equivalent to 30 metres or paces) along a row, omit three rows and continue the count on the 4th row etc.

Table 5. Minimum number of plants count during field inspections

Area (ha)	No. of counts each of 30 m	No. of plants[1]
< 1	10	1000
1-6	20	2000
6.1-8	24	2400
8.1-10	28	2800
10.1-12	32	3200
12.1-14	36	3600
14.1-16	40	4000
16.1-18	44	4400
18.1-20	48	4800

[1]For basic seed, double the number of plants counted

9. **Field standards**

- Fields will be rejected when seriously infected or damaged by late blight, insects, drought, wind, hail, or frost, other diseases or causes which interfere with proper inspection of potatoes. Poor stands, low soil fertility, poor cultural conditions, or excessive weed growth will also disqualify a field from certification.
- Fields showing symptoms of some disease new to Uganda will be disqualified or may have certification withheld pending further investigation.
- No volunteer potato plants will be permitted in any field, except where the previous potato crop was of a **higher generation** and of the same variety as the one currently being produced.
- Inspection tolerances for disease, insect and other damages are as indicated in Annexes 1- 3 which are based on percent visible disease symptoms. Zero tolerance (0) means none found during the normal inspection procedures. Zero, however, does not guarantee that the lot inspected is free of the disease.
- Foliage destruction (dehaulming) date depends on seed size and aphid pressure**.** The inspector may advice the grower on the appropriate time to dehaulm after approval**.**
- Sampling for Bacterial wilt (*Ralstonia solanacearum*) laboratory test: Before dehaulming, a seed grower should request for sampling for bacterial wilt testing. 400 tubers per hectare shall be taken from a seed crop. For seed crops in a less than 0.5ha, a sample representing 1% of the total plant population is taken. Sampling shall be carried out such that the sample taken is representative of

the whole field. These samples are tested in the laboratory upon which seeds can be sorted, graded and packed if free from bacteria wilt, mainly.

10. **Harvest and storage requirements**

- Growers who have fields eligible for certification should notify MAAIF prior to harvest and work out a satisfactory plan for maintaining the identity of the potatoes through harvest to storage. A lot is eligible for tags only when this identity is maintained. Harvesting equipment and storage areas must be properly disinfected before handling certified lots.
- A seed lot eligible for certification in storage must be clearly distinguished from other seed lots and stored separately from commercial potatoes. Empty containers or tight walls (concrete block, wood, etc.) that prevent mixing are acceptable to separate the lots.
- A clearly written chart or identification marks showing the variety, seed lot origin, and field from which harvested, for each container or store should be made to aid MAAIF or its representative in making the inspections.
- If the inspector is unable to distinguish, to his own satisfaction, the identity of any seed in the storage place, all or any part of the seed in the storage place may be declared ineligible for certification.
- Storage inspections will be made as soon after harvest as possible before the potatoes are sorted.
- Any certified seed lot stored in a cellar with other potatoes found to be infected with ring rot (other seed lots or commercial potatoes) will be immediately downgraded to the last generation or Certified III and depending on the circumstances may be rejected for certification totally.
- Scab, *Rhizoctonia*, early and late blight tuber lesions, etc. are grade defects, to be graded and/or removed during the sorting process.
- Seed potatoes may be rejected for certification if they have been improperly stored as indicated by excessive black heart, sprouting, shriveling, or soft rot breakdown, or they are so marred in general appearance by dirt, blight, scab, or other diseases or condition that it is obvious sorting will not produce good quality seed potatoes.

11. Lot inspection

Seed potatoes are usually graded on the farm. Once the results of the laboratory tests show that the seed is free from the specified diseases, bacteria wilt in particular, the grower is allowed to sort tubers. This will ensure that the damaged, rotten, misshapen and diseased tubers are removed from the seed lot. The tubers are then sized into size 1 (25-35mm), size 2 (36-45mm) and size 3 (46-55mm) and packed in 50 kg new sisal bags. During lot inspection, the inspector shall pick bags of seed at random and empty's the seed on to clean polythene sheet and checks for:

- Conformity to specified seed size (Size 1: 28 to 45 mm and Size 2: 45 to 60 mm)
- Tuber diseases and defects (as per **Table 6**)
- Physiological condition (soft tubers)
- Contamination (e.g. adhering soil)
- Weight (50 Kg bag)

Lot inspection should ensure that the tolerances presented in **Table** 6 are met.

Table 6. Tolerances to deformities in lot inspection

Abnormality	**Tolerance (number of tubers per 50kg bag)**	
	Basic seed	**Certified seed**
Scab (*Streptomyces* spp., *Spongospora subterranean*), not more than 50% tuber surface covered	25	50
Rhizoctonia (*Rhizoctonia solani*)	10	30
Pink rot (*Phytophthora erythroseptica*), Soft rot (*Erwinia* spp.)	0	1
Severe tuber moth	2	5
Deformed and damaged tubers, and severe millipede damage	0	5
Late Blight (*Phytophthora infestans*)	0	0
Early Blight (*Alternaria solani*)	0	6
Dry rot (*Fusarium* spp., *Phoma* spp.)	0	6
Nematodes (*Meloidogyne* spp., *Ditylenchus* spp.)	0	<5

12. Certified Seed potato Grading

Seed potatoes shall be graded into the sizes as described in **Table 7**. Tolerances for sizes 1-3 above will not be more than 5 tubers per 50kg. Size 4 is applicable to mini tubers only.

Table 7. Description of seed grading into the size based on diameter range of the tubers

Size	Diameter range (mm)
1	25-35
2	36-45
3	46-55
4	15-27

13. Sampling for post control

- For tubers, a sample of 120 tubers per seed lot shall be taken for post control purposes, where the maximum lot size shall be 40 tonnes.
- For rooted cuttings, a sample of 60 rooted cuttings per seed lot shall be taken for post control purposes where the Maximum lot size shall be 400,000 cuttings.

14. Other requirements for seed potato production

- Certification fees. Certification of seed potato shall be done after payment of associated fees for inspection and certification.
- No application will be accepted for land that has grown bulbs, corms or tubers imported from a country with a known potato cyst nematode (PCN) infestation or planted with bulbs that were grown in a PCN-infested district unless intense soil testing has been done.
- Any seed stocks entered for certification must be from a source/registered seed merchant approved by MAAIF prior to planting.
- Growers must only use approved seed stocks with a label, for further seed multiplication and shall provide MAAIF inspectors with records which may include proof of purchases.
- Growers are responsible for securing planting materials from MAAIF approved sources.
- All seed from approved sources must be from fields that have been soil sampled and tested negative of potato cyst nematode or other quarantine pests and diseases. Supporting documented evidence of plant health status may be requested by MAAIF.
- All potatoes must meet the requirements of this section and meet the disease tolerances in **Annex 1, 2 & 3.**

- Mandatory PVY testing for all seed stocks for sale or transfer to another country is required.
- Certified seed potatoes shall not be stored or graded in a storage facility containing non-certified potatoes.

15. Rejection of a seed potato crop

A potato seed field or lot shall be rejected for certification for any of the following reasons:

- A failure to plant MAAIF approved seed or ability to demonstrate traceability of seed source.
- Field(s), or any portion thereof, planted without adequate crop rotation (2-5 years).
- Blending or mixing of seeds lots from of two different sources.
- At the time of inspection or testing, potato plants failed to meet disease tolerance limits set forth in **Annexes 1 to 3**.
- The detected presence of potato cyst nematode (PCN) (*Globodera rostochiensis and G. pallida*) shall disqualify a field for future production of certified seed potatoes, until soil tests indicate absence of PCN to the satisfaction of MAAIF.
- The confirmed diagnosis of bacterial wilt (*Ralstonia solanacerum*) shall disqualify from seed certification of all seed potatoes produced under that application for certification, or different applications using the same equipment. All such fields will be disqualified from seed potato production for a period of six (6) years, with no other host crops being grown in this period.
- If the field contains noxious weeds, as per the plant protection Act, the crop will be rejected
- The inspector may also reject the seed crop if it is excessively weedy or severely lodged to a degree that it adversely affects the inspection and quality of the seed.
- In the field, failure to meet physical separation, at least 50m between certified seed potato fields and commercial potato fields, and 100m for basic, pre basic and breeder seed from commercial potato, will result in rejection of the seed crop (**Table 4**).
- In storage, if seed is stored together without a demonstrable separation and clear labelling of all potato stocks, all the stored seed will be denied certification. Where a disqualifying disease is found in any of the potato stocks or lots in the storage, all the lots will be disqualified.

16. Zero tolerance levels for seed potato

A **zero tolerance** will apply to the following three diseases, which automatically precludes the crop from being certified as seed. The nil tolerance is based on 200 tubers/50 Mt of harvested seed potato and 400tubers/ha for field sampling.

- Potato cyst nematode (PCN) (*Globodera rostochiensis* or *G. pallida*)
- Bacterial wilt (*Ralstonia solanacearum*)
- Potato spindle tuber viroid

Annexes

Irrespective of the generation, crops will be rated from 1 to 4, according to the following tolerances for foreign varieties, viruses, and other diseases in annexes 1 to 3.

Annex 1. Maximum tolerances for diseases and foreign varieties (% of plants)

Inspection	**Rating 1**		**Rating 2**		**Rating 3**		**Rating 4**	
	1st	**2nd**	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**
Foreign Varieties (Group 4)	0.05	0.00	0.10	0.01	0.10	0.10	0.10	0.10
Virus diseases (Group 3)	0.10[1]	0.01	0.25	0.10	1.00	1.00	4.00[2]	4.00[2]
Other diseases (Group 2)	0.25	0.10	0.50	0.25	2.00	2.00	2.00	2.00
Total Diseased plants	0.25	0.10	0.50	0.25	2.00	2.00	6.00[2]	6.00[2]

[1] *0.10 = 1 plant in one thousand.*

[2] *Potato Virus Y only all other virus tolerance as per rating 3.*

Any seed having a field rating of 3 or 4 cannot be further multiplied for certified seed.

The highest rating score recorded in any category shall be the overall rating for that crop. (E.g. for a foreign variety rating of 1, virus rating of 2, and other diseases rating of 3, then the overall rating = 3).

Annex 2. Tolerances of diseases for seed potato certification at final field inspection

Disease	Causal organism	Breeder TC	Final inspection rating %			
			R1	R2	R3	R4
Group 1 Restricted diseases						
Brown rot (bacterial wilt)	*Ralstonia solanacearum*	Nil	0	0	0	**0**
Ring rot	*Clavibacter michiganensis sepedonicus*	Nil	0	0	0	0
Potato cyst nematode	*Globodera rostochiensis* or *G. pallida*	Nil	0	0	0	0
Potato spindle tuber viroid	Pospiviroidae	Nil	0	0	0	0
Potato wart	*Synchytrium endobioticum*	Nil	0	0	0	0
Tobacco rattle virus	Tobacco Rattle Virus	Nil	0	0	0	0
Zebra chip	*Candidatus* Liberibacter *solanacearum*	Nil	0	0	0	0
Group 2 Crop assessment (Bacterial and Fungal Diseases)						
Fusarium wilt	Fusarium spp.	Nil	0.1	0.25	2	2
Verticillium wilt	*Verticillium dahlia, V. albo-atrum*	Nil	0.1	0.25	2	2
Blackleg/soft rot	*Pectobacteria* (*Erwinia* spp.), *Dickeya* spp.	Nil	0.1	0.25	2	2
Total Group 2 Bacterial and fungal diseases		**Nil**	**0.1**	**0.25**	**2**	**2**
Group 3 Crop assessment (Viral Diseases)						
Potato leaf roll virus		Nil	0.01	0.1	1	4
Potato virus Y		Nil	0.01	0.1	1	4
Potato virus X		Nil	0.01	0.1	1	4
Potato virus A		Nil	0.01	0.1	1	4
Potato virus S		Nil	0.01	0.1	1	4
Tobacco mosaic virus		Nil	0.01	0.1	1	4
Tomato spotted wilt virus		Nil	0.01	0.1	1	4
Purple top wilt		Nil	0.01	0.1	1	4
Total Group 3 virus diseases		Nil	0.01	0.1	1	4
Group 4 Foreign Cultivars		Nil	0.05	0.10	0.10	0.10

Annex 3. Post-harvest tuber assessments for diseases, insects and defects for certified seed.

Disease	Causal organism	Breeder TC	Rating AA (%) by tuber count)	Rating BB (%) by tuber count)
Group 5 Tuber assessment – Diseases				
Dry rots	*Fusarium* spp., *Phoma* spp.	Nil	2	2
Black scurf	*Rhizoctonia solani*	Nil	-	-
Silver scurf	*Helminthosporium solani*	Nil	-	-
Black dot	*Colletotrichum coccodes*	Nil	-	-
Common scab	*Streptomyces* spp.	Nil	2	4
Powdery scab	*Spongospora subterranea*	Nil	2	4
Root knot nematode	*Meloidgyne* spp.	Nil	2	4
Soft rots	*Pythium* spp.	Nil	0.25	0.25
Pink Rot	*Phythophtora ethyroseptica*	Nil	0.25	0.25
Group 6 Tuber assessment – Insects and Defects				
Potato tuber moth damage	*Phthorimaea operculella*	Nil	2	2
Insect damage	Other than *Phthorimaea operculella*	Nil	2	2
Total insect damage		*Nil*	*2*	*4*
Malformed tubers		n/a	2	4
Mechanical damage		n/a	2	4
Skinning		n/a	5	5
Stem end discoloration		Nil	2	2
Miscellaneous (e.g. sunburn)		Nil	1	1
Foreign cultivars		Nil	0	0

Annex 4. Check list for inspection of tissue culture laboratory inspections

Facility	Requirements	Meeting standard (If yes tick if No (x)	Comment/Remarks
Washing Area	Sinks (lead-lined to resist acids and alkalis), ceramic sinks.		
	Proper drainage system		
	Racks, and have access to water		
	Distiller or alternatives		
	Space for drying ovens or racks		
	Pipette and pipette washer		
	Storage cabinets		
Media Preparation Area	Storage space for the chemicals		
	Culture vessels and closures		
	Glassware required for media preparation and dispensing.		
	Bench space for hot plates/stirrers		
	pH meters and balances		
	Refrigerators and freezers for storing stock solutions and chemicals		
	A microwave or a convection oven		
	Autoclave for sterilizing media glassware and instruments.		
Transfer Area	All surfaces in the room should be designed and constructed in such a manner that dust and microorganisms do not accumulate, and the surfaces can be thoroughly cleaned and disinfected. A room of such design is particularly useful if large numbers of cultures are being manipulated or large pieces of equipment are being utilized		
	Laminar flow hood or sterile transfer room be utilized for making transfers. The ventilation should be equipped with a high-efficiency particulate air (HEPA) filter. A 0.3-μm HEPA filter of 99.97-99.99% efficiency works well.		
	Source of power: electricity or gas or solar		

Culture/Growth room	All types of tissue cultures should be incubated under conditions of well-controlled temperature, humidity, air circulation, and light quality and duration. These environmental factors may influence the growth and differentiation process directly during culture or indirectly by affecting their response in subsequent generations. Typically, the culture room or growth of plant tissue cultures should have a temperature between 15 and 30°C		
	Fluorescent lighting (10,000 lux) the lighting should be adjustable in terms of quantity and photoperiod duration. Both light and temperature should be programmable.		
	Air conditioner (The culture room should have fairly uniform forced-air ventilation, and a humidity range of 20-98% controllable to ±3%)		
	Thermometers		
General Requirements			
1.	Technical personnel with tissue culture knowledge		
2.	Isolation from foot traffic		
3.	Thermostatically controlled heat		
	Good lighting		
4.	Locate the building away from sources of contamination such as a gravel driveway or parking lot, soil mixing area, shipping dock, pesticide storage, or dust and chemicals from fields		
5.	The floor should be preferably tiled or concrete. Walls and ceiling should be insulated with a water-resistant material.		
6.	Windows, if desired, may be placed wherever convenient in the media preparation and glassware washing rooms.		
7.	Air conditioning for cooling in each room would be necessary.		
8.	Electric service capacity for equipment, lights and future expansion should be calculated. A minimum 100-amp service is recommended.		

Name of Company…….

Contacts……

Contact person/Responsible…….Date……..Signature.....

Name of inspector/ officer/s……Date……Signature…….

Name of inspector/ officer/s……Date…… …Signature…….

Annex 5: Inspection check list for Greenhouse facility (Minitubers and apical stem cuttings)

Requirement	Status	Comments
1. The facility should be insect proof screen/glasshouse or facility.		
2. Cemented slabs /or ground cover within the glasshouse provided with walking paths		
3. Have a double door entry		
4. have protective clothing and the changing area		
5. Adequate but controlled ventilations		
6. Have competent personnel		
7. Have a pest monitoring and management system		
8. Have operational notifications and records including operating instructions		
9. A disinfecting trough (moat) on the entrance with disinfecting solution is required		
10. Not be accessible to un-authorized persons.		
11. The facility should be used exclusively for the specified purpose		
12. Be inspected regularly by MAAIF		

Name of Company…….

Contact person/Responsible…… ……. Date…… ……Signature……

Name of inspector /officer……..Date……...Signature……