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SWEET POTATO

GUIDELINE TO FACILITATE INTRA-REGIONAL TRADE IN THE CARIBBEAN

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REGIONAL GUIDELINES FOR
PHYTOSANITARY MEASURES

GUIDELINE TO FACILITATE INTRA-REGIONAL TRADE IN SWEET POTATO

Produced by the Caribbean Agricultural
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Adoption

This guideline was adopted by the Council of Trade and Economic Development (COTED) in June 2022.

INTRODUCTION

Scope

This guideline provides assistance to national plant protection organisations (NPPOs) within the Caribbean region in managing the risk of introduction of specific pests associated with cross-border movement of sweet potato (*Ipomoea batatas*) tubers intended for consumption or processing by providing clear guidance and protocols for intra-regional trade of the commodity in the Caribbean region. The guideline applies to all varieties of sweet potato tubers from which the leaves and stems have been removed.

The major pests of sweet potato, pests of regional priority and pests regulated by countries in the Caribbean region – and phytosanitary measures to manage these pests – are included in this guideline. Recommended measures include those that have been adopted as International Standards for Phytosanitary Measures (ISPMs) as well as those that are generally used in trade amongst Caribbean countries.

This guideline does not address issues related to living modified organisms, climate change, quality of sweet potato tubers, or diversion from intended use; trade in the whole plant, cuttings, leaves or other plant parts is not covered in this document.

Definitions

Definitions of phytosanitary terms used in the present guideline can be found in ISPM 5 (*Glossary of phytosanitary terms*).

OUTLINE OF REQUIREMENTS

The issue of pest risk varies within and between countries. It is therefore important for importing NPPOs to apply pest risk analysis (PRA) (see ISPM 2: *Framework for pest risk analysis*

and ISPM 11: *Pest risk analysis for quarantine pests*) in the process of identifying quarantine pests and providing the technical justification for the imposition of phytosanitary import requirements. The importing country should consider equivalence of phytosanitary measures if the country of export is unable to conduct specific requests for phytosanitary measures. Such a process should be in keeping with ISPM 24 (*Guidelines for the determination of equivalence of phytosanitary measures*).

Phytosanitary certification and import regulatory systems should be in accordance with ISPM 7 (*Phytosanitary Certification System*), ISPM 12 (*Guidelines for Phytosanitary Certificates*) and ISPM 20 (*Guidelines for a phytosanitary import regulatory system*). Inspections and sampling of consignments should be in keeping with ISPM 23 (*Guidelines for inspection*) and ISPM 31 (*Methodologies for sampling of consignments*), respectively. Wood packaging materials, including pallets, used for consignments must be in conformance with ISPM 15 (*Regulation of Wood packaging material in international trade*).

This document seeks to provide guidance on procedures to establish phytosanitary import requirements. It also identifies and describes specific phytosanitary measures that may be used to reduce pest risk and it provides guidance on sampling, inspection and phytosanitary certification of sweet potato tubers for export.

BACKGROUND

Description of sweet potato

Sweet potato (*Ipomoeae batatas*) is a dicotyledonous plant of the bindwood or morning glory family, Convolvulaceae. The leaves are green or purple, cordate, palmately veined, and borne on long petioles. The tuberous roots or tubers are used as a vegetable and are large, starchy and sweet tasting. Several sweet potato cultivars have been bred to bear tubers, the flesh and skin of which are of various colours. The plant is a herbaceous perennial vine, the stems of which usually crawl of the ground and form adventitious roots at the nodes. The roots are mostly located within the top 25 cm of the soil. The edible tuberous root is long and tapered, with a smooth skin, the colours of which range between yellow, orange, red, brown, purple and beige. The flesh of the tubers ranges from beige through white, red, pink, violet, yellow,

orange and purple. The varieties of sweet potato with white or pale-yellow flesh are usually less sweet and moist than those with red, pink or orange flesh.

I. batatas is native to the tropical regions of the Americas. Of all species of Convolvulaceae, this species is the only crop plant of major importance. The plant grows best at an average temperature of 24ºC (75ºF), with warm nights and abundant sunshine, and it requires annual rainfalls of 750-1,000 mm; irrigation may be required if annual rainfall is less than 850 mm. The crop is drought-sensitive at the tube initiation stage 50-60 days after planting and is intolerant of waterlogging. Persistent wet conditions may cause tuber rots and reduce growth of the storage roots if soil aeration is poor. Sweet potato grows on a variety of soils but prefer well-drained, light- and medium-textured soils with a pH range of 4.5 – 7.0. Notably, the commodity is extremely sensitive to aluminum toxicity and lime may have to be applied to the soil prior to planting. A cultivar of the sweet potato known as the boniato is grown in the Caribbean. The flesh of this cultivar is cream-coloured and is not as sweet and moist as other sweet potatoes; the consistency and delicate flavour of these cultivars are different than the orange-coloured cultivars.

Sweet potato is a major and minor host of a large and varied list of pests (*CABI ISC datasheet 28783*). Common pests affecting the commodity include Alternaria leaf spot and leaf stem blight (*Alternaria* spp.), black rot (*Ceratocystis fimbriata*), bacterial soft rot (*Erwinia chrysanthemi*), leaf and stem scab (*Sphaceloma batatas*), pox (*Streptomyces ipomoea*), sweet potato virus disease (sweet potato feathery mottle virus and sweet potato chlorotic stunt virus), and sweet potato stem borer (*Omphisa anastomosalis*).

Identity

Preferred Scientific Name
***Ipomoea batatas* (L.) Lamk (1793)**
Preferred Common Name
Sweet potato
Other Scientific Names
Batatas edulis (Thunb.) Choisy (1833)
Convolvulus batatas L. (1753)
Convolvulus edulis Thunb. (1784)

Taxonomic Tree

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphyllum: Angiospermae
Class: Dicotyledonae
Order: Solanales

Family: Convolvulaceae
Genus: Ipomoea
Species: Ipomoea batatas

Intended Use

The guideline covers sweet potato tubers for the intended purpose of consumption as food or for processing.

REQUIREMENTS

Pest risk analysis

The NPPO of the importing country should conduct PRA associated with sweet potato tubers in accordance with ISPM 2, *Framework for pest risk analysis* and ISPM 11, *Pest risk analysis for quarantine pests*, to determine the regulatory status of the pests for the area from which the commodity originates.

Pests of phytosanitary significance affecting trade in sweet potato tubers

None of the current regional priority plant pests are known and/or confirmed to affect sweet potato grown in the Caribbean region. Appendices 1 and 2, respectively provide combined lists of general pests and regulated pests found on sweet potato grown in the Caribbean region.

Table 1 is a list of pests associated with fresh sweet potato tubers that may be identified as regulated pests requiring phytosanitary measures by the PRA process. Measures in Table 3 are recommended for the management of these quarantine pests. These measures may be substituted where technically justified.

In the conduct of the pest risk assessment, significant uncertainty may be identified, making it difficult to evaluate phytosanitary measures. Cases of uncertainty do not mandate the application of measures unless it is determined that a pest is likely to be introduced and result in negative economic impacts in the PRA area.

In Table 2, included is a list of pests for which there is uncertainty in the Caribbean as to association with sweet potato tubers in trade and a description of the uncertainty.

Table 1. Pest groups associated with sweet potato tubers

Pest Group	Family	Example species

Ants	Formicidae	*Acromyrmex octospinosus* (Reich) *Atta cephalotes* (Linnaeus) *Atta sexdens* (Linnaeus) *Solenopsis invicta* (Buren, 1972)
Mealybugs	Pseudoccidae	*Phenacoccus manihoti*
Moths	Bedelliidae	Bedellia orchilella Walsingham
	Pyralidae	Megastes grandalis (Guence)
	Crambidae	Omphisa anastomosalis Guenée
Slugs	Veronicellidae	*Veronicella cubensis* (Pfeiffer)
Fungi	Mycosphaerellaceae	*Cercospora batatae* Zimm.
Phytoplasma	Acholeplasmataceae	Sweet Potato Little Leaf Phytoplasma
Beetles	Chrysomelidae	*Cassida bivittata* Say *Chaetocnema confinis* Crotch, 1873 *Diabrotica balteata* (Leconte) *Typophorus nigritus*
	Scarabaeidae	*Strigoderma arboricola*
Weevils	Apionidae	*Cylas formicarius* (Fabricius)
	Curculionidae	*Euscepes postfasciatus* *Palaeopus costicollis* Marshall
Mites	Tetranychidae	*Tetranychus cinnabarinus* (Boisduval) *Tetranychus tumidus* Banks
Wireworms	Elateridae	*Conoderus rudis* (Brown)

Table 2. Pests with uncertain association with fresh sweet potato tubers

Pest Group	Family	Pest	Description
Fungi	Elsinoaceae	*Elsinoe batatas* (Saw.) Viegas & Jenkins	Limited information is available on the biology of this pathogen so it is uncertain if and how it affects the sweet potato tuber, and its implications for trade in the commodity in areas where the pathogen is present.

General Procedures

Once technically justified, general procedures include the following:

Production:

- Registration of producers, farms and exporters and maintenance of a registry of these entities by the NPPO of the exporting country
- Application of good agricultural practices (GAP) (e.g., site and land selection, use of agrochemicals in as recommended by the manufacturer, use of pest resistant or tolerant varieties where available, farm sanitation, weed management)
- Monitoring for pests and their vectors where applicable
- Farm certification.

Packaging and grading:

- Registration of packing houses
- Development of, and compliance with, packing house requirements
- Pest management in the packing house
- Packing in new and clean material (including protective material, where required)
- Labelling of packaging
- Storage prior to export and transportation in a secure manner to prevent contamination and infestation (e.g., use of insect-proof packaging)
- Grading to ensure suitability of tubers for export, including freedom from damage and/or rot, symptoms of pests and contamination with soil, plant debris and extraneous materials

Treatment facilities:

- Registration and approval of export treatment facilities (where different to the packinghouse) in accordance with established procedures
- Secure management to prevent contamination and infestation.

Sanitary (Food Safety) Measures

Food contamination can be caused in several ways, the main types of which are biological, chemical, physical and allergenic. Some such contamination could be due to naturally occurring contaminants in the environment or artificially introduced by certain agricultural practices.

Food contamination is a matter of serious food safety concern because high concentration of chemicals and contaminants present in food can pose serious health risks. The handling, packaging, transportation and storage of commodities intended for consumption are significant contributors to food contamination. It is therefore important that good agricultural practices and good hygiene practices are maintained from the point of production to the point of export to reduce or eliminate contamination of sweet potato tubers. Use of chemical treatments must be approved for use on commodities for consumption and should be applied strictly in accordance with the manufacturer's recommendations on the label.

Phytosanitary Measures

There are no regional pests of quarantine significance that have been confirmed/shown to be associated with sweet potato tubers in the Caribbean region. Table 3 below provides information on pests associated with sweet potato tubers along with measures considered to be effective in managing each pest group previously identified in Table 1.

NPPOs of importing countries in the region should recognize the effectiveness of treatments to manage the target pests or provide technical justification in support of alternative measures. Phytosanitary measures applied to manage the risk(s) from one pest could likely also manage the risks posed by other pests of the commodity.

In the case of phytosanitary import requirements, such should be required solely for pests that countries have identified as regulated pests that require the application of phytosanitary measures thus determined by PRA for the endangered area. In cases where the association of the pest or pest group to the pathway is uncertain, phytosanitary measures should be justified through PRA.

Table 3. Phytosanitary measures considered to be effective in managing the risk from specified pest groups

Pest Group	Phytosanitary Measure(s)
Ants	Systems approach, PFA[1], PFPP[2]
Beetles	GAP (incl. IPM, use of tolerant varieties), visual examination
Fungi	Strict field sanitation, elimination of wild host plants
Mealybugs	Harvest and post-harvest management, visual examination
Mites	GAP (e.g., rationalize use of soil applications of neonicotinoid and broad-spectrum insecticide applications)
Moths	PFA, PFPP, systems approach
Phytoplasma	IPM (incl. vector control, removal of all plant material, debris & wild hosts, use of clean [planting material)
Slugs	PFA, systems approach, GAP, visual inspection
Weevils	PFA, PFPP, irradiation, IPM (e.g., cultural, mechanical & chemical methods; field sanitation, removal of alternate hosts)
Wireworms	Systems approach, visual inspection

Pest Free Areas (PFA)

Guidance on pest free areas may be sourced in ISPM 4 (*Requirements for the establishment of pest free areas*) and ISPM 8 (*Determination of pest status in an area*).

Pest Free Places of Production (PFPP) and Areas of Low Pest Prevalence (ALPP)

Guidance on pest free places of production and areas of low pest prevalence is found in ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*) and ISPM 22 (*Requirements for the establishment of areas of low pest prevalence*). The utility of these phytosanitary measures may be limited by some characteristics of pests.

Pre-Harvest and Harvest Management

Pre-harvest management

Sweet potato crops should be managed using good agricultural practices. Varieties grown in the Caribbean region require well drained sandy or sandy loam soils, a pH of 5.8-6.4, and an annual average rainfall of 750-1250 mm for production. Avoid fields with high nematode populations and fields that have not been used for sweet potato for 2-3 years. An integrated system of pest management (e.g., pheromone pest trapping, elimination of alternate hosts,

[1] Pest Free Area
[2] Pest Free Place of Production

moulding to reduce cracks in the soil, prompt harvesting of the tubers, crop rotation) should be employed to manage the major pests, inclusive of sweet potato weevils.

Harvesting

Sweet potato tubers should be harvested as soon as possible after reaching maturity. The skin of the tuber is thin and easily damaged. Care should be taken when removing tubers from the soil since mechanical damage can provide a site for the entry of disease organisms, resulting in post-harvest losses due to rot. Tubers should be handled carefully and sparingly. Upon harvesting, tubers should be first graded and then placed in field crates for transport from the field.

Post-harvest handling and treatments

Handling and sorting

All diseased, defective and damaged sweet potato tubers should be removed from tubers to be exported. Plant debris should also be removed. Care should always be taken to reduce or prevent damage to the tubers.

Cleaning

Sweet potato tubers should be washed in water using a sponge to remove all particles of soil. Care must also be taken at this stage to minimize surface skin damage. The cleaning process may be done manually of use of a specialized washing machine. The water should contain 15 cc per 4.5 litres of commercial bleach (that is 160 fl. oz./gal). Any water used to wash tubers in this process should be clean. The cleaning solution should be changed when it looks dirty and/or after every 500 kg (1,100 pounds) of tubers. Once clean, the tubers should be dipped in a solution of Mertec®20S (500ppm of TBZ *a.i.*) and then left to air dry overnight. The degree of cleaning is dependent on the requirements of the importing country.

Curing

One of the simplest and most effective ways to reduce water loss and decay during postharvest storage of sweet potato tubers is curing after harvest. This involves the process of wound healing with the development and suberization of new epidermal tissue. Ironically, the high temperature and humidity required for the curing process is also favourable for the rapid growth of microorganisms and deterioration of the commodity being cured. As such, the process should be done quickly and carefully, and handling of the cured produce should be reduced to a

minimum in order to avoid further tuber injury and hence postharvest losses. Sweet potato tubers may be cured by holding at (i) ambient temperature (26-29ºC [80-85ºF] and 85-90% relative humidity] for 3-5 days, or (ii) 30-32ºC and 85-90% relative humidity for 4-7 days.

Storage

The rotting of sweet potato tubers in storage generally results from injury of the tubers during harvest and subsequent handling. Prior to storing, prompt curing as described helps to prevent rotting, as well as careful handling and sorting to remove defective or infested tubers.

Treatments

Treatments include a range of processes that are targeted at the control or eradication of pests and contaminants from approved commodities, empty containers and export vessels. Treatments can include – but are not limited to – fumigation; irradiation; use of controlled atmosphere or temperature; application of a chemical substance; dismantling, repairing or cleaning; repacking; or blending. The choice of the treatment applied is the responsibility of the importing country, unless otherwise determined by legislation or international standards.

Specific treatments for sweet potato tubers may be selected and mutually agreed upon between the countries of import and export in accordance with approved international standards and treatments or where bilaterally agreed.

Irradiation

Treatments for the use of ionizing radiation (irradiation) may be used for pest risk management. Phytosanitary irradiation is a treatment which uses ionizing radiation on commodities such as fruits and vegetables to inactivate pests. The method is used for international food trade as a means to prevent spread of non-native organisms. NPPOs should be assured that the efficacy of the treatment is scientifically demonstrated for the regulated pest(s) of concern and the required response. The application of irradiation as a phytosanitary treatment should be in accordance with ISPM 18 (*Guidelines for the use of irradiation as a phytosanitary measure*), ISPM 28 (Phytosanitary treatments for regulated pests), as well as phytosanitary treatments PT 12 (*Irradiation treatment for Cylas formicarius elegantulus*) and PT 13 (*Irradiation treatment for Euscepes postfasciatus*).

Sweet potato tubers originating in areas where *Palaeopus costicollis*, *Cylas formicarius* and *Euscepes postfasciatus* are present and not under official control, must be irradiated at the recommended dose that achieves elimination of these pests.

Fumigation treatment

Fumigation is the treatment with a chemical agent that reaches the commodity and target pest(s) in a gaseous state. The fumigant may be effective against all pest groups or used to target a particular pest group and may address all or most life stages. The application of fumigation as a phytosanitary treatment should be in accordance with ISPM 43 (*Requirements for the use of fumigation as a phytosanitary measure*).

Chemical treatment

Chemical treatments are used on a wide range of agricultural products from pre-planting through to post-harvest stages. These treatments are intended to destroy, repel and control pests of agricultural commodities. The chemicals are commonly applied by **dipping** (i.e., fully immersing the commodity into a solution) or spraying at a specific concentration for a specified period, to reduce the risk of a broad range of pests in the target area or on the target commodity. Chemical treatments may also be used to destroy pests within empty holds of a vessel or container.

Temperature treatment

Temperature treatments may be used as a phytosanitary treatment option. The application of heat treatments and systems to support the treatments should be in accordance with ISPM 42 (*Requirements for the use of temperature treatments as phytosanitary measures*) and technically justified by PRA.

Vapour Heat Treatment (VHT) is the process in which water vapours are used to heat a commodity until it reaches a minimum temperature for a specified period of time to effectively control live infestations of certain pests. It is an option generally used for commodities that are resistant to high moisture and vulnerable to drying out.

Cold treatment involves the use of refrigerated air to lower the temperature of a product to, or below, a specific temperature for a specific period to mitigate the risks of infestations of target pests. This treatment is used primarily for fresh fruits and vegetables that are hosts of internally feeding pests. The treatment is generally commodity and pest specific.

Packing, packaging and labelling

Packaging is a pivotal step in the journey of fresh produce from the farm to the table, and a number of options is available depending on the specifications of individual consignments (NC State Extension Publications, 1996). Solanaceous vegetables should be packaged using clean or

new containers, usually cardboard or plastic. The packaging materials should be free of any toxic chemicals and allow for a rapid cooling of the produce.

Sweet potatoes should be packed in approved cartons (e.g., two-piece full telescopic fibreboard banana-type) holding 18 kg (40 pounds) and the packaging should be properly labelled in compliance with the importing country's requirements. Generally, the label placed on each packing container of sweet potato tubers should include the name and address of the packer or dispatcher, name of producer, crop name, origin of the produce, and the net weight. Handwritten labels are discouraged.

Transportation

In the transportation of sweet potato tubers for consumption, the vehicles should be kept clean and records kept of all cleaning activities. All applicable handling, packaging and storage procedures must serve to prevent damage to the produce and proliferation of pests during the process. Closed trucks used to transport fresh produce should be either refrigerated or suitably retrofitted to allow for ventilation of the produce. Ventilation of long-distance vehicles should be done by fitting the vehicle with air intakes and louvres to allow for a positive air flow through the load. During the shipping process, sweet potato consignments should not be placed in areas with extreme temperatures. The cartons should not be dropped, thrown, packed in inverted position, rolled or tipped. Regardless of the means of transport, the produce must be kept as cool as possible, dry, and moved to market as quickly as possible.

Sweet potatoes can be transported by air or sea for a period of up to 14 days in refrigerated containers. During shipment of consignments of the tubers, the storage temperature should be 12-13ºC (54-55ºF). Chilling occurs if temperatures fall below this range while higher temperatures result in increased decay, sprouting and water loss.

Systems Approaches

Guidance for the use in development and evaluation of integrated measures in a systems approach can be found in ISPM 14 (*The use of integrated measures in a systems approach for pest risk management*). At least two measures which are independent of each other may be used to manage specific quarantine pests and any uncertainty.

Verification of compliance

Sampling and inspection should be carried out by the NPPO to verify compliance of consignments of sweet potato tubers with phytosanitary import requirements.

The NPPO may authorize entities to conduct specific phytosanitary activities (e.g., sampling, inspection and testing in accordance with the ISPM 45 (*Requirements for national plant protection organizations if authorizing entities to perform phytosanitary actions*).

Sampling and phytosanitary inspection

ISPM 31 (*Methodologies for sampling of consignments*) and ISPM 23 (*Guidelines for Inspection*) may be used for official guidance on sampling and phytosanitary inspection.

In accordance with official procedures, the NPPO of the exporting country should sample and inspect each consignment of fresh sweet potato tubers to verify conformance with importing requirements and freedom from quarantine pests. If infield controls require the registration of the production area or farm(s), sampling and inspection should be conducted in each homogenous grower lot. In instances where live pests are found, the exporting country NPPO should determine whether additional actions are required to meet the conditions of the importing country NPPO.

The number of packages presented for inspection should be consistent with documentation for the consignment. The documentation should certify that basic measures have been applied and that any required traceability labelling is complete. Initial inspection of the consignment should also verify that the phytosanitary security is maintained for the consignment.

Minimum sample size for inspection should be based on a 95% confidence level as set out in ISPM 31 (*Methodologies for sampling of consignments*), or as specified by the NPPO of the importing country with technical justification.

Phytosanitary certification

All commodities intended for export attain a phytosanitary status when they are produced in a PFA or PFPP; after harvest, for commodities from certified farms required to eliminate, manage or monitor specific pests; after a phytosanitary treatment, and after export inspection. A phytosanitary certificate should only be issued when the requirements of the importing country,

as set out in an Import Permit issued by its NPPO, have been verified as being met as confirmed in the certifying statement. Phytosanitary certification (for export and re-export) should be in keeping with the import requirements as specified by the importing country's NPPO.

For consignments of sweet potato tubers to received phytosanitary certification, the consignments must:

- Meet the specific requirements as indicated in the Import Permit issued by the importing country
- Originate only from officially approved places of production
- Be clean (i.e., practically free from viable regulated pests and associated tissue damage, soil, chemical contaminants, or other extraneous material and substances)
- Be treated in a manner consistent with the application standard and treatment certificate presented
- Be accompanied by pest free area declaration, where required
- Be considered free from viable regulated pests, soil and other contamination
- Be packaged in clean and new material (including packaging material used to prevent damage during transport)
- Be exported in a secure manner to prevent contamination.

Fresh sweet potato tubers must be intact and clean, and free from rot, visible foreign matter and damage caused by pests. If viable regulated pests are detected, a phytosanitary certificate should not be issued unless appropriate phytosanitary measures have been applied.

If a consignment of fresh sweet potato tubers is opened, split up or packaging changed prior to arriving in the country of import, a phytosanitary certificate for re-export is required from the re-exporting country. Re-exported consignments must be accompanied by (a copy of) the original phytosanitary certificate.

Phytosanitary certificates, and Phytosanitary Certificates for Re-export should be in accordance with ISPM 12 (*Phytosanitary certificates*).

Phytosanitary security

Once commodities have received phytosanitary certification, and until such commodities are exported, the phytosanitary security of the commodities must be maintained at all times. As such, the commodities must be adequately protected to prevent infestation or contamination

and labelled (in keeping with the legislation and importing country requirements) to prevent substitution. Breaches of security during transport or storage disqualifies the phytosanitary status of the commodities.

Phytosanitary security is maintained:

1. when secure packaging (cartons, pallets) is used and/or
2. the consignment is isolated by physical barriers, distance or insect-proof space), AND
3. appropriate measures are taken while loading export containers.

Secure packaging

Secure packaging requirements could comprise of the following:

Carton level security

- The commodity is fully enclosed in a carton with the lids tightly fixed to the base
- Ventilation holes or other openings are covered with insect-proof mesh that has no more than a 1.6mm diameter pore size diagonally; alternatively, ventilation holes are fully sealed.
- Vented cartons having plastic liners or bags must be fully sealed. The overlapping folded edges of the plastic liner with the carton lid on top would be considered fully sealed.

Pallet level security

For cartons that are palletized, security would be achieved using one of the following options:

- Each pallet is fully shrink-wrapped, with the base and the top of the pallet sealed (e.g., using a sheet of cardboard), as well as all sides, to completely enclose the commodity consignment.
- Each pallet is secured with insect-proof mesh using a pallet net with no more than a 1.6 mm pore size diagonally, to include the surface area between the bottom row of the cartons and the pallet.

Isolation requirements

Commodities that are not secure-packaged may be kept secure if they are isolated from all potential sources of infestation or contamination and from other goods of different or unknown phytosanitary status.

Isolation by physical barriers

Physical barriers (e.g., walls or solid structures) can be used to form a barrier to exclude pest access. This option can be applied when the commodities are stored and handled in insect-proof spaces, shipping containers, enclosed vans or cool rooms.

Isolation by distance

The phytosanitary status of consignments may be maintained by creating a minimal acceptable distance between goods of different or unknown phytosanitary status within insect-proof spaces. This can be achieved if goods are kept at optimal storage temperature with at least 1m separation from any other goods.

Isolation by insect-proof spaces

The phytosanitary security of a consignment can be maintained if, at all times, the goods are kept in insect-proof spaces and are kept isolated from all potential sources of infestation or contaminants, to include products of different or unknown phytosanitary status. Packhouses, treatment facilities and cool room storage doors must be suitably insect-proof through the use of double doors, automatic doors, rubber curtains, air curtains or other approved mechanism.

Loading procedures

During the loading process, it is important to maintain phytosanitary security of the consignment by ensuring the following occurs:

- Containers with vent holes and openings must be sealed, with openings no more than 1.6 mm pore size diagonally (e.g., drain holes or air intakes)
- Consignments must be loaded directly into the export container
- Commodities not securely packaged and not immediately loaded must be stored securely to prevent contamination or infestation
- Personnel loading export containers must ensure that the consignments are moved from the secured area into the export containers as quickly as possible
- Consignments must not be left unsecured and loading procedures must mitigate potential infestation.

One or more methods to safeguard fresh sweet potato tubers against infestation after the application of a phytosanitary measure should be applied. Such methods should take into account the biological characteristics of pests and the strength of the phytosanitary measures that have been applied.

Consignments in transit

In the movement of regulated commodities within the Caribbean, such commodities may transit various countries *en route* to the country of import. Procedures to identify, assess and manage pest risks associated with consignments of these commodities which pass through a country without being imported, should be conducted in such a manner that any phytosanitary measures applied in the country of transit are technically justified and necessary to prevent the introduction into and/or spread of pests within that country. ISPM 25 (*Consignments in transit*) provides guidance for handling of consignments in transit.

Audit and compliance of the export pathway

In keeping with ISPM 20 (*Guidelines for a phytosanitary import regulatory system*), the importing country's NPPO may request an audit of specific elements of the fresh sweet potato tuber export system. This could relate to entities registered/approved to export as well as the records relating to exported consignments. Verification of compliance of the consignment may be sought by the importing country in the country of export.

REFERENCES

This guideline refers to International Standards for Phytosanitary Measures (ISPMs). ISPMs are available on the International Phytosanitary Portal (IPP) at https://www.ippc.int/core-activities/standards-setting/ispms

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APPENDICES

Appendix 1. List of pests found on sweet potato in the Caribbean region

[source: National Plant Protection Organizations of Member States]

Pest Type	Scientific name	Common name(s)
Bacterium	*Erwinia carotovora subsp. carotovora* (Jones)	Bacterial root rot of sweet potato
Bacterium	*Erwinia chrysanthemi*	Bacterial soft rot
Bacterium	*Pseudomonas* sp. (E.F. Smith)	Canker, leaf and stem spots, blight, soft rot, galls
Bacterium	*Ralstonia solanacearum*	Bacterial wilt
Fungus	*Alternaria* spp.	Alternaria leaf spot & Leaf and stem blight
Fungus	*Aspergillus niger* (Van Tieghem)	Black mold (rot), crown rot, vine canker
Fungus	*Athelia rolfsii*	Sclerotium rot
Fungus	*Botryodiplodia theobromae* (Pat.)	Diplodia stem rot
Fungus	*Ceratocystis fimbriata* Ellis and Halstead	Black rot
Fungus	*Cercospora ipomoeae Wint.*	Angular leaf spot
Fungus	*Coleosporium ipomoeae*	Sweet potato rust
Fungus	*Corticium rolfsii (*Sacc.)	Sclerotium rot, collar rot
Fungus	*Fusarium oxysporum*	Basal rot
Fungus	*Fusarium solani* (Mart.) Sacc	Fusarium root and stem rot
Fungus	*Lasiodiplodia theobromae*	Diplodia pod rot of cocoa
Fungus	*Macrophomina phaseolina*	Charcoal rot of bean/tobacco, ashy stem blight
Fungus	*Macrophomina* sp.	Charcoal rot
Fungus	*Phoma glomerata* (Corda) Wollenw. & Hoch.	Blight of grapewine
Fungus	*Phyllosticta batatas* (Thuemen) Cooke	Leaf spot of sweet potato
Fungus	*Plenodomus destruens* Harter	Foot rot
Fungus	*Rhizopus stolonifer* (Ehrenb.) Vuill.	Tuber rot
Fungus	*Rigidoporus microporus*	Root rot disease
Fungus	*Sclerotium rolfsii* (Sacc.)	Southern blight
Insect	-	Weevils
Insect	-	Whiteflies
Insect	*Acrospila tripunctata* (F.) *[=Pilocrocis tripunctata]*	Sweet potato leafroller
Insect	*Agrius cingulatus* (Fabricius)	Pink-spotted hawkmoth, sweet potato hornworm
Insect	*Aleurodicus dispersus*	Spiralling whitefly
Insect	*Aleurotrachelus trachoides*	Whitefly
Insect	*Aleurotrachylus* sp.	Whitefly
Insect	*Anasa scorbutica* (Fabricius)	Squash bug
Insect	*Aphis gossypii* (Glover)	Cotton aphid, melon aphid, betelvine aphid, green aphid, cucurbit aphid
Insect	*Aphis spiraecola*	Spirea aphid
Insect	*Araecerus fasciculatus*	Cocoa weevil
Insect	*Atta* sp.	Leaf-cutter ant
Insect	*Bemisia tabaci* (Gennadius)	Tobacco whitefly, cotton whitefly, cassava whitefly, sweet potato whitefly, silver leaf whitefly
Insect	*Brachmia convolvuii* Wa Isingham	Sweet potato leafroller
Insect	*Candotella jamaicensis*	Leaf beetle
Insect	*Ceratoma ruficornis* (Olivier)	Leaf beetle
Insect	*Cerconota anonella*	Soursop moth
Insect	*Ceroplastes cirripediformis* (Comstock)	Barnacle scale

Pest Type	Scientific name	Common name(s)
Insect	*Chaetanaphothrips orchidii* (Moulton)	orchid thrips, anthurium thrips; orchid thrips; banana red rust thrips; banana rust thrips; citrus rust thrips
Insect	*Chaetocnema confinis* Crotch	Sweet potato flea beetle
Insect	*Charidotella jamaicensis*	Leaf beetle
Insect	*Charidotella sexpunctata* (Fabricius) *[=Metriona/Charidotella bicolor]*	Southern golden tortoise bug
Insect	*Chelymorpha multipunctate*	Tortoise beetle
Insect	*Chirida signifera* (Herbst)	Beetle
Insect	*Coptocycla judaica* (Fabricius)	Mottled tortoise beetle
Insect	*Corecoris fuscus* (Thunberg)	leaf-footed bug
Insect	*Cylas formicarius* (Fabricius)	Sweet potato weevil
Insect	*Cylas formicarius elegantulus*	Sweet potato beetle
Insect	*Cylas formicarius elegantulus* (Summers)	sweet potato weevil
Insect	*Deloyala fuliginosa* (Oliver 1790)	Tortoise beetle
Insect	*Deloyala guttata* (Olivier)	Golden (tortoise) beetle
Insect	*Dendrothripoides innoxius*	Sweet potato thrips
Insect	*Diaprepes abbreviatus* (Linnaeus)	Citrus weevil
Insect	*Draeculacephala* spp.	Vampire leafhoppers
Insect	*Dysmicoccus brevipes* (Cockerell)	Pineapple mealybug)
Insect	*Empoasca fabae* (Harris)	Leafhopper
Insect	*Epitrix cucumeris (?)*	Black flea beetle
Insect	*Epitrix hirtipennis* (Melscheimer)	Tobacco flea beetle
Insect	*Epitrix parvula* (Fabricius)	tobacco flea beetle
Insect	*Euschistus servus* (Say)	Brown stink bug
Insect	*Euscepes batatae* (Waterhouse)	West Indian sweet potato weevil
Insect	*Euscepes porcellus* (Boheman)	West Indian sweet potato weevil
Insect	*Euscepes postfasciatus* (Fairmaire)	West Indian Sweet potato weevil, scarabee weevil
Insect	*Ferrisia virgata* (Cockerell)	Striped mealybug
Insect	*Frankliniella insularis* (Franklin)	Blossom thrips, flower thrips, Cuban flower thrips, West Indian bean-flower thrips
Insect	*Frankliniella occidentalis* Pergaude	Western flower thrips
Insect	*Frankliniella melanommatus* (Williams)	Flower thrips
Insect	*Heliothis virescens* (Fabricius)	Tobacco budworm
Insect	*Herpetogramma hipponalis* Walker	Green leaf roller
Insect	*Lerema accius* (J.E. Smith)	Clouded skipper, corn leaf-tier
Insect	*Ligyrus cuniculus* (Fabricius)	Rough black hard-back (PR)
Insect	*Liorhyssus hyalinus* (Fabricius)	Hyaline grass, bug
Insect	*Liriomyza sativae*	vegetable leaf miner
Insect	*Macrosiphum euphorbiae* (Thomas)	potato aphid, tomato aphid
Insect	*Megastes grandalis*	Sweet potato moth
Insect	*Metriona bicolor*	Tortoise beetle
Insect	*Metriona flavolineata* (Latreille)	Golden-striped tortoise beetle
Insect	*Microthyris anormalis*	Sweet potato leaf roller
Insect	*Microthyris prolongalis (?)*	Sweet Potato Leaf folder/webworm
Insect	*Mormidea ypsilon*	Stink bug
Insect	*Myzus persicae* (Sulzer)	Green peach aphid, peach curl aphid, cabbage aphid, tobacco aphid, potato aphid, green sesame aphid
Insect	*Naupactus [= Graphognathus]* spp.	White-fringed beetles
Insect	*Nemorimyza maculosa*	Chrysanthemum leaf miner
Insect	*Nezara viridula* (Linnaeus)	Green stink bug

Pest Type	Scientific name	Common name(s)
Insect	*Nipaecoccus nipae* (Maskell)	Spiked mealybug/coconut mealybug
Insect	*Omphisa anastomosalis*	Sweet Potato stem borer
Insect	*Palaeopus costicollis* (Marshall)	Yam weevil
Insect	*Peregrinus maidis* (Ashmead)	Cord delphacid
Insect	*Phyllobius pomaceus* Gyllenhal	Green weevil
Insect	*Phyllophaga smithi*	White grub
Insect	*Phyllophaga spp.*	White grubs
Insect	*Pilocrocis tripunctata* (Fabricius)	Sweet potato leaf roller
Insect	*Planococcus citri*	Citrus mealybug
Insect	*Pseudococcus jackbeardsleyi*	Jack Beardsley mealybug
Insect	*Ptericoptus sp.*	Long horned beetle
Insect	*Rhopalosiphum maidis*	Green corn aphid
Insect	*Rhyssomatus nigerrimus* (Fahraeus)	Curculionid beetle
Insect	*Scapteriscus* sp.	Mole crickets
Insect	*Schistocerca americana* (Drury)	American bird grasshopper
Insect	*Schistocerca* spp.	Grasshoppers
Insect	*Scirtothrips dorsalis*	Chilli thrips
Insect	*Spartocera batatas* F.	Giant sweet potato bug
Insect	*Spartocera fusca (?)*	Sweet potato stink bug
Insect	*Spodoptera dolichos*	Larger cotton cutworm
Insect	*Spodoptera eridania* (Stoll)	southern army worm
Insect	*Spodoptera frugiperda* (Smith)	Fall armyworm
Insect	*Spodoptera latifascia*	Lateral lined armyworm
Insect	*Systena s-littera*	Flea beetle
Insect	*Tenebrio molitor* (L.)	Darkling beetle
Insect	*Thyanta* spp.	Pentatomid stinkbugs
Insect	*Trialeurodes vaporariorum*	Whitefly, greenhouse
Insect	*Tribolium castaneum*	Red flour beetle
Insect	*Trichoplusia ni*	Cabbage looper
Insect	*Typohorus nigritus viridicyaneus* (Fabricius)	Black sweet potato beetle
Mite	*Aculops lycopersici*	Tomato russet mite
Mite	*Aculus lycopersici*	Tomato russet mite
Mite	*Aleurotrachelus trachoides*	Pepper whitefly
Mite	*Brevipalpus phoenicis* (Geijskes)	Red and black flat mite, false spider mite
Mite	*Eriophyes gastrotrichus* Nalepa	Gall mite
Mite	*Tetranychus cinnabarinus* (Boisd)	Carmine spider mite
Mite	*Tetranychus marianae*	Spider mite
Mite	*Tetranychus* spp.	Spider mites
Mite	*Tetranychus telarius* (Linnaeus)	red spider mite
Nematode	*Aphelenchoides besseyi*	Rice leaf nematode
Nematode	*Aphelenchus sp* (Bastian)	Fungivorous nematodes
Nematode	*Cacopaurus sp* (Thorne)	Sessile nematodes
Nematode	*Criconemoides sp* (Taylor)	Ring nematodes
Nematode	*Helicotylenchus dihystera*	Common spiral nematode
Nematode	*Helicotylenchus multicinctus*	Banana spiral nematode
Nematode	*Helicotylenchus nanus* (Steiner)	Spiral nematodes
Nematode	*Meloidogyne incognita*	Root-knot eelworm
Nematode	*Meloidogyne* sp. (Goeldi)	Root knot nematodes
Nematode	*Paratylenchus* sp. (Micoletzky)	Pin nematodes
Nematode	*Pratylenchus* sp. (Filipjev)	Lesion nematodes
Nematode	*Radopholus* sp. (Cobb) Thorne	Borrowing nematodes
Nematode	*Rotylenchus reniformis* (Linford & Oliveira)	Reniform nematode

Pest Type	Scientific name	Common name(s)
Nematode	*Xiphinema vulgare* (Tarjan)	Dagger nematode
Nematode	*Tylenchorynchus acutus* (Allen)	Stylet-stunt nematode
Nematode	*Tylenchorynchus* sp (Cobb)	Stunt nematodes
Nematode	*Xiphinema* sp. (Cobb)	Dagger nematodes
Oomycete	*Albugo ipomoeae* (Schwein.) Swingle	Common white blister
Oomycete	*Albugo ipomoeae-panduratae*	White rust
Virus	Caulimomosaic virus	-
Virus	Cucumber mosaic virus	Cucumber mosaic
Virus	LSU-2	-
Virus	SPCSV	-
Virus	SPFMV	-
Virus	SPVG	-
Virus	Sweet potato feathery mottle virus	-
Virus	Virus complex	-
Weed	*Emilia sonchifolia*	Consumption weed
Weed	*Synedrella nodiflora*	Cinderella weed

Appendix 2. List of pests of sweet potato regulated by countries in the Caribbean region

[Source: National Plant Protection Organisations of Member States]

Pest Type	Scientific name	Common name(s)
Fungus	*Cercospora batatae* Zimm.	Sweet potato leaf spot
	Elsinoe batatas (Saw.) Viegas & Jenkins	Leaf and stem scab
Insect	*Acromyrmex octospinosus* (Reich)	Leaf cutting ant
	Atta cephalotes (Linnaeus)	Bachac/Umbrella ant
	Atta sexdens (Linnaeus)	Acoushi ant
	Bedellia orchilella Walsingham	Sweet potato leafminer
	Cassida bivittata	Striped sweet potato beetle
	Chaetocnema confinis Crotch, 1873	Sweet potato flea beetle
	Conoderus rudis (Brown)	Wireworm
	Cylas formicarius (Fabricius)	Sweet potato weevil
	Diabrotica balteata (Leconte)	Banded cucumber beetle
	Megastes grandalis (Guence)	Sweet potato moth
	Omphisa anastomosalis Guenée	Sweet potato vine borer
	Palaeopus costicollis	Yam weevil
	Phenacoccus manihoti	Cassava mealybug
	Solenopsis invicta (Buren, 1972)	Red imported fire ant
	Strigoderma arboricola	Spring rose beetle
	Typophorus nigritus	Black sweet potato beetle
Mite	*Tetranychus cinnabarinus* (Boisduval)	Carmine spider mite
	Tetranychus tumidus Banks	Tumid spider mite
Mollusc	*Veronicella cubensis* (Pfeiffer)	Two-striped slug
Phytoplasma	Sweet potato witches broom (little leaf)	Sweet potato witches broom (little leaf)