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WHITE 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 WHITE POTATO

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Health and Food Safety Agency (RPPO)
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Contents

Adoption

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

INTRODUCTION

Scope

This guideline provides guidance to national plant protection organisations (NPPOs) within the Caribbean region for management of the risk of introduction of specific pests associated with cross-border movement of white potato tubers intended for consumption or processing. The guidance provided is intended to facilitate intra-regional trade of the commodity in the Caribbean region and applies to all varieties of white potato produced in the region.

The major pests of white potato as well as the 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 used in trade amongst Caribbean countries.

This guideline does not address issues related to living modified organisms, climate change, quality of the commodity, or diversion from intended use.

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 white potato tubers for export.

BACKGROUND

Description of white potato

The potato is one of the world's most important crop plants, the starchy tuber of the plant being used globally as a root vegetable. The plants are herbaceous perennials that grow about 24 inches high as a branched, bushy herb with underground stems which bear the edible tubers. The leaves die back after flowering, fruiting and tuber formation. The potato grows on any soil type with the exception of saline and alkaline soils. Naturally loose soils are best for tuber development; loamy, sandy loam soils that are rich in organic matter and a pH range of 4.2-8.2, with good drainage and aeration are most suitable.

The plant, though a temperate climate crop, grows under a diverse range of climatic conditions. The vegetative growth of the plant is best at a temperature of 24°C and tuber development is favoured by a temperature of 20°C. The potato crop can be grown up to an altitude of 3,000 meters above sea level. To achieve their yield potential, well-distributed rainfall of 500-700 mm in a growing period of 3-4.5 months is required.

The white potato tuber is a modified stem which develops by the swelling of the tip of the underground stem or stolon. The growing period varies depending on the cultivar, fertilization, pest attack, disease and weather conditions.

This guideline will focus on measures to facilitate intra-regional trade of white potato tubers grown in the Caribbean.

Identity

Preferred Scientific Name
***Solanum tuberosum* L.**
Preferred Common Name
Potato
Other Scientific Names
Solanum cultum (A. DC.) Berth.
Solanum esculentum Neck.
Solanum tuberosum subsp. *andigena* Hawkes
Solanum tuberosum subsp. *tuberosum* (L.) Hawkes

Taxonomic Tree

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphyllum: Angiospermae
Class: Dicotyledonae
Order: Solanales
Family: Solanaceae
Genus: *Solanum*
Species: *Solanum tuberosum*

Intended Use

The guideline covers white potato tubers for the intended purpose of consumption or for processing.

REQUIREMENTS

Pest risk analysis

The NPPO of the importing country should conduct PRA associated with white 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 white potato tubers

The potato is affected by a range of pathogens to include fungi, bacteria and viruses. Although some pests attack the foliage while others attack the tubers, many of the disease affecting the potato are soil or seed-borne and very difficult to control. Intensive potato cultivation provides an ideal environment for increase in pest and disease pressure, often leading to intensive use of harmful pesticides. The use of resistant potato varieties and improved cultural practices can help to reduce or eliminate many of the common pests of this commodity. An integrated pest management approach to crop pest management helps to significantly reduce the need for chemical inputs while increasing production.

Some of the important pests attacking the potato crop, or which serve as vectors for commonly transmitted pests, include late blight (*Phytophthora infestans*), pink rot (*Phytophthora erythroseptica*), early blight or target spot (*Alternaria solani*), wart, common scab (*Streptomyces scabies*), black scurf (*Rhizoctonia solani* [*Thanetophorus cucumeris*]), bacterial wilt (*Ralstonia solanacearum*), bacterial soft rot/black leg (*Erwinia carotivora*), viruses (potato leafroll luteovirus [PRLV], potato X potexvirus [PXV], and potato Y potyvirus [PVY]), cutworm, white grub, aphids (e.g., *Myzus persicae*), leaf hoppers, thrips, tuber moth, wireworms, mites, potato cyst nematode and root knot nematode.

For sustainable management of pests affecting production and storage of white potato, pest control must begin from selection of pest-free production sites; clean, certified planting material must be used. During production, pest management should be maintained through proper soil and nutrient management and judicious use of chemical control agents.

Table 1 is a list of pests associated with white potato in the Caribbean region 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 white potato tubers in trade and a description of the uncertainty.

Table 1. Pest groups associated with white potato grown in the Caribbean.

Pest Group	Family	Example species
Bacteria	Burkholderiaceae	*Ralstonia solanacearum* Race 3 (Smith) Yabuuchi *et al.*
Fungi	Pleosporaceae	*Phoma exigua var. foveata* (Foister) Boerema
	Synchytriaceae	*Synchytrium endobioticum* (Schilb.) Percival
Midges	Cecidomyiidae	*Contarinia maculipennis* Felt
		Prodiplosis longifila Gagné
Moths	Gelechiidae	*Keiferia lycopersicella* (Walsingham)
		Phthorimaea operculella (Zeller, 1873)
Nematodes	Heteroderidae	*Globodera pallida* (Wollenweber) Behrens
		*Globodera rostochiensis (*Wollenweber) Behrens
Oomycetes	Peronosporaceae	*Phytophthora infestans*
Slugs	Veronicellidae	*Vaginula plebeia* Fischer
Viruses	Potyviridae	Potato Virus Y
	Tombusviridae	Tomato bushy stunt tombusvirus (TBSV)
	Secoviridae	Tomato ringspot nepovirus
Wireworms	Elateridae	*Conoderus falli (*Lane)
		Conoderus rudis (Brown)

Table 2. Pests with uncertain association with white potato grown in the Caribbean.

Pest Group	Family	Pest	Description
Moth	Gelechiidae	*Tuta absoluta* (Meryick, 1917)	The larvae have a preference for the leaves and stems of potato but can also mine the tubers. The specific conditions under which the tubers would be attacked may differ between environments and this would have to be determined for the specific place of production.

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 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

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 (guided by CODEX standards[1]) to ensure suitability of white potato 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 packing house) in accordance with procedures established by the exporting NPPO.
- 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, transporting 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

[1] CODEX Alimentarius "Standard for Ware Potatoes CXS 339-2020". https://www.fao.org/fao-who-codexalimentarius/sh-proxy/es/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXS%2B339-2020%252FCXS_339e.pdf

to reduce or eliminate contamination of white potato tubers. Use of chemical treatments must be approved for use on commodities for consumption and should be applied strictly in keeping with established international standards on maximum residue levels (MRLs).

The potato is a nightshade in the genus *Solanum*, the vegetative and fruiting parts of which contain toxic compounds known as glycoalkaloids, the most prevalent of which are solanine and chaconine which is dangerous for human consumption. Glycoalkaloids are substances that occur naturally in the peel of potatoes, are toxic to humans at high levels, and are only partly broken down by cooking. Potato tubers that have been properly grown and stored produce glycoalkaloids in small enough amounts to be negligible to human health; however, if green sections of the plant, such as the sprouts and skin, are exposed to light, the tuber can accumulate a high enough concentration of this chemical to adversely affect human health.

Persons handling white potato in production and after harvest should be (made) aware of proper personal hygiene and apply good hygienic practices at all times.

Phytosanitary Measures

The tomato leafminer (*Tuta absoluta Meyerick*) and brown rot of potato (*Ralstonia solanacearum* race 3, Smith 1986) are two priority plants pests identified for the Caribbean region that are known to be associated with white potato and are of concern for trade in white potato tubers. Table 3 below provides information on pests associated with white potato tubers in the Caribbean region 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 demonstrated by the exporting country to manage the target pests or provide technical justification in support of requests to the exporting country for application 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)
Bacteria	Use of clean &/or resistant planting material, rogue symptomatic plants, GAPs
Fungi	PFA, PFPP, well-drained soil, crop rotation
Midges	GAPs, PFA, IPM (e.g., use of resistant planting material, biocontrol, etc.)
Moths	PFPP, ALPP, IPM, GAPs (host weed control, pre-planting field sanitation, etc.)
Nematodes	PFA, PFPP, Nematode certification of field, use of certified planting material
Oomycetes	PFA, PFPP, IPM (incl. use of resistant plant varieties), GAPs (good field sanitation, appropriate soil selection, irrigation management, etc.)
Slugs	GAPs
Viruses	IPM of vectors, ALPP, PFPP
Wireworms	PFA, PFPP, prophylactic chemical soil treatment prior to planting, avoid fields known to have prior infestation.

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

Site selection for the cultivation of white potato as well as proper field sanitation are particularly important in preventing or reducing the chances of infestation with soil-borne pathogens of quarantine significance as well as overwintering arthropod pests. Pest resistant potato varieties should be used where available. Fields selected for production of white potatoes should not be prone to flooding or waterlogging and, ideally, should not have been under production with other solanaceous crops for at least three years. Weed management prior to, and during production, should be a priority.

The enhancement of tuber dormancy and plant defoliation may be determined to be pre-harvest requirements. This may be achieved by the application of chemicals such as Maleic Hydrazide 14-21 days before the planned date for harvest. Persistent haulms may be treated with foliage desiccants such as Reglone about two weeks prior to the harvest date and desiccated materials removed.

Harvesting

White potatoes reach maturity and can be harvested 90-100 days after planting. Commercial harvesting of potato tubers is usually done with large potato harvesters. Harvesting for small scale production is often done manually or through the use of plows. Tubers should be harvested early in the morning or late in the afternoon when field temperatures are lower. Soil and other foreign matter adhering to the tubers should be removed prior to transporting them from the field.

Post-harvest handling and treatments

Handling and sorting

Care should be taken to reduce or prevent damage to the tubers during the harvesting process since these will allow the entry of pathogens. Tubers should be sorted while damaged, diseased or abnormally shaped ones should be removed.

Transportation

Vehicles used to transport white potato tubers should be clean and records should be kept of cleaning activities. Damage and loss incurred during non-refrigerated transport is caused mainly by mechanical damage and over-heating; in this regard, tubers should be kept as cool as possible before and during loading, transportation and unloading. The tubers should also be kept dry and transported during the cool of the day. Containers should not be overloaded, and closed, unrefrigerated vehicles should not be used to transport the tubers.

Curing

Potatoes are usually cured after harvesting in order to improve skin-set – the process by which the potato skin becomes resistant to skinning damage acquired during harvest and handling operations. The curing process allows for the skin to fully set and wounds to heal, thus

preventing water-loss and infection during storage. White potatoes are usually cured at relatively warm temperatures (10-16°C) with high humidity and good gas-exchange if possible.

Cleaning

Cleaning of potato tubers and all equipment and machinery used to harvest and process them is an important step in removing pest-harbouring plant residues and soil. Potable water should be used to conduct any necessary washing of tubers and equipment. The level of soil tolerance should be determined between the countries of import and export.

Storage

Any damage that is incurred during harvesting and transportation should be allowed to heal before the potato tubers are stored; it is recommended that tubers be kept for two to three weeks at a relative humidity of 90% and at a temperature ranging from 20-25°C to allow for suberization to occur.

To slow the natural process of sprouting, white potato storage facilities need to be carefully designed to ensure that the area is dark, well-ventilated, and maintained at appropriate temperatures near 4°C or 7-10°C for long and short-term storage, respectively. Under optimal conditions in commercial warehouses, white potato tubers can be stored for up to one year. Commercial storage and retrieval of white potatoes comprises several phases: drying surface moisture; wound healing at 85-95% relative humidity and temperatures below 25°C; a staged cooling phase; a holding phase; and a reconditioning phase involving the slow warming of the tubers. At various stages of commercial storage, mechanical ventilation is used to prevent condensation and carbon dioxide accumulation.

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 (to include sprout-inhibition of tubers); dismantling, repairing or cleaning; repacking; or blending. Additionally, the removal of soil and leaf material from the tubers and conveyances is pivotal in mitigating the movement of pests via these pathways. The choice of the treatment applied is the responsibility of the importing country, unless otherwise determined by legislation or international standards.

Specific treatments for white 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*).

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*).

Storage facilities, both on- and off-farm, should be approved and outfitted with the required cool stores and warehousing facilities linked to postharvest crop management. Fumigation should only be done when necessary and only by a licensed or trained operator. All fumigation instances, chemical agents used, and dates of application should be documented.

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

White potato tubers should be packaged using clean or new containers. Green onions are typically shipped in waxed cartons with easy opening tops for the addition of crushed ice to maintain optimal conditions for the commodity. Dry onions are generally packed in sacks or burlap bags.

A label to be affixed to each carton/container should clearly detail the name of the commodity and other relevant information, including but not limited to: the variety, the farmer's registration number, the name and address of the exporter, the harvest date, the packing date, the gross weight or net weight, and the names of the grower and the processor/exporter. Any other quantitative information should be also included on the label in keeping with the importing country's requirements.

Transportation

In the transportation of white potato tubers for consumption, all applicable handling, packaging and storage procedures must serve to prevent damage and proliferation of pests during the process.

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 white 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 white 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 ISPM 12 (*Phytosanitary certificates*). Re-exported consignments must be accompanied by (a copy of) the original phytosanitary certificate.

An additional declaration may be required by the country of import to verify compliance with the import requirements as specified by the importing country's NPPO.

For consignments of white potato tubers for consumption to receive 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 any 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 packaged in clean and new material (including packaging material used to prevent damage during transport)
- Be exported in a secure manner to prevent contamination.

White 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 white 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.

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 (containers, 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:

Container level security

- The commodity is fully enclosed in a container 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 containers having plastic liners or bags must be fully sealed. The overlapping folded edges of the plastic liner with the container lid on top would be considered fully sealed.

Pallet level security

Any pallets used should be compliant with ISPM 15 (*Regulation of wood packaging material in international trade*). For containers 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 containers 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 temperatures 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. Pack houses, 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 white 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 export system for white potato tubers. 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 white potato in the Caribbean region

[source: National Plant Protection Organizations of Member States]

Pest Type	Scientific name	Common name(s)
Bacterium	*Erwinia carotovora* subsp. *atroseptica*	Black leg
Bacterium	*Pseudomonas solanacearum*	Bacterial wilt
Bacterium	*Pseudomonas syringae*	Bacterial blast
Bacterium	*Ralstonia solanacearum*	Bacterial wilt
Bacterium	*Streptomyces scabies*	Common Scab
Fungus	*Alternaria solani*	Early blight
Fungus	*Athelia rolfsii*	collar rot
Fungus	*Colletotrichum coccodes*	leaf spot
Fungus	*Corticum solani*	Black scurf/stem canker
Fungus	*Didymella bryoniae*	Gummy stem blight
Fungus	*Didymella lycopersici*	canker of tomato
Fungus	*Erwinia caratovora*	Soft rot/black leg
Fungus	*Fusarium avenaceum*	Leaf necrosis
Fungus	*Fusarium coeruleum*	Dry rot
Fungus	*Fusarium oxysporum*	Wilt
Fungus	*Fusarium solani*	Stem rot, foot rot, tuber rot
Fungus	*Helminthosporium solani*	Silver scurf
Fungus	*Leveillula taurica*	Powdery mildew
Fungus	*Rhizoctona* sp.	Blight
Fungus	*Rhizoctonia solani*	Collar rot, root rot, damping off, wire stem
Fungus	*Rosellinia bunodes*	Black root rot
Fungus	*Spondylcladium atrovirens*	Silver scurf
Insect	*Anila infecta*	Cut worm
Insect	*Aphis craccivora* Koch	Ground/cowpea aphid
Insect	*Aphis gossypii*	Cotton aphid
Insect	*Aphis spiraecola*	Green citrus aphid
Insect	*Araecerus fasciculatus*	cocoa weevil
Insect	*Bemisia tabaci*	Tobacco whitefly
Insect	*Diabrotica balteata*	Banded cucumber beetle
Insect	*Diaprepes abbreviatus*	citrus weevil
Insect	*Dysmicoccus brevipes*	pineapple mealybug
Insect	*Edessa meditabunda*	green and brown stink bug
Insect	*Empasca fabae* (Harris)	Potato leaf hopper
Insect	*Epitrix hirtipennis*	Tobacco flea beetle
Insect	*Feltia subterranea*	Granulate cutworm
Insect	*Insignorthezia insignis*	greenhouse orthezia
Insect	*Keiferia lycopersicella*	Tomato pinworm
Insect	*Ligyrus tumulosus*	White grub
Insect	*Liriomyza sativae*	Vegetable leaf miner
Insect	*Liriomyza trifolii*	American serpentine leafminer

Pest Type	Scientific name	Common name(s)
Insect	*Macrosiphum euphorbiae*	Potato aphid
Insect	*Manduca sexta*	Tobacco hornworm (USA)
Insect	*Myzus persicae*	Green peach aphid
Insect	*Nipaecoccus nipae*	Spiked mealybug
Insect	*Orthezia insignis*	Greenhouse orthezia
Insect	*Phenacoccus madeirensis*	Madeira mealybug
Insect	*Phyllophaga smithi*	White grub
Insect	*Planococcus citri*	Citrus mealybug
Insect	*Polyphagotarsonemus latus*	Broad mite
Insect	*Prodenia* (Spodoptera) *ornithogalli*	Caterpillar
Insect	*Pseudococcus jackbeardsleyi*	Jack Beardsley mealybug
Insect	*Pseudococcus longispinus*	Long-tailed mealybug
Insect	*Rhopalosiphum maidis*	Green corn aphid
Insect	*Spodoptera eridania*	Southern armyworm
Insect	*Spodoptera frugiperda*	Fall armyworm
Insect	*Spodotera ornithogalli* (Guenee)	Yellow-striped armyworm
Insect	*Thrips palmi*	Melon thrips
Insect	*Thrips tabaci*	Onion thrips
Insect	*Trialeurodes vaporariorum*	Whitefly, greenhouse
Insect	*Trichoplusia ni*	Cabbage looper
Insect	*Xylomiges (Spodoptera) sunia*	Caterpillar
Nematode	*Helicotylenchus dihystera*	Common spiral nematode
Nematode	*Helicotylenchus pseudorobustus*	Spiral nematode
Nematode	*Longidorus*	Longidorids
Nematode	*Meloidogyne arenaria*	Peanut root-knot nematode
Nematode	*Meloidogyne incognita*	Root-knot nematode
Nematode	*Meloidogyne javanica*	Sugarcane eelworm
Nematode	*Pratylenchus coffeae*	Banana root nematode
Nematode	*Rotylenchulus reniformis*	Reniform nematode
Oomycete	*Phytophthora infestans*	Late Blight of potato
Virus	Cucumber mosaic virus	Cucumber mosaic
Virus	Potato virus X	Rugose mosaic
Virus	Potato virus Y	Potato mottle
Weed	*Datura stramonium*	Jimsonweed
Weed	*Emilia sonchifolia*	Consumption weed
Weed	*Parthenium hysterophorus*	Parthenium weed

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

[Source: National Plant Protection Organisations of Member States]

Pest Type	Scientific name	Common name(s)
Bacterium	*Ralstonia solanacearum* Race 3 (Smith) Yabuuchi *et al.*	potato brown rot
Fungus	*Phoma exigua var. foveata* (Foister) Boerema	potato gangrene
	Phytophthora infestans	Potato Late Blight
	Synchytrium endobioticum (Schilb.) Percival	potato wart
	Synchytrium endobioticum (Schilbersky) Percival	Potato wart disease
Insect	*Conoderus falli (*Lane)	Potato wireworm
	Conoderus rudis (Brown)	Wireworm
	Contarinia maculipennis Felt	Blossom midge
	Keiferia lycopersicella (Walsingham)	Tomato pin worm
	Phthorimaea operculella (Zeller, 1873)	Potato tuber worm
	Prodiplosis longifila Gagné	Citrus gall midge
Mollusc	*Vaginula plebeia* Fischer	Brown slug
Nematode	*Globodera pallida* (Wollenweber) Behrens	White tip nematode Golden nematode
	*Globodera rostochiensis (*Wollenweber) Behrens	Golden nematode
Virus	Potato Virus Y	
	Tomato bushy stunt tombusvirus (TBSV)	tomato bushy stunt virus
	Tomato ringspot nepovirus	tomato ringspot virus