

BANANA PLANTIN &



**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 BANANA & PLANTAIN

Produced by the Caribbean Agricultural
Health and Food Safety Agency (CAHFSA)
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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 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 plantain and banana fruit 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 banana and plantain produced in the region.

The major pests of banana and plantain 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 cannot 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 provides guidance on sampling, inspection and phytosanitary certification of banana and plantain fruit for export.

BACKGROUND

Description of banana and plantain

Bananas are elongated edible fruits which are botanically berries and are produced by several kinds of large herbaceous plants in the genus *Musa* classified under the family Musaceae. The plants, though tall as trees, are not woody but rather herbaceous. The herbaceous plants comprise a modified underground stem or rhizome, a false trunk or pseudostem, a network of roots, and a large flower stalk. The leaves of banana plants comprise a stalk or petiole, and a blade or lamina. A number of *Musa* cultivars bearing edible fruit have been developed with those bearing sweet fruit (that is, bananas) usually eaten raw, while the starchier varieties are referred to as plantains and are normally cooked before being eaten. The curved, elongated fruit is variable in size, color and firmness and has a soft flesh that is rich in starch and is covered with a rind that, when ripe, may be green, yellow, red, purple or brown.

Bananas, a tropical crop, grow in a wide variety of soils that are at least 60 centimeters (2 feet) deep, well drained/not compacted, and adequately fertilized; deep, rich loamy soils of pH ranging from 6-7.5 are most preferred. The crop grows best in a temperature range of 13-38°C and a relative humidity of 75-85%. The plants are susceptible to damage by high winds

exceeding 80 km per hour and thrive best in sheltered valleys that do not experience strong winds. Well-distributed rainfall averaging at least 1,750 mm per annum are best for banana and plantain cultivation. Altitudes not exceeding 300 meters are best for the crop.

The most widely distributed groups of cultivated bananas are derived from *Musa acuminata* Colla and *Musa balbisiana* Colla, either alone or in a number of hybrid combinations. *M. acuminata* Colla and *M. balbisiana* Colla are accepted scientific names for the ancestral species, while *Musa x paradisiaca* L. is used for the hybrid *M. acuminata* x *M. balbisiana*.

This guideline will focus on measures to facilitate intra-regional trade of plantain and banana fruit grown in the Caribbean.

Identity

Preferred Scientific Name
Musa x paradisiaca L.
Preferred Common Name
Banana
Other Scientific Names
Musa x sapientum

Taxonomic Tree

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Monocotyledonae
Order: Zingiberales
Family: Musaceae
Genus: *Musa*
Species: *Musa x paradisiaca*

Intended Use

The guideline covers banana and plantain fruit for the intended purpose of consumption or for processing.

REQUIREMENTS

Pest risk analysis

The NPPO of the importing country should conduct PRA associated with plantain and banana fruit 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 plantain and banana fruit

Several pests are of major phytosanitary significance to the production of all cultivars of banana and plantain.

Insects

The **banana weevil or banana borer**, *Cosmopolites sordidus*, is a principal pest of banana and plantain, along with the **banana stem weevil (banana pseudostem borer)**, *Odoiporus longicollis*; these pests can cause up to 90-100% yield loss depending on the crop growth stage and management efficiency.

Fungi

Panama disease caused by race 1 of a fusarium soil fungus causes wilting and eventual death of infected susceptible plants. A significantly more virulent form of Panama disease, known also as **Tropical race 4 (TR4)** and first reported in 1993, is highly transmissible and is of major phytosanitary importance in banana and plantain trade. **Black sigatoka**, another fungal disease, affects all main cultivars of banana and plantain, is spread through the movement of infected leaf material and fungal spores, and has become increasingly resistant to treatment.

Viruses

Banana bunchy top disease (BBTV) is the most important and widespread viral disease of banana and is vectored by the banana aphid, *Pentalonia nigronervosa*; the disease stunts the growth of leaves of infected plants and can be effectively controlled by the removal and destruction of infected plants and the use of clean planting materials. **Banana Streak Viruses (BSV)** are worldwide in distribution and affect a wide range of *Musa* genotypes, causing banana streak disease. BSV symptoms vary considerably, depending on the species and strain of the pathogen, the host cultivar, environment and the season. The disease may present in various forms from inconspicuous chlorotic flecking to lethal chlorosis, but the most common symptoms are chlorotic streaks and blotched leaves. Transmission of BSV is by citrus mealybugs but spread

is primarily through the multiplication and dissemination of infected planting material. Co-infection with **Banana Mild Mosaic Virus (BanMMV)** has been shown to increase the severity of the banana streak disease.

Bacteria

Banana bacterial wilt (BBW), caused by *Xanthomonas campestris* pv. *musacearum*, is known to be a pest of quarantine significance in banana and plantain production in parts of Africa and is considered to be a pest of significance internationally. Symptoms of this disease (BBW) are cultivar-specific and are determined by the stage and route of infection. **Moko disease** is a vascular wilt of bananas and plantains and is caused by strains of race 2 of *Ralstonia* (formerly *Pseudomonas*) *solanacearum*.

Nematodes

The **burrowing nematode**, *Radopholus similis*, is one of the most important root pathogens that attacks banana in the tropics. Destruction of hosts by these nematodes causes reduction of host growth and development, inclusive of uprooting and toppling of affected plants. *Pratylenchus* spp. are **root-lesion nematodes** which are major pests of *Musa* species along with **root-knot nematodes** (including *Meloidogyne* spp.). Root lesion and root-knot nematodes may be controlled through the use of nematicide applications as well as planting of clean, pest-free materials.

Table 1 is a list of pests associated with banana and plantain 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. Appropriate measures necessary to reduce the risk of the uncertainty may be taken. In Table 2, included is a list of pests for which there is uncertainty in the Caribbean as to association with plantain and banana fruit in trade and a description of the uncertainty.

Table 1. Pest groups associated with banana and plantain grown in the Caribbean.

Pest Group	Family	Example species
Aphids	Aphididae	<i>Pentalonia nigronervosa</i>
Bacteria	Burkholderiaceae	<i>Ralstonia solanacearum</i> (E.F. Smith) <i>Ralstonia solanacearum</i> race 2 (Smith)
	Xanthomonadaceae	<i>Xanthomonas campestris</i> pv. <i>musacearum</i> (Dagnachew and Bradbury) Dye
Beetles	Chrysomelidae	<i>Colaspis hypochlora</i> (Lefevre)
	Curculionidae	<i>Rhynchophorus palmarum</i>
Fruitflies	Tephritidae	<i>Bactrocera dorsalis</i> (Hendel)
Fungi	Mycosphaerellaceae	<i>Mycosphaerella eumusae</i> (Crous & Mourichon) <i>Mycosphaerella fijiensis</i>
Mites	Tenuipalpidae	<i>Raoiella indica</i> Hirst
	Tetranychidae	<i>Tetranychus cinnabarinus</i> (Boisduval)
Mollusc	Veronicellidae	<i>Veronicella cubensis</i> (Pfeiffer)
Moths	Noctuidae	<i>Spodoptera litura</i> (Fabricius)
Nematode	Hoplolaimidae	<i>Helicotylenchus multicinctus</i> (Cobb)
	Pratylenchidae	<i>Radopholus citrophilus</i> Huettel, Dickson and Kaplan, 1984
Stem borer	Castniidae	<i>Castnia licoides</i> (<i>Castniomera licus</i>) (Drury)
Thrips	Thripidae	<i>Chaetanaphothrips signipennis</i> (Bagnall)
		<i>Elixothrips brevisetis</i> (Bangnall)
		<i>Thrips hawaiiensis</i> (Morgan, 1913)
Virus	Potyviridae	Banana Bract Mosaic Virus (BBrMV)
	Nanoviridae	Banana bunchy Top Virus (BBTV)
	Caulimoviridae	Banana Streak Virus (BSV)
	Betaflexiviridae	Banana Virus X (BVX) Banana Mild Mosaic Virus (BanMMV)
	?	Banana Dieback Virus (BDBV)
Weevils	Curculionidae	<i>Asynonychus godmanni</i> (Boheman)

Table 2. Pests with uncertain association with banana and plantain grown in the Caribbean.

Pest Group	Family	Pest	Description
Fruitflies	Tephritidae	<i>Ceratitis capitata</i>	The Mediterranean fruitfly rarely infests <i>Musa</i> spp. In the absence of the pest, not much can be said about the behavior of this pest and its preferred hosts were it to become established within the Caribbean region.
Fungi	Nectriaceae	<i>Fusarium oxysporum</i> f.sp. <i>cubense</i> (Fusarium wilt Tropical Race 4)	Little is known of how the pathogen reaches the aerial components of the plant since it is primarily a soil fungus. Research is ongoing as to the nature of transmission of the pathogen to the aerial plant parts.

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 standards¹) to ensure suitability of plantain and banana fruit 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.

¹ CODEX Alimentarius “Fresh Fruits and Vegetables”.
<https://www.fao.org/3/a1389e/a1389e00.htm>

Sanitary (Food Safety) Measures

Food contamination can be caused in several ways, the main types of which are microbial, 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 to reduce or eliminate contamination of plantain and banana fruit. Use of chemical treatments must be approved for use on commodities for consumption and should be applied strictly in accordance with established international standards on maximum residue levels (MRLs).

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

Phytosanitary Measures

Fusarium oxysporum f. *ubense* race 4 (*Foc* TR4; Panama disease tropical race 4) and *Ralstonia solanacearum* race 2 (moko disease) are two priority plants pests identified for the Caribbean region that are known to be associated with banana and plantain and are of concern for trade in plantain and banana fruit. *F. oxysporum* tropical race 4 is soil-borne and there is no evidence, despite the spread of the disease, that it is spread through the transportation of banana and plantain fruit. Table 3 below provides information on pests associated with plantain and banana 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	PFA, PFPP, vector management, GAPs (disinfection of cutting tools, field sanitation, selection of disease-free planting material), exclusion of leaf material
Fungi	Use of resistant varieties, cultural & chemical control, use of efficient drainage and irrigation, multicropping, plant in locations at or exceeding 2000 meters above sea level, elimination of plantain & banana plant material from fruit consignment.
Aphids	ALPP, IPM, chemical dipping
Beetles	Use of resistant planting material, crop rotation, chemical dip of fruits, IPM (incl. proper cultural practices [e.g., elimination of weeds from, and adequate drainage of, the field; allowing sufficient sunlight to penetrate the canopy] & chemical control)
Fruitflies	PFA, PFPP
Mites	ALPP, IPM, Exclusion of leaf material from consignment, washing of fruit
Molluscs	IPM, visual inspection & washing of fruit
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, exclusion of all other plant parts, use of marigold as a trap crop; application of suitable nematicide at planting & 4 months after planting; weed management
Stem borers	ALPP, IPM, chemical dip
Thrips	PFA, PFPP, IPM, chemical dip, exclusion of leaf material, use of chlorpyrifos-impregnated bunch covers soon after bunch emergence
Viruses	IPM of vectors, ALPP, PFPP, PFA, phytosanitation (e.g., use of disease-free planting material, restriction of movement of infected plant material, field sanitation), & management of alternate hosts near the production area
Weevils	ALPP, chemical dip, exclusion of soil & leaf material

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

Production sites selected should have a history of freedom from pests of quarantine significance for the best outcome of the banana and plantain crop. Pest-free planting material and pest resistant cultivars should be used where possible and/or available in keeping with market requirements. Fields should be scouted for signs of pests (including weeds) and appropriate actions taken to manage these pests. Weeds such as water grass (e.g., *Commelina diffusa* and *C. elegans*) are nematode hosts and should be controlled. Plants should be well-spaced, and well irrigated and fertilized to optimize productivity. All tools and equipment used in the production process should be disinfected to prevent spread of disease from one place of production to another.

Relatively good control of thrips is obtained if bunches of fruit are treated with appropriate pesticides (e.g., 0.2% monocrotophos) after the emergence of all hands of the fruit on the bunch. The TR4 strain of the *Fusarium* fungus has no cure, and although the disease is not known to be present in the Caribbean region, it is important that producers are trained on the best containment measures should the disease appear. The main contributor to spread of the pathogen is human travel, and as a precaution, it is important to guarantee adequate hygiene (e.g., removal of soil and decontamination of shoes, clothes and tools) amongst people closely involved in banana farming.

Harvesting

Fruit that has been compromised at harvest are more susceptible to post-harvest losses due to disease development while in storage and during transport. Banana and plantain fruits for

export are harvested before the fruit is mature and while still green (that is, at physiological maturity) as part of the process of preventing premature ripening and reduction of the shelf life. In very hot weather, bananas should be harvested during the coolest part of the day. The fruit can be harvested by cutting the stalk when the fruit are plump but green; hands of fruit to be tree-ripened should be cut one hand at a time as they ripen and the stalks should be checked daily for rodent feeding damage. Any fruits that have been contaminated by faecal matter should not be harvested.

Harvested bunches should be collected in containers that are well padded to help to reduce damage to the fruit. Due to the perishable nature of the crop, the timing of harvesting and transportation is of utmost importance.

Post-harvest handling and treatments

Handling and sorting

Banana and plantain fruit are susceptible to impact injury and abrasion which could permit contaminant and/or pest entry and subsequent decay. The harvested fruit must therefore be handled with care and should be kept out of light to reduce the rate of ripening. Once harvested, damaged and over-mature fruit should be discarded. To help prevent damage to the skin of the fruit, wad wrapping and polythene bags are commonly used in the handling of the fruit after harvesting. Harvested banana and plantain should be cooled within 10-12 hours of the bunches being harvested.

In order to restrict crown disease development in the hands once they have been cut from the bunch and after the latex has been allowed to drain and the fruit have been washed, it is recommended that they are dipped in a 0.1% solution of an approved fungicide.

Transportation

Vehicles used to transport plantain and banana fruit should be clean and records should be kept of all such cleaning activities. Transportation vehicles should also be outfitted to prevent pest entry subsequent to post-harvest treatment. Transport of harvested fruit should be done as quickly as possible and the fruit should ideally be kept at temperatures between 13.5 and 15°C.

Cleaning

Cleaning of banana and plantain fruit and all equipment and machinery used to harvest and process them is an important step in removing pest-harboring plant residues and soil. Fruits should be cleaned in running water or washed in a solution (e.g., 2% alum, 20% chlorine) to sterilize the fruit and prevent the latex from cut fruit staining the peel; the fruit can then be treated with thiobendazole or other approved chemical. Potable water should be used to conduct any necessary washing or treatment of the fruit. After washing and/or treatment, fruit should be air-dried.

Storage

The process of careful handling of the fruit, rapid transport to the place of export, cooling and refrigeration at optimal temperatures allows storage and transport of the fruit for periods of up to 4 weeks at 89-90% relative humidity. Humidity may be controlled with the help of a humidistat and can be raised in the storage container or room by spraying the fruit intermittently with water in a fine mist; conversely, humidity may be reduced by venting. Controlled atmosphere and modified atmosphere storage of banana and plantain fruit has been shown to reduce mechanical damage, avoid fungal infection, and increase the shelf life of the fruit while in storage.

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. Additionally, the removal of soil and leaf material from the fruit 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 in keeping with international standards. The process of treatments should be guided by ISPM 28 (*Phytosanitary treatments for regulated pests*).

Specific treatments for plantain and banana fruit 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. Wherever the option is available, 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*).

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.

Banana and plantain fruit should be immersed in an insecticidal solution (2 tsp. liquid soap: 1 gallon water OR 13 fl. oz. bleach: 1 gallon water) for 3 minutes OR subjected to an importing NPPO-approved equivalent.

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

Plantain and banana fruit should be packaged using clean or new containers. When packing in boxes, the hands of the fruit should be arranged horizontally, keeping the crown ends towards the base of the box and the fruit tips pointing upwards and towards the centre of the box. Boxes used for packaging should preferably be lined with 100-gauge low density polyethylene (LDPE) liners to create a modified atmosphere, particularly for banana fruit.

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 plantain and banana fruit for consumption, all applicable handling, packaging and storage procedures must serve to prevent damage and proliferation of pests during the process. During the shipping process, banana and plantain fruit should not be placed in areas with extreme temperatures. The cartons should not be dropped, thrown, packed in inverted position, rolled or tipped.

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 plantain and banana fruit 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 plantain and banana fruit to verify conformance with importing requirements and freedom from quarantine pests. Each consignment must be visually inspected in keeping with official phytosanitary procedures detailed in ISPM 23 (*Guidelines for inspection*) and ISPM 31 (*Methodologies for sampling of consignments*) for all pests of banana and plantain regulated in the Caribbean region.

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 that not more than 0.5% of the units in the consignment are infested as set out in ISPM 31 (*Methodologies for*

sampling of consignments Appendix 2), 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 example, an additional declaration could be as follows: “Fruits of *Musa* species were harvested from areas officially designated free from *Ralstonia solanacearum* and were prepared in accordance with conditions outlined in Permit No. XXXX”.

For consignments of plantain and banana fruit 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 unapproved 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.

Plantain and banana fruit 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 plantain and banana fruit 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 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:

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 container 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 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 least 0.5m 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 plantain and banana fruit 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 plantain and banana fruit. 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.

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APPENDICES

Appendix 1. List of pests found on banana and plantain in the Caribbean region

[source: National Plant Protection Organizations of Member States]

Pest Type	Scientific name	Common name(s)	Host ²
Bacterium	<i>Erwinia musae</i> (?)	Pseudostem heart rot	Banana
Bacterium	<i>Fusarium moniliforme</i> Sheldon	Bacterial head rot	Banana
Bacterium	<i>Pseudomonas solanacearum</i> race 2	Moko disease	Banana
Bacterium	<i>Ralstonia solanacearum</i> race 2	Moko Disease	Banana, plantain
Bacterium	<i>Ralstonia solanacearum</i> race 2 (biovar 1)	Bacterial wilt, Moko disease	Banana, Plantain
Fungus	<i>Athelia rolfsii</i>	sclerotium rot	Banana
Fungus	<i>Botryodiplodia theobromae</i> (Pat.)	Fruit rot	Banana, Plantain
Fungus	<i>Colletotrichum musae</i>	Anthracnose, tip rot of banana	Banana, Plantain
Fungus	<i>Cordana musae</i>	Cordana leafspot	Banana, Plantain
Fungus	<i>Corynespora torulosa</i> (Deightonella torulosa)	leaf speck	Banana
Fungus	<i>Fusarium oxysporum</i>	basal rot	Banana, plantain
Fungus	<i>Fusarium oxysporum</i> f. sp. cubense (E.F. Smith) Snyder and Hansen	Panama Disease or Fusarium Wilt	Banana, plantain
Fungus	<i>Fusarium</i> spp.	Crown rot	Banana, Plantain
Fungus	<i>Gleosporium musarum</i> (Cke & Masse.)	Anthracnose	Banana, Plantain
Fungus	<i>Glomerella cingulata</i>	anthracnose	Banana
Fungus	<i>Lasiodiplodia theobromae</i>	diplodia pod rot of cocoa	Banana, plantain
Fungus	<i>Mycosphaerella fijiensis</i> Morelet	Black Sigatoka or Black Leaf Streak	Banana, plantain
Fungus	<i>Mycosphaerella musicola</i> Leach	Yellow Sigatoka	Banana, Plantain
Fungus	<i>Phoma musicola</i>	leaf spot	Banana
Fungus	<i>Pseudocercospora musaea</i> (syn. <i>Mycosphaerella musicola</i>)	Yellow sigatoka	Banana, Plantain
Fungus	<i>Rosellinia bunodes</i>	black root rot	Banana, plantain
Fungus	<i>Sclerotium rolfsii</i>	Pseudo-trunk breakage	Banana, plantain
Fungus	<i>Thanatephorus cucumeris</i>	many names, depending on host	Banana
Fungus	<i>Verticillium theobromae</i>	Cigar tip	Banana, plantain
Fungus	<i>Zasmidium musae</i> (syn. <i>Stenella musae</i>)	leaf speck	Banana
Insect	<i>Alegoria dilatata</i> Cast.	beetle	Banana, plantain
Insect	<i>Aleurocanthus woglumi</i>	citrus blackfly	Banana, plantain
Insect	<i>Aleurodicus cocois</i>	coconut whitefly	Banana
Insect	<i>Aleurodicus dispersus</i>	Spiraling whitefly	Banana, Plantain
Insect	<i>Aonidiella aurantii</i>	red scale	Banana, plantain
Insect	<i>Aonidiella orientalis</i>	oriental yellow scale	Banana, plantain

² As declared by BMCs

Pest Type	Scientific name	Common name(s)	Host ²
Insect	<i>Aonidomytilus (Lepidosaphes) albus</i>	Cassava stem mussel scale	
Insect	<i>Aphis gossypii</i>	Cotton aphid	Banana, Plantain
Insect	<i>Aspidiotus destructor</i> (Sign.)	coconut scale	Banana, plantain
Insect	<i>Bactrocera dorsalis</i>	Oriental fruit fly	Banana, Plantain
Insect	<i>Ceroplastes cirripediformis</i>	Barnacle scale	
Insect	<i>Ceroplastes floridensis</i>	soft scale	Banana, plantain
Insect	<i>Chaetanaphothrips clarus</i> (Moulton)	Banana thrips, rust thrip	Banana, plantain
Insect	<i>Chaetanaphothrips leeuweni</i>	Rust thrips of banana	banana
Insect	<i>Chaetanaphothrips orchidii</i>	Anthurium thrips	banana
Insect	<i>Chaetanaphothrips signipennis</i>	Banana Rust Thrips	banana
Insect	<i>Chrysomphalus aonidum</i> (L.)	Black scale	banana
Insect	<i>Chrysomphalus dictyospermi</i>	dictyospermum scale	Banana, plantain
Insect	<i>Coccus hesperidum</i>	brown soft scale	Banana, plantain
Insect	<i>Colaspis hypochlora</i>	Banana Fruit Scarring Beetle	banana
Insect	<i>Corynethrips stenopterus</i>	Thrips	
Insect	<i>Cosmopolites sordidus</i> (Germ.)	Banana root borer/weevil	Banana, plantain
Insect	<i>Danothrips trifasciatus</i> Sakimura	Rust thrip	Banana
Insect	<i>Diaprepes abbreviatus</i>	citrus weevil	Banana
Insect	<i>Diaspis boisduvalii</i>	Boisduval scale	banana
Insect	<i>Dysmicoccus brevipes</i>	pineapple mealybug	Banana, plantain
Insect	<i>Dysmicoccus neobrevipes</i>	grey pineapple mealybug	Banana, plantain
Insect	<i>Erinnyis ello</i>	Cassava hornworm	
Insect	<i>Ferrisia virgata</i>	striped mealybug	Banana, plantain
Insect	<i>Frankliniella insularis</i> Franklin	Flower thrip	Banana
Insect	<i>Frankliniella melanommata</i>	Thrips	
Insect	<i>Frankliniella parvula</i> (Hood)	Banana flower thrips	Banana, plantain
Insect	<i>Hemiberlesia lataniae</i>	latania scale	Banana, plantain
Insect	<i>Lachnosterna (Phyllophaga) sp.</i>	White grub	Banana, plantain
Insect	<i>Lagochirus araneiformis</i>	Beetle borer	
Insect	<i>Lepidosaphes beckii</i>	purple scale	Banana, plantain
Insect	<i>Leptopharsa illudens</i>	Cassava lacewing bug	
Insect	<i>Ligyris ebenus</i> (Degeer)	Black sugarcane chafer	Banana, plantain
Insect	<i>Longchaea chalybea</i>	Cassava shoot fly	
Insect	<i>Maconellicoccus hirsutus</i>	pink hibiscus mealybug	Banana, plantain
Insect	<i>Metamasius hemipterus</i> (L)	Silky cane weevil	Banana, plantain
Insect	<i>Metamasius maurus</i>	Bromeliad weevil	Banana, plantain
Insect	<i>Nezara viridula</i>	Green stink bug	
Insect	<i>Nipaecoccus nipae</i> (Mask.)	spiked mealybug	Banana, plantain
Insect	<i>Opatrinus gemellatus</i>	Darkling beetle	Banana, plantain
Insect	<i>Paracoccus marginatus</i>	papaya mealybug	Banana, plantain
Insect	<i>Parlagena benetti</i>	White mealybug	Banana
Insect	<i>Pentalonia nigronervosa</i> Coq.	Banana aphid	Banana, plantain
Insect	<i>Phyllophaga smithi</i>	white grub	Banana
Insect	<i>Pinnaspis strachani</i>	lesser snow scale	Banana
Insect	<i>Planococcus citri</i>	citrus mealybug	Banana, plantain

Pest Type	Scientific name	Common name(s)	Host ²
Insect	<i>Polytus mellerborgii</i> (Bol.)	Small banana weevil	Banana, plantain
Insect	<i>Pseudaulacaspis pentagona</i>	Scale	
Insect	<i>Pseudaulacaspis tubereularis</i>	Scale	
Insect	<i>Pseudococcus aonidium</i> (L.)	mealybug	Banana, plantain
Insect	<i>Pseudococcus elisae</i>	banana mealybug	Banana, plantain
Insect	<i>Pseudococcus jackbeardsleyi</i>	Jack Beardsley mealybug	Banana, plantain
Insect	<i>Saissetia coffeae</i> (hemisphaerica)	Scale	
Insect	<i>Selenaspis albus</i> McKenzie	White euphorbia scale	Banana, plantain
Insect	<i>Selenaspis articulatus</i> Morgan	West Indian red scale	Banana, plantain
Insect	<i>Spodoptera eridania</i>	southern armyworm	Banana, plantain
Insect	<i>Spodoptera frugiperda</i>	fall armyworm	Banana, plantain
Insect	<i>Tapinoma melanocephalum</i>	ghost ant	Banana, plantain
Insect	<i>Thrips florum</i>	Banana Flower Thrips	banana
Insect	<i>Trialeurodes vaporariorum</i> (Westwood)	Greenhouse whitefly	Plantain
Insect	<i>Unaspis citri</i>	Citrus snow scale	banana
Mite	<i>Roiella indica</i> Hirst	Red Palm Mite	Banana, plantain
Mite	<i>Tetranychus abacae</i>	Spider mite	Banana, plantain
Mite	<i>Tetranychus lambi</i>	Red Spider Mite	banana
Mite	<i>Tetranychus urticae</i> Koch	Spider mite	banana
Mollusc	<i>Lissachatina fulica</i>	Giant African land snail	Banana
Nematode	<i>Bitylenchus iphilus</i>	Stunt nematode	Banana
Nematode	<i>Bitylenchus maximus</i>	Stunt nematode	Banana
Nematode	<i>Helicotylenchus dihystera</i>	Common spiral nematode	Banana, plantain
Nematode	<i>Helicotylenchus erythrinae</i>	Spiral nematode	banana
Nematode	<i>Helicotylenchus multicinctus</i>	Banana spiral nematode	Banana, plantain
Nematode	<i>Helicotylenchus pseudorobustus</i>	Spiral nematode	banana
Nematode	<i>Helicotylenchus spp.</i>	Spiral nematodes	banana
Nematode	<i>Hemicriconemoides mangifera</i>	Ring nematode	Banana, plantain
Nematode	<i>Hoplolaimus para robustus</i> (Stekhoven & Teunissen) Sher.	Lance nematode	Banana, plantain
Nematode	<i>Longidorus laevicapitatus</i>	Needle nematode	Banana, plantain
Nematode	<i>Macroposthonia peruensis</i>	Ring nematode	Banana, plantain
Nematode	<i>Meloidogyne incognita</i> (Kofoid & White) Chitwood	Root knot nematode	Banana, plantain
Nematode	<i>Meloidogyne javanica</i>	Sugarcane eelworm	banana
Nematode	<i>Peltamigratus luci</i>	-	Banana, plantain
Nematode	<i>Pratylenchus coffeae</i>	Banana root nematode	Banana, plantain
Nematode	<i>Pratylenchus goodeyi</i>	Root lesion nematode	banana
Nematode	<i>Radopholus similis</i>	Burrowing nematode	Banana, plantain
Nematode	<i>Rotylenchulus reniformis</i>	Reniform nematode	banana
Nematode	<i>Xiphinema americanum</i>	Dagger nematode	Banana, plantain
Nematode	<i>Xiphinema macrostylis</i>	Dagger nematode	Banana, plantain
Nematode	<i>Xiphinema vulgare</i>	Dagger nematode	Banana, plantain
Virus	Banana Streak Virus	Banana stripe virus	Banana, plantain
Virus	Cucumber mosaic virus	cucumber mosaic	Banana

Appendix 2. List of pests of banana and plantain regulated by countries in the Caribbean region

[Source: National Plant Protection Organisations of Member States]

Pest Type	Scientific name	Common name(s)	Host
Bacteria	<i>Ralstonia solanacearum</i> (E.F. Smith)	Moko disease or bacterial wilt	Banana
	<i>Ralstonia solanacearum</i> race 2 (Smith)	Moko Disease	All
	<i>Xanthomonas campestris</i> pv. <i>musacearum</i> (Dagnachew and Bradbury) Dye	Banana xanthomonas wilt (BXW)	
Fungus	<i>Fusarium oxysporum</i> f.sp. <i>cubense</i> (Foc)	Fusarium wilt of bananas and plantains-Tropical Race 4	All
	<i>Mycosphaerella eumusae</i> (Crous & Mourichon)	Mycosphaerella leaf spot disease of bananas	Banana
	<i>Mycosphaerella fijiensis</i>	Black Sigatoka Race 4	Banana
Insect	<i>Asynonychus godmanni</i> (Boheman)	Fuller's rose weevil	
	<i>Batrocera dorsalis</i> (Hendel)	Oriental Fruit fly	
	<i>Castnia licoides</i> (<i>Castniomera licus</i>) (Drury)	Giant moth borer (banana stem borer)	
	<i>Chaetanaphothrips signipennis</i> (Bagnall)	Banana Thrips	
	<i>Colaspis hypochlora</i> (Lefevre)	Banana fruit scarring beetle	
	<i>Elixothrips brevisetis</i> (Bangnall)	Banana rind thrips	Banana
	<i>Pentalonia nigronervosa</i>	Banana aphid	
	<i>Rhynchophorus palmarum</i>	Palm weevil	
	<i>Spodoptera litura</i> (Fabricius)	Cluster caterpillar	Banana
	<i>Thrips hawaiiensis</i> (Morgan, 1913)	Hawaiian flower thrips	All
Mite	<i>Tetranychus cinnabarinus</i> (Boisduval)	Carmine spider mite	Banana
Mollusc	<i>Veronicella cubensis</i> (Pfeiffer)	Two-striped slug	Banana
Nematode	<i>Helicotylenchus multincinctus</i> (Cobb)	Banana spiral nematode	All
	<i>Radopholus citrophilus</i> Huettel, Dickson and Kaplan, 1984	Burrowing nematode	Banana
Virus	Banana Bract Mosaic Virus	BBrMV	
	Banana Bunchy Top Virus	BBTV	All
	Banana Dieback Virus	BDBV	All
	Banana Mild Mosaic Virus	BMMV	All
	Banana Mosaic Virus	-	
	Banana Streak Virus	BSV	
	Banana Virus X	BVX	All