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CARIBBEAN AGRICULTURAL HEALTH & FOOD SAFETY AGENCY

CARIBBEAN DEVELOPMENT BANK

CRUCIFEROUS VEGETABLES & LETTUCE

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 CRUCIFEROUS VEGETABLES & LETTUCE

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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 cruciferous vegetables and lettuce intended for consumption or processing. The guidance provided is intended to facilitate intra-regional trade of the commodities in the Caribbean region and applies to all varieties of cruciferous vegetables and lettuce produced in the region.

The major pests of cruciferous vegetables and lettuce 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 conform 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 cruciferous vegetables and lettuce for export.

BACKGROUND

Description of cruciferous vegetables and lettuce

Cruciferous vegetables are vegetables classified mainly in the Brassicaceae (or Cruciferae) family, many of which have been cultivated for food production, inclusive of cauliflower, cabbage, kale, garden cress, bok choy, broccoli, Brussel sprouts and the mustard plant. These vegetables can be grown on a wide range of well-drained soils and locations and within a pH range of 6.0 – 6.8. Plants require between 1 and 2 inches of water in a week and an optimal temperature range of 60 – 85°F.

Lettuce (*Lactuca sativa*) is a plant of the daisy family, Asteraceae, and is consumed generally in its raw state as a leaf vegetable. The plant is an annual and grows in almost all areas of the world. The height and spread of lettuce plants range from 15 to 30 cm, the leaves are often in the green and red color spectrums, and some varieties are variegated. Lettuce leaves have a range of shapes and textures and a root system consisting of a tap root and smaller secondary roots. From planting to harvest, field grown lettuce live from 65 – 130 days, depending on the

variety and the time of year. Lettuce grows best in full sunlight and prefers loose, nitrogen-rich soils with a pH range of 6.0 to 6.8 and temperatures ranging from 16 – 18ºC (61 to 64ºF).

This guideline will focus on measures to facilitate intra-regional trade of cruciferous vegetables and lettuce grown in the Caribbean.

Identities

Preferred Scientific Name
Brassicaceae
Preferred Common Name
Cruciferous crops
Other Scientific Names
Cruciferous crops
Cruciferae Juss.

Preferred Scientific Name
***Lactuca sativa* L.**
Preferred Common Name
Lettuce
Other Scientific Names
-

Taxonomic Trees

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphyllum: Angiospermae
Class: Dicotyledonae
Order: Capparidales
Family: Brassicaceae

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphyllum: Angiospermae
Class: Dicotyledonae
Order: Asterales
Family: Asteraceae
Genus: *Lactuca*
Species: *Lactuca sativa*

Intended Use

The guideline covers cruciferous vegetables and lettuce for the intended purpose of consumption or for processing.

REQUIREMENTS

Pest risk analysis

The NPPO of the importing country should conduct PRA associated with cruciferous vegetables and lettuce 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 in which the commodity originates.

Pests of phytosanitary significance affecting trade in cruciferous vegetables & lettuce

Several pests are of major phytosanitary significance to the production of all cultivars of cruciferous vegetables and lettuce.

Pests of cruciferous vegetables

A number of pests are known to affect cruciferous crops and could significantly affect yield of marketable produce which meet requirements for trade. Some of these pests are described below.

BACTERIA

Black rot of crucifers is caused by *Xanthomonas campestris* pv. *campestris* and is a destructive disease affecting all cultivated crucifers in areas infested by the pathogen. Symptoms of initial infection are small, yellow-brown, V-shaped at the leaf margins which, as they enlarge, turn nearby veins black; affected leaf tissues dry out and turn brown. The bacterium may survive in infested crop residue and spread by splashing water, mechanical spread, insects and handling infected plants. Infection and spread are favoured by wet weather and temperatures ranging from 80-86°F.

FUNGI

Alternaria leaf spot is a fungal disease caused by *Alternaria brassicae*. Symptoms manifest as round, brown lesions on leaves and oval or elongated lesions on stems. The lesions can enlarge and are characterized by the presence of concentric rings within the dead tissue. Infection on the head of cauliflower, for example, results in smaller brown or black lesions which ruin the appearance of the vegetable. In warm, wet conditions, lesions produce spores that may be windblown or rain-splashed to other locations or crops. The disease persists in infested crop residue.

Fusarium yellows disease is another fungal disease affecting susceptible cruciferous vegetables such as cabbage and is caused by *Fusarium oxysporum conglutinans*. Symptoms of the disease are seen within two to four weeks after transplanting and comprise of a dull cast to the entire plant while the lower leaves turn yellow-green in colour. The pathogen can survive in an infested field for many years, even in the absence of host plant debris. Infection is favoured by warm soil temperatures ranging from 80-85°F. The disease effectively blocks water transport in the infected plant by affecting the xylem tissues after entering though wounds or young rootlets and spreading through the plant.

OOMYCETES

The oomycete, *Peronospora parasitica*, causes downy mildew, a disease affecting many cruciferous vegetables and manifests as purplish, irregular spots on the leaves. When conditions are cool and moist, the spots enlarge, becoming yellow-brown in colour. Under these conditions, a white mold develops between the veins on the abaxial leaf surface. Affected areas eventually become tan and papery as they continue to enlarge. Spores may be rain-splashed or wind-blown to other plants and fields and may survive in the soil after the crop decays.

White rust is a disease caused by the oomycete, *Albugo candidans*, and causes defoliation and root injury.

INSECTS

The diamondback moth, *Plutella xylostella*, is the most destructive pest of cruciferous vegetables. Moth larvae are very efficient at developing resistance to all insecticide classes and are extremely adaptive to new environments. Crop damage is due to the feeding damage inflicted on the leaves of cruciferous plants and may be best controlled using an integrated strategy comprising crop rotation, trap cropping (e.g., planting collards and Indian mustard on the periphery of cabbage or broccoli fields), and a knowledge of insecticide and awareness of resistance.

Pests of lettuce

There are a number of pests which are of significance to cultivation and trade in lettuce. Some of these pests are mentioned below.

INSECTS & MOLLUSCS

Several important insect pests include cutworms (cut seedlings off at the soil line), wireworms tarnished plant bugs and aphids (causes yellow, distorted leaves), leafhoppers (cause stunted growth and pale leaves), thrips (turn leaves grey-green or silver), leafminers (create tunnels within the leaves), flea beetles (cut small holes in leaves), and caterpillars, slugs and snails (cut large holes in leaves).

NEMATODES

A number of nematodes are known to affect lettuce grown in the Caribbean region and generally result in stunted growth and yellowing of affected plants *(See Appendix I)*.

PATHOGENS

A number of plant pathogens also affect lettuce, including viral diseases (e.g., big vein – causes yellow, distorted leaves; mosaic virus – spread by aphids and causes stunted plant growth and deformed leaves), bacterial diseases (e.g., aster yellows – vectored by planthoppers and causes deformed leaves), and fungal diseases (e.g., powdery & downy mildew – cause leaves to mold and die; bottom rot, lettuce drop and gray mold – cause entire plants to rot and collapse).

WEEDS

Weeds act as alternative hosts of pests of significance in lettuce production and generally outcompete lettuce for nutrients and other resources. Weeds should be kept to a minimum in and around the place of production.

Table 1 is a list of pests associated with cruciferous vegetables and lettuce in the Caribbean region that may be identified as regulated pests requiring phytosanitary measures by the PRA process. Measures in Table 2 are recommended for the management of these quarantine pests. These measures may be substituted where technically justified.

Table 1. Pest groups associated with cruciferous vegetables and lettuce grown in the Caribbean.

Pest Group	Family	Example species
Ant	Formicidae	*Solenopsis geminata* (Fabricius)
Aphids	Aphididae	*Aulacorthum solani* (Kaltenbach)
		Hyadaphis erysimi (Kaltenbach)
		Nasonovia ribis-nigri
Beetles	Chrysomelidae	*Diabrotica balteata* (LeConte)
		Phyllotreta striolata (Fabricius, 1803)
	Elateridae	*Agriotes lineatus*
Bug	Coreidae	*Anasa tristis* (De Geer)
Butterfly	Pieridae	*Pieris rapae* Linnaeus
Fungus	Nectriaceae	*Fusarium oxysporum* f. sp. *conglutinans*
Midge	Cecidomyiidae	*Contarinia maculipennis* Felt
Molluscs	Achatinidae	*Lissachatina fulica* (Bowdich)
	Veronicellidae	*Vaginula plebeia* Fischer
		Veronicella cubensis (Pfeiffer)
Moth	Crambidae	*Duponchelia fovealis* (Zeller)
Oomycete	Albuginaceae	*Albugo candida*
Thrips	Thripidae	*Thrips tabaci* Lindeman, 1889
		Frankliniella occidentalis (Pergorde)
Weevil	Curculionidae	*Listroderes costirostris obliquus* (Schonherrr)
Whiteflies	Aleyrodidae	*Trialeurodes abutiloneus* Haldeman
		Trialeurodes vaporariorum Westwood 1856

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. During the PRA process, NPPOs should note any pests for which there is uncertainty as to association with cruciferous vegetables and lettuce in trade as well as a description of the uncertainty.

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 cruciferous vegetables and lettuce 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 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 to reduce or eliminate contamination of cruciferous vegetables and lettuce. Use of chemical treatments must be approved for use on these vegetables and should be applied strictly in accordance with established international standards on maximum residue levels (MRLs).

Contaminated lettuce is often a source of bacterial, viral and parasitic foodborne illness in humans, including *Escherichia coli* (*E. coli*) and *Salmonella* spp. Bacterial contamination occurs mainly through contact with animal faeces. Cruciferous vegetables and lettuce that have come into contact with faeces should not be harvested.

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

[1] CODEX Alimentarius "Fresh Fruits and Vegetables".
https://www.fao.org/3/a1389e/a1389e00.htm

Phytosanitary Measures

None of the priority plants pests identified for the Caribbean region are known to be associated with cruciferous vegetables and lettuce. Table 2 below provides information on pests associated with cruciferous vegetables and lettuce in the Caribbean region along with measures considered to be effective in managing each pest group previously identified in Table 1.

Table 2. Phytosanitary measures considered to be effective in managing the risk from specified pest groups

Pest Group	Phytosanitary Measure(s)
Ants	PFA, PFPP, systems approach
Fungi	Use of resistant varieties, cultural & chemical control (e.g., copper spray), use of efficient drainage and irrigation, crop rotation, avoid fields with a disease history
Aphids	ALPP, IPM (incl. biological control, pheromone trapping, preservation of natural enemies), visual inspection
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)
Bugs	Harvest management, systems approach, visual inspection, IPM to control vectoring of viruses
Butterflies	IPM
Molluscs	IPM, visual inspection
Moths	PFPP, ALPP, IPM, GAPs (host weed control, pre-planting field sanitation, etc.), visual inspection for eggs & larvae
Oomycetes	PFA, PFPP, IPM (incl. use of resistant plant varieties), GAPs (good field sanitation, appropriate soil selection, irrigation management, etc.), field rotation out of cruciferous crops, good weed control
Whiteflies	IPM, ALPP
Thrips	PFA, PFPP, IPM, visual inspection
Midges	GAPs, PFA, IPM (e.g., use of resistant planting material, biocontrol, etc.)
Weevils	ALPP, exclusion of soil

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.

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 preferably have a history of freedom from pests of quarantine significance and should be of the preferred soil type and pH for the best outcome of the cruciferous vegetables and lettuce crops. Pest-free planting material and pest resistant cultivars should be used where possible and/or available in keeping with market requirements. Monitoring is extremely important in the production of cruciferous vegetables and lettuce, such that fields should be scouted for signs of pests (including weeds) and timely and appropriate actions taken to manage these pests.

Cabbage plants growing in saline soils are prone to diseases. Crops should be kept free of weeds by the application of appropriate pre-emergent herbicides followed by hand weeding as necessary after transplanting.

Lettuce contains several defensive compounds (e.g., sesquiterpene lactones) and other natural phenolics (e.g., flavonol and glycosides) which help the defensive response to pests. Planting of varieties bred to express such pest resistance, where available commercially, should be considered for cultivation.

All tools and equipment used in the production process should be disinfected to prevent spread of disease from one place of production to another.

Harvesting

Harvesting at the correct stage and proper post-harvest handling are extremely important for cruciferous vegetables. The vegetables should be harvested promptly upon maturity to reduce incidence of field disease. Upon harvesting, stalks should be cut with a sterile knife as broken stalks have been found to be more susceptible to decay.

Heads of broccoli and cauliflower should be collected in bins in the field and taken to a location where the field heat can be quickly removed to prevent wilting. Access to adequate cold storage space between harvesting and packing, and packing and shipping, is crucial.

At harvest, the presence and level of soilborne disease of lettuce should be recorded and the appropriate actions taken to identify the pest and apply phytosanitary measures where necessary. Plants with thrips and any signs of disease should be destroyed and old crop residue should be ploughed in or sprayed off as these may serve as reservoirs for pests.

Post-harvest handling and treatments

Handling and sorting

Harvested produce should always be stored in shade and cooled as quickly as possible after harvesting and before they are packed. All infested produce should be removed and disposed of appropriately. Each load should be stowed stably and be kept well ventilated. Packages should be strong enough to protect the contents and should not be stacked higher than the maximum recommended to prevent collapse under the weight above. Packages should be loaded on dunnage or pallets on the beds of transport vehicles to allow for circulation of air around the stacks.

Transportation

Vehicles used to transport cruciferous vegetables and lettuce should be clean and provide a cool environment for the produce. Records should be kept of all vehicle cleaning activities. Additionally, every effort should be made to prevent damage to the produce while being loaded, transported and off-loaded, regardless of the method of transport being used to move the goods.

Cleaning

Cleaning of cruciferous vegetables and lettuce 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 or treatment of the vegetables.

Storage

Freshly harvested cruciferous vegetables should be cooled rapidly to below 2°C and stored between 0 and 2°C and a relative humidity higher than 90%. After harvest lettuce lasts longest when kept at 0°C (32°F) and a relative humidity of 96%. Notably, the rate of degradation of cruciferous vegetables and lettuce is increased when stored with ethylene-producing fruit (e.g., bananas, tomatoes, melons).

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, based on importing country requirements in line with international standards. The process of treatments should be guided by ISPM 28 (*Phytosanitary treatments for regulated pests*).

Specific treatments for cruciferous vegetables and lettuce 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 where available and applicable. 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*). Nitric oxide fumigation has been demonstrated as a safe option for postharvest pest control for fresh fruit and vegetables.

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.

Cruciferous vegetables and lettuce may be subjected to an importing NPPO-approved chemical treatment where necessary.

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 are available depending on the specifications of individual consignments (NC State Extension Publications, 1996). Cruciferous vegetables and lettuce should be packaged using clean or new containers.

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 cruciferous vegetables and lettuce for consumption, 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, cruciferous vegetables and lettuce 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 of the fresh cruciferous vegetables and lettuce, the produce must be kept as cool as possible, dry, and moved to market as quickly as possible.

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 cruciferous vegetables and lettuce 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 cruciferous vegetables and lettuce 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 cruciferous vegetables and lettuce 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*).

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 cruciferous vegetables and lettuce 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, to include packaging material used to prevent damage during transport
- Be exported in a secure manner to prevent contamination.

Cruciferous vegetables and lettuce 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 cruciferous vegetables and lettuce 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:

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*). Additionally, 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 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 for the commodity and 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 cruciferous vegetables and lettuce 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 cruciferous vegetables and lettuce. 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 cruciferous vegetables & lettuce in the Caribbean region

[source: National Plant Protection Organizations of Member States]

Pest Type	Scientific name	Common name(s)	Host[2]
Bacterium	*Erwinia carotovora*	Bacterial soft rot	All
Bacterium	*Erwinia carotovora subsp. carotovora*	Bacterial root rot of sweet potato	*Brassica* spp.
Bacterium	*Pectobacterium caratovorum*	bacterial soft rot	*Brassica* spp.
Bacterium	*Pseudomonas marginalis* pv. *marginalis*	lettuce marginal leaf blight	*Brassica* spp.
Bacterium	*Pseudomonas syringae* pv. *syringae*	bacterial canker	*Brassica* spp.
Bacterium	*Xanthomonas campestris* (Pammel) Dowson	Black rot	All
Bacterium	*Xanthomonas campestris pv. campestris*	Black rot	All
Fungus	*Alternaria brassicae* (Schw.) Wiltshire	Grey leaf spot, dark leaf spot of cabbage	All
Fungus	*Alternaria brassicicola*	dark leaf spot of cabbage	*Brassica* spp.
Fungus	*Alternaria dauci*	leaf blight of carrot	All
Fungus	*Athelia rolfsii*	sclerotium rot	*Brassica* spp.
Fungus	*Cercospora beticola*	Cercospora leaf spot	Lettuce
Fungus	*Cercospora brassicae* (Fautr. & Rous) Hohnel	Leaf spot	All
Fungus	*Cercospora* sp.	*Cercospora* leaf spot	Lettuce
Fungus	*Colletotrichum dematium*	leaf spot	*Brassica* spp.
Fungus	*Corticium rolfsii (*Sacc.)	Sclerotium rot, collar rot	*Brassica* spp.
Fungus	*Corticium salmonicolor*	Damping off	*Brassica* spp.
Fungus	*Erysiphe cruciferarum*	powdery mildew of crucifers	*Brassica* spp.
Fungus	*Fusarium oxysporum*	basal rot	*Brassica* spp.
Fungus	*Fusarium oxysporum* f.sp. *conglutinans*	Fusarium wilt	Cabbage
Fungus	*Macrophomina phaseolina*	charcoal rot of bean/tobacco	*Brassica* spp.
Fungus	*Rhizoctonia solani* (*Thanatephorus cucumeris*)	root rot, damping off	*Brassica* spp.
Fungus	*Rhizoctonia* spp.	Damping off	Lettuce, cabbage
Fungus	*Sclerotinia sclerotiarum*	White mold	Cabbage
Fungus	*Septoria* sp.	*Septoria* leaf spot (?)	Lettuce
Fungus	*Thanatephorus cucumeris (*Frank*)*	Leaf spot, sharp eyespot etc.	*Brassica* spp.

[2] As declared by BMCs

Pest Type	Scientific name	Common name(s)	Host[2]
Insect	-	Cabbage worms	All
Insect	-	Cutworms	All
Insect	-	Root Maggots	All
Insect	-	Flea Beetle	All
Insect	-	Aphids	All
Insect	*Agrotis ipsilon* Hufnagel	cutworm	All
Insect	*Aleurodicus dispersus*	Spiralling whitefly	All
Insect	*Aphis (Doralis) fabae* Scop.	Black aphid	All
Insect	*Aphis craccivora (?)*	Groundnut aphid	*Brassica* spp.
Insect	*Aphis gossypii*	Cotton aphid	All
Insect	*Aphis spiraecola*	Green citrus aphid	Lettuce
Insect	*Ascia monuste* (L.)	Cabbage white butterfly	All
Insect	*Aspidiotus destructor*	coconut scale	*Brassica* spp.
Insect	*Bemisia tabaci* (Gennadius)	Tobacco White fly, silverleaf whitefly, sweet potato whitefly	All
Insect	*Dysmicoccus brevipes*	pineapple mealybug	*Brassica* spp.
Insect	*Ferrisia virgata*	striped mealybug	*Brassica* spp.
Insect	*Frankliniella schultzei*	Cotton thrips	Lettuce
Insect	*Helicoverpa zea* (Boddie)	American cotton bollworm	*Brassica* spp.
Insect	*Hellula phidilealis* (Wlk.)	Cabbage budworm	All
Insect	*Liriomyza pusilla*	Leafminer	All
Insect	*Liriomyza sativae*	vegetable leaf miner	All
Insect	*Liriomyza trifolii*	American serpentine leafminer	*Brassica* spp.
Insect	*Maconellicoccus hirsutus*	pink hibiscus mealybug	*Brassica* spp.
Insect	*Mythimna unipuncta*	rice armyworm	*Brassica* spp.
Insect	*Myzus persicae*	green peach aphid	*Brassica* spp.
Insect	*Nezara viridula* (L.)	Green stink bug	All
Insect	*Oxycarenus hyalinipennis*	cotton, seed bug	*Brassica* spp.
Insect	*Phylophaga spp.*	White grubs	*Brassica* spp.
Insect	*Pieris brassicae* (Linnaeus)	Cabbage cutworm	*Brassica* spp.
Insect	*Planococcus citri*	citrus mealybug	*Brassica* spp.
Insect	*Plutella xylostella (maculipennis)* (L.)	Diamondback moth	All
Insect	*Pseudococcus longispinus* Targioni Tozzetti	Longtailed mealybug	*Brassica* spp.
Insect	*Scapteriscus vicinus* Scudder	Mole cricket	All
Insect	*Spodoptera eridania*	southern armyworm	*Brassica* spp.
Insect	*Spodoptera frugiperda* (J.E.Smith)	Fall armyworm	All
Insect	*Spodoptera ornithogolli* (Guenee)	Yellow striped army worm	*Brassica* spp.
Insect	*Thrips palmi*	Melon thrips	Lettuce
Insect	*Thrips tabaci* (Linderman)	Potato thrips, onion thrips	All
Insect	*Trichoplusia (phytometra) ni* (Hubner)	Cabbage looper	All
Mite	*Polyphagotarsonemus latus (Banks)*	Broad mite	*Brassica* spp.
Nematode	*Helicotylenchus dihystera*	Banana spiral nematode	Lettuce
Nematode	*Helicotylenchus pseudorobustus*	Spiral nematode	Lettuce

Pest Type	Scientific name	Common name(s)	Host[2]
Nematode	*Meloidogyne incognita*	Root knot nematode	All
Nematode	*Meloidogyne* spp.	Root knot nematodes	Lettuce
Nematode	*Rotylenchulus reniformis*	Reniform nematode	All
Nematode	*Xiphimena vulgare* (Tarjan)	Dagger nematode	Lettuce
Oomycete	*Albugo candida*	white rust of crucifers	*Brassica* spp.
Oomycete	*Peronospora parasitica*	Downy mildew	*Brassica* spp.
Oomycete	*Pythium debaryanum*	Damping-off	*Brassica* spp.
Virus	*Cucumber mosaic virus*	Cucumber mosaic	Lettuce

Appendix 2. List of pests of cruciferous vegetables & lettuce regulated by countries in the Caribbean region

[Source: National Plant Protection Organisations of Member States]

Pest Type	Scientific name	Common name(s)	Host
Fungus	*Albugo candida*	White rust of crucifers	*Brassica* spp.
	Fusarium oxysporum f. sp. *conglutinans*	Cabbage fusarium wilt	*Brassica* spp.
Insect	*Agriotes lineatus*	wireworm	*Brassica* spp.
	Anasa tristis (De Geer)	Squash bug	All
	Aulacorthum solani (Kaltenbach)	Foxglove aphid	
	Contarinia maculipennis Felt	Blossom midge	*Brassica* spp.
	Diabrotica balteata (LeConte)	Banded cucumber beetle	
	Duponchelia fovealis (Zeller)	Moth	
	Frankliniella occidentalis (Pergorde)	Western flower thrips	
	Hyadaphis erysimi (Kaltenbach)	Turnip aphid	
	Listroderes costirostris obliquus (Schonherrr)	Vegetable weevil	
	Nasonovia ribis-nigri	Lettuce aphid	Lettuce
	Phyllotreta striolata (Fabricius, 1803)	Striped flea beetle	
	Pieris rapae Linnaeus	Imported cabbage worm	*Brassica* spp.
	Solenopsis geminata (Fabricius)	Fire ant	
	Thrips tabaci Lindeman, 1889	Onion thrips	Cabbage
	Trialeurodes abutiloneus Haldeman	Bandedwinged whitefly	Lettuce
	Trialeurodes vaporariorum Westwood 1856	Greenhouse whitefly	*Brassica* spp.
Mollusc	*Lissachatina fulica* (Bowdich)	Giant African Snail	All
	Vaginula plebeia Fischer	Brown slug	Lettuce
	Veronicella cubensis (Pfeiffer)	Two-striped slug	Cabbage