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SOLANACEOUS VEGETABLES

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 SOLANACEOUS PRODUCTS

Produced by the Caribbean Agricultural
Health and Food Safety Agency (RPPO)
Adopted 2022; published 2022

Publication history
This is not an official part of the guideline
2022-07 COTED Adopted the guideline

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 solanaceous vegetables 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 *Capsicum* spp. (bell peppers and chili peppers), *Solanum lycopersicum* (tomato), and *Solanum melongena* (eggplant) produced in the region.

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

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

Definitions

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

OUTLINE OF REQUIREMENTS

The issue of pest risk varies within and between countries. It is therefore important for importing NPPOs to apply pest risk analysis (PRA) (see ISPM 2: *Framework for pest risk analysis* and ISPM 11: *Pest risk analysis for quarantine pests*) in the process of identifying quarantine pests and providing the technical justification for the imposition of phytosanitary import

requirements. The importing country should consider equivalence of phytosanitary measures if the country of export is unable to conduct specific requests for phytosanitary measures. Such a process should be in keeping with ISPM 24 (*Guidelines for the determination of equivalence of phytosanitary measures*).

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

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

BACKGROUND

Description of solanaceous vegetables

The Solanaceae is a family of flowering plants which includes a number of agricultural crops in the *Solanum* genus, comprising the tomato (*S. lycopersicum*), the potato (*S. tuberosum*)[1], and the eggplant (*S. melongena*). Bell peppers and chili peppers are also economically important crops in the *Capsicum* genus of the Solanaceae. The fruits of the majority of species in these genera – with the exception of *S. tuberosum*, a root/tuber – are botanical berries but are usually referred to in culinary terms as vegetables.

Tomatoes are the edible berries of *Solanum lycopersicum* and may be consumed raw or cooked. Varieties of this species can be grown in temperate and tropical climates across the world. The plants typically attain heights of 1-3 meters (3-10 feet) and grow as weak-stemmed vines that typically require support. Fruit size varies by cultivar, ranging from 1-10 cm (0.5-4 inches) in

[1] *Solanum tuberosum* (white potato) is not covered in this guideline document and is available in a separate document dedicated to the species.

width. *S. lycopersicum* is a warm season crop which requires low to medium levels of rainfall. Tomato can be grown on a wide range of soil types but a well-drained, loamy soil, rich in organic matter and with a pH range of 6.0-7.0 is preferred. The cherry tomato (*S. lycopersicum* var. *cerasiforme*) is a small variety of tomato that is believed to be an intermediate between wild currant-type tomatoes and domesticated garden tomatoes.

Solanum melongena, the eggplant, is a solanaceous crop grown worldwide for its edible fruit, most varieties of which are purple in colour. The skin and seeds of the eggplant are edible and the fruit is usually eaten cooked. Different cultivars of the eggplant produce fruit which vary in size, shape and color, although they are typically purple and less commonly white; they also occur in color gradients of, or striped in, these colors. All eggplants have a smooth, stomata-less, glossy skin which makes them relatively resistant to loss of moisture. Both cultivar and the production environment affect the storage characteristics of the vegetable. Plants are tropical and grow to 40-150 cm (1 ft 4 in – 4ft 11in) in height. *S. melongena* can be grown at elevations of 1200m above sea level; well-drained, fertile soils at a pH of 5.5-6.6 are ideal.

The genus *Capsicum* comprises up to 33 species, five of which have been domesticated, namely *C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum* and *C. pubescens*. *C. annuum* is often grouped with *C. frutescens* (chillies, hot or tabasco pepper) as *C. annuum* sensu lato. The fruit of *Capsicum* plants have a variety of names influenced by the place and type, with more piquant varieties commonly referred to as chili peppers and the large, mild form referred to as bell peppers. The fruit is a non-pulpy berry which is very variable in size, shape, colour, and pungency and can be eaten raw or cooked. In essence, this genus is very variable, with plants attaining heights of 0.5 – 1.5m. *Capsicum* species grow best in loamy, moist (but not water-logged) soils in sunny locations with temperatures ranging from 21-29ºC (70-84ºF).

Many solanaceous species are important weeds due to the fact that they serve as alternate hosts of pests of the cultivated relatives, thus increasing the loss of yield of the harvested product if present in the production area.

This guideline will focus on measures to facilitate intra-regional trade of fresh pepper, tomato and eggplant grown in the Caribbean for consumption.

Identities

Preferred Scientific Name	***Solanum melongena* L.**	***Solanum lycopersicum* L.**	***Capsicum annuum* L.**	***Capsicum chinense***
Preferred Common Name	Eggplant	Tomato	Bell pepper	Habanero pepper
Variety	S.*m.* var. *esculentum* (common aubergine incl. white vars.) S.*m.* var. *depressum* (dwarf aubergine) S.*m.* var. *serpentium* (snake aubergine)	*Solanum lycopersicum* var. *cerasiforme* *Solanum lycopersicum* var. *lycopersicum*	-	Scotch Bonnet pepper Trinidad Moruga scorpion peppers Carolina Reaper peppers
Other Scientific Names	*Solanum ovigerum* Dunal *Solanum trongum* Poir.	*Lycopersicon esculentum* Mill. *Lycopersicum esculentum* var. *cerasiforme* *Lycopersicon esculentum* var. *esculentum* *Lycopersicon lycopersicum* (L.) H. Karst	*Capsicum annuum* L. var. *aviculare* (Dierb.) D'Arcy & Eshbaugh *Capsicum annuum* L. var. *glabriusculum* (Dunal) Heiser & Pickersgill *Capsicum baccatum sensu* Britton & Millsp., non L. *Capsicum hispidum* var. *glabriusculum* Dunal *Capsicum indicum* Dierb. var. *aviculare* Dierb.	-
International Common Names	aubergine, brinjal	tomato	Green pepper, red pepper, sweet pepper, paprica	Chili pepper
Local Common names	eggplant	tomato	Bird pepper, piment, piment doux, spaanse Peper	Hot pepper

Taxonomic Trees

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphyllum: Angiospermae
Class: Dicotyledonae
Order: Solanales
Family: Solanaceae
Genus: *Solanum*/ *Solanum*/ *Capsicum*
Species: *Solanum melongena*/ *Solanum lycopersicum*/ *Capsicum annuum*

Intended Use

The guideline covers the solanaceous vegetables tomato, pepper and eggplant for the intended purpose of consumption or for processing.

REQUIREMENTS

Pest risk analysis

The NPPO of the importing country should conduct PRA associated with solanaceous vegetables 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 solanaceous vegetables

A number of pests are known to affect solanaceous crops and could significantly affect yield of marketable produce which meet requirements for trade. Of the priority plant pests identified as being of importance to the Caribbean region, *Tuta absoluta* (tomato leafminer), *Ralstonia solanacearum* race 3 biovar 2 (brown rot of potato) and *Ceratitis capitata*, the Mediterranean fruit fly, have been isolated from the Solanaceae family of plants and have therefore been included in the list of pests of significance to trade (Table 1). Appendices 1 and 2, respectively provide combined lists of general pests and regulated pests found on, or listed for, solanaceous vegetables in the Caribbean region. *T. absoluta* is highly destructive to tomato plants and fruit and has been reported to infest other solanaceous crops. *R. solanacearum* R3bv2 causes

bacterial wilt of tomato, and *C. capitata* is known to occasionally affect pepper and tomato cultivars but rarely affect eggplant.

Available cultivars of tomato vary widely in their resistance to pests. A range of mildews and blights (e.g., late blight), verticillium wilt, fusarium wilt, tobacco mosaic virus, nematodes, *Alternaria* spp., tomato bug, stink bugs, cutworms, tomato hornworms, aphids, cabbage loopers, whiteflies, tomato fruitworms, flea and other beetles, red spider mite, the beet leafhopper and slugs commonly affect tomato. Additionally, the tomato russet mite, *Aculops lycopersici*, feeds on foliage and young fruit of tomato plants and could result in plant death. Companion planting has been used in the arsenal of pest management options in the cultivation of tomato crops. A number of parasitic wasps predate the devastating tomato hornworm while other plant species, including parsley, Queen Anne's lace and dill, attract predatory flies which attack a number of tomato pests. Additionally, the alliums, mints and French marigold – thought to mask the scent of the tomato plant – serve to reduce the odds of tomato pests attacking the correct plant. Asparagus and marigold plants also repel nematodes that affect tomato.

The eggplant is affected by many of the pests that affect other solanaceous crops and as such should not be rotated with them. It is recommended that four years separate successive eggplant crops, where possible, to reduce pest pressure in a production area. Mulching helps to conserve moisture and prevent the growth of weeds. Eggplants are particularly susceptible to whiteflies and could be grown using chili peppers as trap crops since they are slightly less susceptible. Eggplant crops are also affected by fruit and shoot borers, mites, bacterial wilt, Phomopsis blight and damping off. An IPM strategy could include the use of pheromone and sticky traps, sprays to control sucking pests and hoppers, and mulching.

Bell Peppers (*Capsicum annuum*) are affected by several common pests. *Colletotrichum* spp. result in the formation of lesions on fruit as well as on the leaves and stem of the plant. The use of disease-free seeds, rotation of fields (if the disease is known to be present) with non-susceptible crops for a period of three years, and deep plowing and/or removal of crop debris helps to reduce the soil inoculum. Cercospora leaf spot (*Cercospora capsici*) infections are usually minor in pepper and may be controlled in much the same way as for *Colletotrichum* spp. Damping off (*Pythium* spp.) and Fusarium wilt are managed by planting in well-drained soils that are not water-logged using fungicide treated seeds where appropriate. Southern blight (*Sclerotium rolfsii*) can survive in soil for long periods and disease emergence is favoured by high temperatures and humidity and acidic soils. Removal of infected plants, crop rotation,

soil tillage and proper spacing of plants to prevent overcrowding help in disease management. Bacterial diseases such as bacterial canker (*Clavibacter michiganensis*), bacterial spot (*Xanthomonas axonopodis* pv. *vesicatoria*), and bacterial wilt (*Ralstonia solanaearum*) can be managed through the use of disease-free planting material, planting in non-infested fields, field and equipment sanitization, crop rotation, and moisture management by avoiding over-irrigation. Phytophthora blight (*Phytophthora capsici*) is an oomycete disease that is managed by planting disease-free materials, managing water carefully, crop rotation, and the application of appropriate fungicides. Aphids (*Myzus persicae*), beet armyworm (*Spodoptera exigua*), Colorado beetle (*Leptinotarsa decemlineata*), and leafminers (*Lyriomyza* spp.) also affect pepper and are managed in much the same way as for tomato and eggplant crops. Pepper weevils (*Anthonomus eugenii*) may be controlled by eliminating alternate hosts from the production area, crop rotation and field sanitation and spraying with pyrethrin. Thrips (*Frankliniella occidentalis*) vector the Tomato spotted wilt virus. Planting adjacent to onions, garlic or cereals should be avoided to prevent build-up of the pest population. Application of appropriate insecticides and the use of reflective mulches help to control problematic thrips populations. In the management of spider mites (*Tetranychus* spp.), soap insecticides may be used and populations of natural enemies should be preserved.

Table 1 is a list of pests associated with solanaceous vegetables 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.

Pest management options

An integrated set of management strategies should be used for handling pests that affect production of solanaceous crops and have implications for trade of the produce. Generally strategies include, but are not limited to, the following options – or combinations thereof:-

- Crop and field rotations
- Removal of pest-hosting weeds (alternate hosts)
- Planting resistant or tolerant varieties
- Application of organophosphates and pyrethroids in tandem with economic pest thresholds
- Conservation of natural enemies and use of relevant biocontrol agents
- Intercropping

- Use of pest traps where available
- Use of reflective mulches

Table 1. Pest groups associated with solanaceous vegetables grown in the Caribbean.

Pest Group	Family	Example species
Bacterium	Burkholderiaceae	*Ralstonia solanacearum* (Smith,1896) Yabuuchi *et al.*,1996 race 3 biovar 2)
	Microbacteriaceae	*Clavibacter michiganensis subsp. michiganensis* (Smith) Davis *et al.*
		Clavibacter michiganensis subsp. sepedonicus (Spieckermann & Kotthoff) Davis *et al.*
	Pectobacteriaceae	*Erwinia carotovora* pv. *atroseptica* (van Hall, 1902) Dye, 1962
Fungus	Glomerellaceae	*Colletotrichum spp.*
Insect	Aleyrodidae	*Trialeurodes abutiloneus* Haldeman
		Trialeurodes vaporariorum Westwood 1856
	Aphididae	*Aulacorthum solani* (Kaltenbach)
	Cecidomyiidae	*Contarinia maculipennis* Felt
		Prodiplosis longifila Gagné
	Chrysomelidae	*Diabrotica balteata* (leconte)
		Chaetocnema confinis Crotch, 1873
	Coreidae	*Leptoglossus zonatus* (Dollas)
	Crambidae	*Duponchelia fovealis* (Zeller)
		Neoleucinodes elegantalis (Guenée) 1854
		Ostrinia nubilalis
		Spoladea recurvalis (Fabricius)
	Cryllotalpidae	*Scapteriscus vicinus*
	Curculionidae	*Anthonomus eugenii* (Cono)
		Faustinus cubae (Boheman)
		Listroderes costirostris obliquus (Schonherrr)
	Elateridae	*Agriotes lineatus*
		*Conoderus falli (*Lane)
		Conoderus rudis (Brown)
	Erebidae	*Othreis fullonia* Linnaeus [*Prefd SN: *Eudocima fullonia* (Clerck, 1764)]
	Formicidae	*Solenopsis geminata* (Fabricius)
	Gelechiidae	*Keiferia lycopersicella* (Walsingham)
		Phthorimaea operculella (Zeller 1873)
		Tuta absoluta
	Noctuidae	*Spodoptera litura* (Fabricius)
	Pseudococcidae	*Paracoccus marginatus* Williams & Granara de Willink, 1992
		Phenacoccus manihoti
	Tephritidae	*Anastrepha suspensa* (Loew)
		Bactrocera cucurbitae (Coquillett)
		Bactrocera invadens (Drew *et al.*, 2005)
		Bactrocera latifrons (Hendel)
		Bactrocera tryoni (Froggatt)
		Batrocera carambolae (Drew & Hancock)
		Batrocera dorsalis (Hendel)
		Ceratitis capitata (Weidermann)
		Zonosemata electa
	Thripidae	*Frankliniella bispinosa* (Morgan)
		Frankliniella occidentalis (Pergorde)
		Thrips palmi Karny

Pest Group	Family	Example species
		Thrips parvispinus Karny
	Tortricidae	*Thaumatotibia leucotreta* (Meyrick)
Mite	Tetranychidae	*Tetranychus cinnabarinus* (Boisduval)
Mollusc	Veronicellidae	*Veronicella cubensis* (Pfeiffer)
Nematode	Heteroleridae	*Globodera pallida* (Wollenweber) Behrens
Phytomonad	Trypanosomatidae	*Phytomonas* spp.
Virus	Geminiviridae	Gemini Virus Complex
	Potyviridae	Potato Virus Y
	Secoviridae	Tomato ringspot nepovirus (ToRSV)
	Tombusviridae	Tomato bushy stunt tombusvirus (TBSV)
	Virgaviridae	Tomato Brown Rugose Fruit Virus (ToBRFV)

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 solanaceous vegetables in trade as well as a description of the uncertainty. In Table 2, included is a pest for which there is uncertainty in the Caribbean as to association with some solanaceous vegetables in trade and a description of the uncertainty.

Table 2. Pests with uncertain association with solanaceous vegetables grown in the Caribbean.

Pest Group	Family	Pest	Description
Fruitflies	Tephritidae	*Ceratitis capitata*	The Mediterranean fruitfly has been found to occasionally affect tomato and pepper. It has rarely been found to infest eggplant.

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 certified seeds and 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 re-infestation (e.g., use of insect-proof packaging)
- Grading (guided by CODEX standards[2]) to ensure suitability of solanaceous vegetables 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 established procedures.
- Secure management to prevent contamination and infestation.

Sanitary (Food Safety) Measures

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

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

Food contamination is a matter of serious food safety concern because high concentrations of chemicals and contaminants present in food can pose serious health risks. Fields should not be located in any area for which there is a likelihood of receiving runoff or drainage from any animal operation or any other source of contamination. Areas of fields that have been contaminated by run-off from an animal operation should not be harvested for fresh consumption. Fecal contamination of the water supply used for irrigation and crop protection must be guarded against, and animals that may be attracted to the fruit - particularly as they ripen in the field and are near harvest - must be excluded as far as possible.

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 consignments of solanaceous vegetables. All surfaces or equipment intended to touch the produce must be cleaned and sanitized at a frequency sufficient to prevent the surfaces from becoming a source of contamination. Chemical treatments must be approved for use on these vegetables/commodities and should be applied strictly in accordance with the manufacturer's recommendations on the label and in keeping with maximum residue levels (MRLs) as prescribed by the suitable authority.

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

Record keeping is fundamental for a proper traceability system. Information to be recorded would include, but not be limited to, employee training, environmental assessments, water usage, pest control, production practices, and the source of all agricultural inputs used in the production of the crops.

Phytosanitary Measures

Table 3 below provides information on pests associated with solanaceous vegetables 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 on solanaceous vegetables grown in the Caribbean

Pest Group	Phytosanitary Measure(s)[3]
Ants	PFPP, ALPP, systems approach
Aphids & whiteflies	ALPP, IPM, preservation of natural enemies, visual inspection, pest trapping, prevention of feeding to reduce virus transmission, weed control
Bacteria	PFPP, GAPs (incl. proper field sanitation, use of disease free seeds & resistant varieties, disinfection of equipment, avoiding over-watering, crop rotation, deep tillage of soil), management/elimination of weeds
Beetles (incl. wireworms)	Biocontrol, IPM
Fruitflies (Tephritid)	PFA, PFPP, irradiation, surveillance, visual inspection
Fungi	PFPP, use of certified planting material, well-drained fields, proper field sanitization, elimination of weed host plants, fungicidal dip.
Gall midge	Cultural controls (proper spacing, good field sanitation, elimination of weeds, destruction of all fruits with blackened stems & infested crop residues), chemical control (application to soil to kill larvae about to pupate & application of contact insecticides in the late afternoon when adults are most active)
Leafminers	PFPP, ALPP, IPM
Mealybugs	Chemical control (with spreader/sticker), biocontrol
Mites	Use of clean planting material, field sanitation, pesticide application to underside of leaves
Mole crickets	Surveillance, IPM (identify pest, establish damage threshold, devise & establish a long-term management plan incl. cultural & biocontrol)
Molluscs	IPM, visual inspection
Moths	PFA, ALPP, Field sanitation & tillage, IPM (incl. scouting, trapping & biocontrol)
Nematodes	Use of tolerant varieties, leaving infested fields fallow for 2-3 years, weed removal
Phytomonads	Vector management
Thrips	Proper field sanitation, use of trap crops, IPM
True bugs	Weed management, biocontrol, hand-picking
Viruses	Management of arthropod vectors, use of disease resistant varieties & certified seeds, weed management, intercropping, use of trap crops, rogueing of infected plants, disinfection of tools

[3] PFPP = Pest Free Place of Production, ALPP = Area of Low Pest Prevalence, IPM = Integrated Pest Management, PFA = Pest Free Area, GAP = Good Agricultural Practice

Pest Group	Phytosanitary Measure(s)[3]
Weevils	ALPP, IPM (monitoring, trapping, chemical treatment if 1 adult is found in 200 plants or 5% terminal buds damaged), collection & disposal of fallen &/or damaged fruit
Whiteflies	GAPs (e.g., proper nutrition, irrigation), IPM (e.g., use of virus-resistant varieties, planting of certified seeds)

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 (i.e., well-drained) and pH for the best outcome of the solanaceous crops. The timing for planting, the maintenance of appropriate moisture levels, and the application of suitable fertilisers as recommended should be adhered to in order to achieve the best crop outcomes. Pest-free and/or certified planting material and pest resistant cultivars should be used where possible and/or available in keeping with market requirements. Anthracnose may be controlled in the field through the use of copper compounds, triazoles and strobilurins but pathogen resistance should be closely monitored to ensure that the pesticides remain effective. Attention should be paid to preventing vectors of viral diseases affecting tomato, pepper and eggplant from feeding and spreading these diseases in the crops.

Tomatoes, eggplants and peppers require regular uniform watering during the growing season such that drip irrigation is well suited for production of these crops. Mulching (black plastic ground mulch) is recommended for weed control and moisture conservation.

Pest surveillance is extremely important in the production of solanaceous vegetables and fields should be scouted for signs of pests (including weeds); timely and appropriate actions should be taken to manage these pests. Fruit fly monitoring should be done regularly from the fruiting stage onwards. Every effort should be made to preserve and/or use natural enemies to effect control of the pests of concern in situations where such natural enemies are available. Post-harvest losses due to anthracnose can be controlled at the field level prior to harvest with the use of appropriate fungicides.

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 is important. The solanaceous vegetables should be harvested promptly upon reaching the required level of maturity to reduce incidence of field disease and to reduce losses. Solanaceous vegetables should be harvested in the early morning when it is still cool. To reduce post-harvest losses to disease, mechanical and surface damage to the fruit should be avoided.

Tomatoes may be harvested at the mature green stage to the fully ripe stage depending on market requirements and transport logistics; harvested tomatoes closer to the fully ripe stage are more susceptible to surface and internal damage during handling. Tomato fruit stalks have a natural abscission layer and, when mature, break away from the cluster when pressure is placed on the area by lifting the fruit upwards. Harvested tomatoes should be placed in clean collecting containers such as plastic pails with a smooth inside finish and then transferred to field containers such as stackable crates.

Eggplants should be hand-harvested using secateurs – taking care to leave 2-4 cm of the stem above the calyx – and placed in ventilated field crates. Sacks and bags should be avoided to reduce mechanical damage and a buildup of heat. Eggplants should not harvested if wet and should be cooled below 20^{o}C as soon as possible after being harvested, then to around 12^{o}C for storage.

The waxy skin of capsicums makes them relatively resistant to water loss, but as little as 3% weight loss causes detectable softening such that fruit harvested in hot weather should be immediately placed in the shade to prevent dehydration and sunburn. Capsicums should not be harvested when wet or too early in the morning as these conditions predispose the fruit to be easily scuffed or damaged. Harvesting should be done by hand and individually, leaving 1-2 cm

of stem attached to the fruit. The best harvest condition for capsicums is when the weather is cool to warm and dry.

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, damaged, bruised, scarred and overripe produce should be removed and disposed of appropriately. Sorting should be done on a sorting table to prevent contact with the soil and persons conducting the sorting should not be sitting. Harvested fruits should be placed in clean field crates. 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 solanaceous vegetables should be clean and provide a cool environment for the produce. Records should be kept of all vehicular cleaning activities. 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 solanaceous vegetables and all equipment and machinery used to harvest and process them is an important step in removing pest-harbouring plant residues and soil. Tomatoes harvested from plants that have not been staked or trellised can be disinfected in chlorinated water; washing in a 2 percent bicarbonate solution (20 grams baking soda per litre of water) has been shown to reduce storage rot. Alternatively, tomato fruit can be cleaned by wiping them with a clean, moist cloth. Field-grown capsicums usually need to be washed but should never be immersed in water; rather, they should be cleaned with brushes and water jets containing approved sanitizers to help reduce the microbial load and subsequent storage rots. Solanaceous produce should not be left in the wash water for more than 2 minutes. Potable water should be used to conduct any necessary washing or treatment of the vegetables and should be changed often. The water could be chlorinated (150 ppm) to minimize the spread of

pathogens. Wash water temperature should be ambient as cold water increases the chance of pathogens entering and infecting the fruits. All fruits should be dried properly prior to packaging. Sorting tables and containers used in the harvesting and processing of solanaceous commodities must be kept clean and be preferably disinfected with chlorinated water after being used.

Storage

Storage areas should be clean and should prevent harbourage of insects and rodents. The produce should be stored separately from chemicals and farm machinery to prevent contamination. Storage containers should not be used for chemicals if used for fresh produce.

Mature green tomatoes should be stored at 55-60ºF (12.8-15.6ºC) while ripe fruit store best at 45-50ºF (7.2-10ºC) at a relative humidity of 90-95%. After being harvested, peppers should ideally be cooled below 8ºC within 24 hours of harvest as longer delays increase softening and rot development. Storage life of peppers is greatest within a temperature range of 2-5ºC (for green peppers) and 1-4ºC (for red peppers) and a relative humidity of 90-95%. Eggplants store best at 10-14ºC and a relative humidity of 90-95%. Forced air and well-circulated room cooling systems are suitable.

Capsicums are sensitive to ethylene gas produced in the ripening process of some fruits and vegetables, including tomatoes, apples, bananas and avocadoes. As such, peppers should never be stored or shipped together with these commodities.

Treatments

Treatments include a range of processes that are targeted at the control or eradication of pests and contaminants from approved commodities, empty containers and export vessels. Treatments can include – but are not limited to – fumigation, irradiation, use of controlled atmosphere or temperature, application of a chemical substance, dismantling/ repairing or cleaning, repacking or blending. The choice of the treatment applied is the responsibility of the importing country, unless otherwise determined by legislation or international standards. The process of treatments should be guided by ISPM 28 (*Phytosanitary treatments for regulated pests*).

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

Irradiation

Treatments for the use of ionizing radiation (irradiation) may be used for pest risk management. Phytosanitary irradiation is a treatment which uses ionizing radiation on commodities such as fruits and vegetables to inactivate pests. The method is used for international food trade as a means to prevent spread of non-native organisms. NPPOs should be assured that the efficacy of the treatment is scientifically demonstrated for the regulated pest(s) of concern and the required response. The application of irradiation as a phytosanitary treatment should be in accordance with ISPM 18 (*Guidelines for the use of irradiation as a phytosanitary measure*). ISPM 28 Annex 7 (*Irradiation treatment for fruit flies of the family Tephritidae [generic]*), ISPM 28 Annex 14 (*Irradiation treatment for Ceratitis capitata*), and ISPM 28 PT 33 (*Irradiation treatment for Bactrocera dorsalis*) would be a guide for treatment for tephritid fruitflies as indicated. Guidance for irradiation for *Ostrinia nubilalis* (European corn borer) is available in ISPM 28 Annex 20 (*Irradiation treatment for Ostrinia nubilalis*).

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.

Solanaceous vegetables may be subjected to an importing NPPO-approved chemical treatment where necessary. Consideration could be given to the use of approved copper compounds, triazoles and strobilurins as a post-harvest treatment for anthracnose.

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. Post-harvest decay of solanaceous vegetables due to *Fusarium* rot may be reduced if subjected to hot water treatments (1 minute at 135^{o}F).

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. Solanaceous products may be subjected to hot water treatment of 50-60^{o}C for 5 – 60 minutes, depending on the heat tolerance of the particular commodity.

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

Packing, packaging and labelling

Packaging is a pivotal step in the journey of fresh produce from the farm to the table, and a number of options is available depending on the specifications of individual consignments (NC State Extension Publications, 1996). Solanaceous vegetables should be packaged using clean or new containers, usually cardboard or plastic. The packaging materials should be free of any toxic chemicals and allow for a rapid cooling of the produce.

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 solanaceous vegetables 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, solanaceous vegetables should not be placed in areas with extreme temperatures. The cartons should not be dropped, thrown, packed in inverted position, rolled or tipped. Regardless of the means of transport, the produce must be kept as cool as possible, dry, and moved to market as quickly as possible.

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 solanaceous vegetables 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*).

The CODEX standard for aubergines (CXS 330-2018) may be used as an additional guide where needed.

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 solanaceous vegetables 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 solanaceous vegetables 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 solanaceous vegetables for consumption to receive phytosanitary certification, the consignments must:

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

Solanaceous vegetables 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 solanaceous vegetables 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

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 optimal storage temperatures for the specific 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 should be applied to safeguard solanaceous vegetables against infestation after the application of a phytosanitary measure. 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 solanaceous vegetables. This could relate to entities registered/approved to export as well as the records relating to exported consignments. Verification of compliance of the consignment may be sought by the importing country in the country of export.

REFERENCES

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

Adams, H., P. Umaharan, R. Brathwaite and K. Mohammed (2011). **Hot Pepper Production Manual for Trinidad and Tobago.** http://www.cardi.org/wp-content/uploads/2011/02/Hot-Pepper-Production-Manual-for-Trinidad-and-Tobago-2011-reprint.pdf

Arah, I.K., G.K. Ahorbo, E.K. Anku, E.K. Kumah, and H. Amaglo (2016). **Postharvest Handling Practices and Treatment Methods for Tomato Handlers in Developing Countries: A Mini Review.** In *Advances in Agriculture, Vol. 2016*. http://dx.doi.org/10.1155/2016/6436945

Arogundade, O., T. Ajose, I. Osijo, H. Onyeanusi, J. Matthew and T.H. Aliyu. (2020). **Management of Viruses and Viral Diseases of Pepper (*Capsicum* spp.) in Africa.** http://dx.doi.org/10.5772/intechopen.92266

Australian Government – Department of Agriculture, Water and the Environment (2021). **Guideline: Maintenance of phytosanitary security for horticulture exports - version no. 4.**

Australian Government – Department of Agriculture, Water and the Environment (2021). **Reference: Use of Phytosanitary treatments for plant exports - version no. 1.**

Australian Institute of Food Safety (2019). **10 High Risk Foods More Likely to Cause Food Poisoning.** https://www.foodsafety.com.au/blog/10-foods-likely-to-cause-food-poisoning

AUSVEG. **Solanaceous Vegetables.** https://ausveg.com.au/biosecurity-agrichemical/crop-protection/solanaceous-vegetables/

Boyette, M., D.C. Sanders and G.A. Rutledge (1996). **Packaging Requirements for Fresh Fruits and Vegetables**: Postharvest Technology Series. https://content.ces.ncsu.edu/packaging-requirements-for-fresh-fruits-and-vegetables#

Boyette, M., L.G. Wilson and E. Estes (1990). **Postharvest Cooling and Handling of Peppers.** https://content.ces.ncsu.edu/postharvest-cooling-and-handling-of-peppers

Burden, J. and R.B.H. Wills (1989). **Prevention of Post-Harvest Food Losses: Fruits, Vegetables and Root Crops - A Training Manual.** Published by Food and Agriculture Organisation of the United Nations. https://www.fao.org/sustainable-food-value-chains/training-and-learning-center/details-materials/en/c/266236/

CABI Invasive Species Compendium (July 2018): **Datasheet - *Lycopersicon*.** https://www.cabi.org/isc/datasheet/31836

CABI Invasive Species Compendium (July 2018): **Datasheet - *Lycopersicon esculentum*.** https://www.cabi.org/isc/datasheet/122417

CABI Invasive Species Compendium (June 2017): **Datasheet - *Capsicum* (peppers).** https://www.cabi.org/isc/datasheet/15783

CABI Invasive Species Compendium (June 2017): **Datasheet - *Capsicum* spp.** https://www.cabi.org/isc/datasheet/15788

CABI Invasive Species Compendium (November 2019): **Datasheet - *Capsicum annuum* (bell pepper).** https://www.cabi.org/isc/datasheet/15784

CABI Invasive Species Compendium (November 2019): **Datasheet - *Capsicum chinense* (habanero pepper).** https://www.cabi.org/isc/datasheet/15785

CABI Invasive Species Compendium (November 2019): **Datasheet – Solanaceae.** https://www.cabi.org/isc/datasheet/1500

CABI Invasive Species Compendium (November 2019): **Datasheet – *Solanum melongena* (aubergine).** https://www.cabi.org/isc/datasheet/50536

CABI Invasive Species Compendium (November 2021): **Database – *Solanum esculentum* (tomato).** https://www.cabi.org/isc/datasheet/31837

Champoiseau, P.G. (2008). ***Ralstonia solanacearum* race 3 biovar 2.** https://plantpath.ifas.ufl.edu/rsol/RalstoniaPublications_PDF/RsolanacearumR3b2_PDF.pdf

Champoiseau, P.G., J.B. Jones and C. Allen (2009). ***Ralstonia solanacearum* race 3 biovar 2 causes tropical losses and temperate anxieties.** https://apsjournals.apsnet.org/doi/abs/10.1094/PHP-2009-0313-01-RV

CODEX Alimentarius (2018). **Standards for Aubergines CXS 330-2018.** https://www.fao.org/fao-who-codexalimentarius/sh-proxy/es/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXS%2B330-2018%252FCXS_330e.pdf

Department of Agriculture, Water and the Environment (2021). **Draft Report for the review of biosecurity import requirements for fresh Capsicum spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu**. CC BY 4.0. https://www.awe.gov.au/sites/default/files/documents/draft-report-review-biosecurity-import-requirements-fresh-capsicum-from-pic.pdf

European Food Safety Authority (2021). **Pest categorization of *Colletotrichum plurivorum*.** In *EFSA Journal 2021:19(11):6886*. https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2021.6886

Ekman, J. (2015). **Fruit Fly Management for Vegetable Growers.** © Horticulture Innovation Australia Ltd. https://www.nillumbik.vic.gov.au/files/assets/public/environment/sustainable-living/fruit-fly-guide-booklet.pdf

Ekman, J., A. Goldwater and E. Winley (2016). **Postharvest management of vegetables: Australian supply chain handbook.** http://static1.squarespace.com/static/5e5856a58220896e4dd6b366/5f14eb62fcfa946754bc0bb2/5f14eb6ffcfa946754bc0fc6/1595206511298/PostharvestVegetables_HIA.pdf?format=original

Esguerra, E.B. and R. Rolle (2018). **Post-harvest management of tomato for quality and safety assurance: Guidance for horticultural supply chain stakeholders**. *Published by FAO-UN*. https://www.fao.org/publications/card/en/c/I8236EN/

FAO and WHO (2007). **CODEX Alimentarius: Fresh Fruits and Vegetables.** 1st Edition. https://www.fao.org/3/a1389e/a1389e00.htm

Government of Australia. **Eggplant: Product guides - Postharvest Management of Vegetables**. http://www.postharvest.net.au/product-guides/eggplant/

Government of Canada (2019). ***Tuta absoluta* (Tomato Leafminer) - Fact Sheet**. https://inspection.canada.ca/plant-health/invasive-species/insects/tomato-leafminer/fact-sheet/eng/1328634442933/1328887251933

Horticulture Innovation Australia. **Capsicum: Product Guides - Postharvest Management of Vegetables**. https://www.postharvest.net.au/product-guides/capsicum/

IICA/CPHD/USDA. **National Emergency Response Plan for Caribbean Countries: Brown Rot of Potato, *Ralstonia solanacearum* (Smith, 1986)**. https://www.iica.int/en/programs/agricultural-health

IICA/CPHD/USDA. **National Emergency Response Plan for Caribbean Countries: Tomato Leafminer, *Tuta absoluta* (Meyrick)**. https://www.iica.int/en/programs/agricultural-health

IPPC (1997). **International Plant Protection Convention**. Rome, IPPC, FAO.

Korycinska, A. and H. Moran (2009). **South American tomato moth - *Tuta absoluta***. https://planthealthportal.defra.gov.uk/assets/factsheets/southAmericanTomatoMoth.pdf

Paltrinieri, G. **Handling of Fresh Fruits, Vegetables and Root Crops - A training manual for Grenada.** Published by FAO-UN. https://www.fao.org/3/au186e/au186e.pdf

PlantVillage. **Bell Pepper: diseases and Pests, Description, Uses, Propagation**. https://plantvillage.psu.edu/topics/pepper-bell/infos

Prajapati, S., S. Singh, S. Chopra and Y.D. Khan (2018). **Field Preparation and Transplanting in Solanaceous Crops**. In *Chapter 3 - Solanaceous Crop cultivator for Class IX*. Published by National Council of Educational Research and Training, India. http://ncert.nic.in/textbook/pdf/ievs103.pdf

Sinha, A. and J. Petersen (2011). **Caribbean Hot Pepper Production and Post Harvest Manual**. https://www.cardi.org/wp-content/uploads/downloads/2013/02/Cbbean-hot-pepper-production-post-harvest-manual.pdf

Steil, A. (2004). **Vegetable Harvest Guide**. https://hortnews.extension.iastate.edu/2004/7-23-2004/vegguide.html

Thomas, M.C., J.B. Heppner, R.E. Woodruff, H.V. Weems, and G.J. Steck (July 2001). **Mediterranean fruit fly – *Ceratitis capitata* (Wiedemann).** *Reviewed September 2019.* © University of Florida. https://entnemdept.ufl.edu/creatures/fruit/mediterranean_fruit_fly.htm

United Fresh Produce Association (July 2008). **Commodity Specific Food Safety Guidelines for the Fresh Tomato Supply Chain** *(2nd ed.)*. https://www.fda.gov/files/food/published/Commodity-Specific-Food-Safety-Guidelines-for-the-Fresh-Tomato-Supply-Chain---2nd-Edition-%28PDF%29.pdf

University of Georgia Extension (2019). **Integrated Pest Management: Solanaceous Crops.** https://extension.uga.edu/programs-services/integrated-pest-management/commodities/vegetables/solanaceous-crops.html

University of Guam (2002). **Eggplant, Pepper, and Tomato Production Guide for Guam: Production and IPM Practices for Solanaceous Crops in Guam** (2nd ed. 2016). https://www.uog.edu/_resources/files/extension/Eggplant-Pepper-and-Tomato-Production-Guide-on-Guam-2nd-E-Web.pdf

USDA-APHIS (2020). **National Pest Alert: *Ralstonia solanacearum* race 3 biovar 2.** https://www.aphis.usda.gov/publications/plant_health/alert-ralstonia.pdf

Utah State University Extension (2020-21). **Utah Vegetable Production and Pest Management Guide**. https://extension.usu.edu/vegetableguide/files/UT-Veg-Guide-2020a.pdf

Vikaspedia (2019). **Tomato**. https://vikaspedia.in/agriculture/crop-production/package-of-practices/vegetables-1/tomato-1

Vikaspedia (2021). **Brinjal.** https://vikaspedia.in/agriculture/crop-production/package-of-practices/vegetables-1/brinjal

Wicker, E., L. Grassart, R. Coranson-Beaudu, D. Mian, C. Guilbaud, M. Fegan and P. Prior (2007). ***Ralstonia solanacearum* Strains from Martinique (French West Indies) Exhibiting a New Pathogenic Potential**. In *Applied and Environmental Microbiology, Nov. 2007, p. 6790-6801*. https://agritrop.cirad.fr/541657/2/document_541657.pdf

Wikipedia (December 2021). **Capsicum.** https://en.wikipedia.org/w/index.php?title=Capsicum&oldid=1060032709

Wikipedia (January 2022). **Cherry tomato**. https://en.wikipedia.org/wiki/Cherry_tomato

Wikipedia (January 2022). **Eggplant**.
https://en.wikipedia.org/w/index.php?title=Eggplant&oldid=1066813917

Wikipedia (January 2022). **Pepper**.
https://en.wikipedia.org/w/index.php?title=Pepper&oldid=1065895375

Wikipedia (January 2022). **Solanaceae**.
https://en.wikipedia.org/w/index.php?title=Solanaceae&oldid=1068033115

Wikipedia (January 2022). **Tomato.**
https://en.wikipedia.org/w/index.php?title=Tomato&oldid=1068433760

Wikipedia (March 2021). **Lycopersicon.**
https://en.wikipedia.org/w/index.php?title=Lycopersicon&oldid=1013644509

WTO. 1994. **Agreement on the Application of Sanitary and Phytosanitary Measures**. Geneva, World Trade Organization.

APPENDICES

Appendix 1. List of pests found on solanaceous vegetables in the Caribbean region

[source: National Plant Protection Organizations of Member States]

Pest Type	Scientific name	Common name(s)	Host[4]
Bacterium	*Clavibacter michiganensis*	Bacterial wilt	tomato
Bacterium	*Clavibacter michiganensis subsp. michiganensis*	Bacterial canker of tomato	Pepper, tomato
Bacterium	*Endobacteriaceae* sp.	Wilt, dieback of stem, leaf spot	Hot pepper
Bacterium	*Erwinia carotovora subsp. carotovora*	Bacterial root rot of sweet potato	Pepper
Bacterium	*Harobacterium* sp.	Wilt, dieback of stem, leaf spot	
Bacterium	*Pseudomonas solanacearum*	Bacterial wilt	Tomato, pepper
Bacterium	*Pseudomonas syringae* pv. *tomato*	Bacterial speck disease	All
Bacterium	*Ralstonia solanacearum*	Bacterial wilt	All
Bacterium	*Senna obtusifolia*	Sicklepod	Pepper
Bacterium	*Thanatephorus cucumeris (*Frank*)*	Leaf spot, sharp eyespot etc.	Pepper, tomato
Bacterium	*Xanthomonas campestris* pv. *vesicatoria* (Doidge) *Dowson*	Bacterial spot disease of tomato and Pepper	Pepper, tomato
Bacterium	*Xanthomonas vesicatoria*	Bacterial spot, bacterial leaf blight	All
Bacterium	*Xanthomonas vesicatoria, X. euvesicatoria*	bacterial spot of tomato and pepper	All
Fungus	-	Anthracnose	All
Fungus	*Alternaria alternata Fr. Keissler*	Alternaria leaf spot (blight), fruit rot	All
Fungus	*Alternaria capsici-annui*	leaf spot	All
Fungus	*Alternaria dauci*	leaf blight of carrot	All
Fungus	*Alternaria porri*	Purple blotch	Pepper
Fungus	*Alternaria solani* (Ell. & Martin) Sorauer	Early blight, fruit rot	Pepper, tomato
Fungus	*Alternaria tenuissima*	Nail head spot	tomato
Fungus	*Athelia rolfsii*	sclerotium rot	All
Fungus	*Botryodiplodia theobromae* Pat.	Root rot	eggplant
Fungus	*Cercospora capsici* (unamunoi) Heald & Wolf	Frog-eye leafspot of pepper	Hot pepper
Fungus	*Cercospora nicotianae*	Leaf spot	tomato
Fungus	*Cladosporium fulvum*	Tomato leaf mould, olive mould	tomato
Fungus	*Clypeolella solani* Theiss.	Sooty mould	Hot pepper
Fungus	*Colletotrichum capsici* (Syd.) Butl. & Bisby	Leaf spot of peppers	All
Fungus	*Colletotrichum dematium*	leaf spot	All
Fungus	*Colletotrichum gloeosporioides* Penz	Anthracnose	Pepper
Fungus	*Colletotrichum graminicola*	Anthracnose	Tomato

[4] As declared by BMCs

Pest Type	Scientific name	Common name(s)	Host[4]
Fungus	*Colletotrichum lycopersici*	Anthracnose	Tomato
Fungus	*Colletotrichum nigrum* Ell. & Halst.	Anthracnose of tomato	Hot pepper
Fungus	*Colletotrichum phomoides*	Anthracnose of tomato	tomato
Fungus	*Corticium rolfsii (*Sacc.)	Seedling blight	Tomato, pepper
Fungus	*Corticium rolfsii* Curzi	Stem and root rot	Hot pepper
Fungus	*Corticium solani*	Bottom rot	tomato
Fungus	*Corynespora cassiicola*	Target leaf spot of tomato	tomato
Fungus	*Curvularia verruculosa* Tandow & Bilgrami	Leaf spot of grasses	Hot pepper
Fungus	*Diaporthe vexans* (Sacc. & Syd.) Harter	Phomopsis blight	eggplant
Fungus	*Drechslera rostrata* (Dreschsl.) Richardson & Fraser	Leaf spot of grasses	Hot pepper
Fungus	*Fulvia fulva* (Cooke) Ciferri	Tomato leaf mould	Tomato
Fungus	*Fusarium oxysporum*	Fusarium wilt, basal rot	All
Fungus	*Fusarium oxysporum* f.sp. *lycopersici* (Saccardo) Snyder & Hansen	Fusarium wilt	Tomato
Fungus	*Fusarium oxysporum* f.sp. *vasinfectum (Schlechtend)*	Vascular cotton wilt	Pepper
Fungus	*Fusarium oxysporum* Schlecht	Fruit spots, vine spots, leaf blotch, root rot	Hot pepper, tomato
Fungus	*Fusarium semitectum* Berk. & Rav.	Tomato root rot, fungal gummosis	tomato
Fungus	*Fusarium solani* (Mart.) Sacc.	Root rot, dry rot of potato	Eggplant,hot pepper
Fungus	*Glomerella cingulata* (Stoneman*)*	Anthracnose	All
Fungus	*Lasiodiplodia theobromae*	diplodia pod rot of cocoa	All
Fungus	*Leveillula taurica*	Powdery mildew	Tomato, pepper
Fungus	*Macrophomina phaseolina*	charcoal rot of bean/tobacco	All
Fungus	*Macrophomina phaseolina* (Tassi) Goid	Root rot	eggplant
Fungus	*Macrophomina* sp.	Charcoal rot	Hot pepper
Fungus	*Odium* sp.	powdery mildew	All
Fungus	*Passalora fulva*	tomato leaf mould	All
Fungus	*Penicillium digitatum*	Green mould	All
Fungus	*Penicillium italicum*	Blue mould	All
Fungus	*Phoma destructive*	Leaf and Fruit spot	tomato
Fungus	*Phoma exigua* Desm.	Fungal blight	tomato
Fungus	*Phomopsis* (Diaportha*) capsici* (Magnaghi) Sacc.	Phomopsis black rot, cucumber black rot, melon soft rot	Hot pepper
Fungus	*Phomopsis caprici*	Fungal fruit rot	tomato
Fungus	*Phomopsis fusiformis*	Fruit rot	tomato
Fungus	*Puccinia psidii*	Guava rust	Pepper
Fungus	*Rhizoctonia solani*	Collar & root rot, damping off	All
Fungus	*Sclerotium rolfsii*	Seedling blight	Pepper
Fungus	*Sclerotium rolfsii*	Collar rot	tomato
Fungus	*Septoria lycopersici*	Leaf spot	tomato
Fungus	*Stemphylium solani*	Grey leaf spot	All
Fungus	*Verticillium* spp.	Verticillium Wilt	All
Insect	-	Aphids	All

Pest Type	Scientific name	Common name(s)	Host[4]
Insect	-	Cutworms	All
Insect	-	Flea Beetles	All
Insect	-	Gray beetle	All
Insect	-	Pepper weevil	All
Insect	-	Thrips	All
Insect	-	Whiteflies	All
Insect	*Agrius cingulatus*	Pink-spotted hawkmoth	Pepper
Insect	*Agromyza inaequalis*	Bean leaf miner	Hot pepper
Insect	*Agrotis ipsilon* Hufnagel	Cutworm	Eggplant
Insect	*Aleurodicus dispersus*	Spiralling whitefly	All
Insect	*Aleurothrixus floccosus*	woolly whitefly	All
Insect	*Aleurotrachellus trachoides (Back)*	Sweet pepper whitefly	All
Insect	*Anasa scarbutica* (F.)	Squash bug	Lettuce
Insect	*Anastrepha obliqua*	West Indian Fruit Fly	Tomato
Insect	*Anoplodera virens* (L.)	Longhorned beetle	Pepper
Insect	*Aphis craccivora* (Koch)	Groundnut aphid	Tomato
Insect	*Aphis gossypii* Glover	Melon aphid, cotton aphid	All
Insect	*Aphis* sp.	Aphids	All
Insect	*Aphis spiraecola*	Green citrus aphid	All
Insect	*Arvelius albopunctatus* De Geer	White speckled/tomato stink bug	Eggplant, tomato
Insect	*Aspidiotus destructor* (Signoret)	Coconut scale	All
Insect	*Asterolecanium pustulans*	Akee fringed scale	All
Insect	*Atherigona orientalis* (Schiner)	Pepper fruit fly	Pepper
Insect	*Bemisia tabaci*	Tobacco whitefly	Pepper, tomato
Insect	*Bemisia tabaci* (B biotype)	Silverleaf whitefly	Pepper, tomato
Insect	*Bemisia tabaci (*Gennadius*)*	Tobacco whitefly	Pepper, tomato
Insect	*Bisaltes bimaculatus* (Auriv)	Beetle	All
Insect	*Calacarus capsici*	Pepper purple mite	Hot pepper
Insect	*Ceroplastes rubens* Maskell.	Red wax scale	Hot pepper
Insect	*Chrysodeixis chalcites (?)*	Golden twin-spot moth	tomato
Insect	*Chrysodeixis includens (?)*	Soybean looper moth	tomato
Insect	*Chrysomphalus dictyospermi*	dictyospermum scale	All
Insect	*Coccus hesperidum*	Brown soft scale	All
Insect	*Conotrachelus spp.*	Weevil	Hot pepper
Insect	*Contarinia lycopersici* Felt.	Tomato flower midge, gall midge	All
Insect	*Corecoris fuscus*	Leaf-footed bug	Pepper
Insect	*Corythaica cyathicollis (planaris)* (Vhl.)	Eggplant lacewing bug	All
Insect	*Corythaica passiflorae*	Eggplant Lace	Eggplant
Insect	*Corythaica planartis*	Eggplant lacewing bug	eggplant
Insect	*Corythuca gossypii* (Fabricius)	Cotton lacebug	Pepper
Insect	*Cyclocephala spp.*	Beetle	Hot pepper
Insect	*Cyrtopeltis tenuis* Reuter	Tomato mirid	All
Insect	*Diabrotica balteata*	Spotted/Banded cucumber beetle	Hot pepper
Insect	*Diaphania sp.*	Caterpillar	Hot pepper
Insect	*Diaprepes abbreviatus (*Linnaeus*)*	Citrus weevil	Pepper
Insect	*Dysmicoccus brevipes*	pineapple mealybug	All
Insect	*Dysmicoccus neobrevipes*	grey pineapple mealybug	All
insect	*Edessa bifida* Say	Leaf footed bug	Tomato

Pest Type	Scientific name	Common name(s)	Host[4]
Insect	*Edessa meditabunda* (Fabricius)	Green and brown stink bug	All
Insect	*Edessa* sp.	Plant bug	eggplant
Insect	*Empoasca fabae* (Harris)	Potato leafhopper	All
Insect	*Epitrix fasciata*	Leaf Beetles, banded epitrix	Tomato, eggplant
Insect	*Epitrix hirtipennis* (Melscheimer)	Tobacco flea beetle	All
Insect	*Epitrix parvula (fasciata)*	Flea beetle	eggplant
Insect	*Epitrix* sp.	Flea beetles	All
Insect	*Euscepes postfasciatus*	West Indian sweet potato weevil	Hot pepper
Insect	*Euschistus bifibulus*	Brown Stink bug	Pepper
Insect	*Epitrix fasciata Blatchy*	Eggplant flea beetle	Eggplant
Insect	*Expitrix spp.*	Flea beetles	Hot pepper
Insect	*Faustinus cubae* Anths.	Cuban pepper weevil	All
Insect	*Feltia subterranea* (Fabricius)	Granulate cutworm	Pepper, tomato
Insect	*Ferrisia virgata* (Cockerell)	Striped mealybug	All
Insect	*Frankliniella cephalica* (Crawford)	Avocado blossom thrips, flower thrips	Pepper
Insect	*Frankliniella kelliae* Sakimura	thrips	Pepper
Insect	*Frankliniella occidentalis*	Western flower thrips	Pepper
Insect	*Frankliniella schultzei*	Cotton thrips	Pepper, tomato
Insect	*Gargaphia solani* Heidemann	Eggplant lace bug	Eggplant
Insect	*Gnorimoschema capsicum*	Flower bud pepper moth	Pepper
Insect	*Helicoverpa zea* (Boddie)	American cotton bollworm	All
Insect	*Heliothis armigera*	Cotton bollworm	tomato
Insect	*Heliothis virescens* (Fabricius)	Tobacco budworm	Pepper, tomato
Insect	*Heliothis zea* Boddie (*Heliothis armigera* auct. Nec. Hubner)	Cotton bollworm/Cotton earworm/ omato fruit worm	All
Insect	*Hemiberlesia lataniae*	Latania scale	All
Insect	*Herpetogramma bipunctalis (?)*	Southern Beet Webworm Moth	Pepper
Insect	*Hortensia simili* (Wlk.)	Leafhopper	Tomato
Insect	*Insignorthezia insignis*	Greenhouse orthezia	All
Insect	*Keiferia lycopersicella*	Tomato pin worm	tomato
Insect	*Leptoglossus cinctus*	Leaf footed bug	All
Insect	*Leptoglossus* spp.	Leaf footed bug	Eggplant, tomato
Insect	*Liorhyssus hyalinus* (Fabricius)	Hyaline grass bug	Tomato
Insect	*Liriomyza pusilla* (Meig.)	Leafminer	All
Insect	*Liriomyza sativae* (Blanchard)	Vegetable leaf miner	All
Insect	*Liriomyza* spp.	Leaf miner flies	Tomato
Insect	*Liriomyza trifolii*	American serpentine leafminer	All
Insect	*Maconellicoccus hirsutus* (Green)	Pink hibiscus mealybug	Pepper, Tomato
Insect	*Manduca* (*Protaparce*) *sexta* (Linnaeus)	Tobacco horn worm	All
Insect	*Manduca sextus jamaicensis*	Hornworm	tomato
Insect	*Megaselia scalaris*	Leafminer, Phoridae	eggplant
Insect	*Miridae (Bryocorinae)* sp. *(?)*	Plant bug	Pepper
Insect	*Mythimna unipuncta*	rice armyworm	All
Insect	*Myzus persicae* (Sulz.)	Green peach aphid	All
Insect	*Naupactus* spp.		Hot pepper
Insect	*Nezara viridula* (Linneaus)	Green stink bug	All
Insect	*Nipaecoccus viridis*	spherical mealybug	All

Pest Type	Scientific name	Common name(s)	Host[4]
Insect	*Orthezia insignis*	Greenhouse orthezia	All
Insect	*Oxycarenus hyalinipennis*	cotton, seed bug	All
Insect	*Paracoccus marginatus* (Williams and Granara de Willink)	Papaya mealybug	All
Insect	*Phenacoccus madeirensis* (Green)	Cassava mealybug	All
Insect	*Phthia picta* (Drury)	Black bug	All
Insect	*Phthorimaea capsicus*	Tuber moth	All
Insect	*Phthorimaea operculella* (Zell.)	Potato tuber moth, leafminer	All
Insect	*Phythia picta* Drury	Tomato sucker	Tomato
Insect	*Pinnaspis strachani*	lesser snow scale	All
Insect	*Planococcus citri*	citrus mealybug	All
Insect	*Planococcus spp.*	Mealy bug	Hot pepper
Insect	*Platymota spp.*	Mealy bug	Hot pepper
Insect	*Polyphagotarsonemus latus*	Broad mite	All
Insect	*Prodiplosis longifila* Gagne	Gall midge, Bud midge	Hot pepper
Insect	*Pseudaulacaspis pentagona* (Targ.)	Mulberry scale	All
Insect	*Pseudococcus elisae*	banana mealybug	All
Insect	*Pseudococcus jackbeardsleyi*	Jack Beardsley mealybug	All
Insect	*Pseudococcus longispinus*	long-tailed mealybug	All
Insect	*Pseudococcus maritimus* (Ehrh.)	Grape mealybug	All
Insect	*Pulvinaria spp. (?)*	Scale insects	Pepper
Insect	*Pulvinaria urbicola* (Cockerell)	Urbicola soft scale	Pepper
Insect	*Rhectocraspeda periusalis (?)*	Eggplant caterpillar	Eggplant
Insect	*Rhopalosiphum (Myzus) persicae* Sulzer	Cabbage aphid	Hot pepper
Insect	*Saissetia coffeae*	Brown coffee scale	Eggplant,hot pepper
Insect	*Saissetia spp.*	Scale insect	Hot pepper
Insect	*Scapteriscus* sp.	Mole cricket	Tomato
Insect	*Scapteriscus vicinus* Scudder	Mole cricket	All
Insect	*Scirtothrips coccolobae* Collins & Edwards	Seagrape thrips	Pepper
Insect	*Scirtothrips dorsalis*	chilli thrips	All
Insect	*Spartocera batatas F.*	Giant sweet potato bug	Tomato
Insect	*Spodoptera (Prodenia) sunia*	Costa Rican armyworm	Hot pepper
Insect	*Spodoptera eridania*	Southern armyworm	All
Insect	*Spodoptera frudiperda* Smith	Fall armyworm	All
Insect	*Spodoptera latifascia*	Lateral lined armyworm	Pepper, tomato
Insect	*Spodoptera ornithogalli* (Guernee)	Yellow striped armyworm	All
Insect	*Spodoptera* sp.	Armyworm	tomato
Insect	*Spoladea recurvalis*	Hawaiian beet webworm	All
Insect	*Stegobium paniceum*	drugstore beetle	All
Insect	*Symmetrischema capsicum*	Pepper bud moth	pepper
Insect	*Systena s-littera*	Flea beetle	Tomato
Insect	*Thrips palmi* (Karny)	Melon thrips	All
Insect	*Thrips parvispinus* (Karny)	Tobacco thrips	
Insect	*Thrips tabaci* (Linderman)	Potato thrips, onion thrips	All
Insect	*Thyanta antiguensis*	Pentatomid bug	tomato
Insect	*Trialeurodes vaporariorum*	whitefly, greenhouse	All
Insect	*Trichoplusia ni*	cabbage looper	All
Insect	*Unaspis citri*	Citrus snow scale	Pepper
Mite	*Aculops lycopersici*	Tomato russet mite	tomato
Mite	*Aculus lycopersici*	Russet mite	tomato

Pest Type	Scientific name	Common name(s)	Host[4]
Mite	*Polyphagotarsonemus latus* (Banks)	Broad mite	Pepper
Mite	*Steneotarsonemus pallidus*	Cyclamen mite	tomato
Mite	*Tetranychus evansi*	Red Spider Mites	Tomato
Mite	*Tetranychus marianae*	Spider mite	All
Mite	*Tetranychus* sp.	Spider mite	Eggplant, tomato
Mite	*Vasates lycopersici*	Tomato russet mite	All
Mollusc	*Veronicella occidentalis*	Slug	tomato
Nematode	*Aphelenchus* sp.	Fungivorous nematodes	Hot pepper
Nematode	*Helicotylenchus dihystera*	Common spiral nematode	All
Nematode	*Helicotylenchus multicinctus*	Banana spiral nematode	All
Nematode	*Helicotylenchus pseudorobustus*	Spiral nematode	Eggplant, tomato
Nematode	*Helicotylenchus sp.*	Spiral nematodes	Hot pepper
Nematode	*Hemicycliophora shepherdi*	-	All
Nematode	*Meloidogyne arenaria* (Neal) Chitwood	Peanut root knot nematode	Tomato, Hot pepper
Nematode	*Meloidogyne hapla*	Root knot nematode	tomato
Nematode	*Meloidogyne incognita* (Kofoid & White) Chitwood	Root knot nematode	All
Nematode	*Meloidogyne javanica*	Root knot nematode	tomato
Nematode	*Meloidogyne* sp	Root knot nematodes	Tomato, eggplant
Nematode	*Pratylenchus sp.*	Root lesion nematode	Tomato, hot pepper
Nematode	*Radopholus similis* (Cobb)	Burrowing nematode	Tomato
Nematode	*Rotylenchulus reniformis* Linford & Oliveira	Reniform/Spiral nematode	All
Nematode	*Scutellonema bradys*	Yam dry rot nematode	Tomato
Nematode	*Trichodorus spp.*	Stubby root nematodes	Hot pepper
Nematode	*Tylenchorhynchus sp.*	Stunt nematode	Tomato, hot pepper
Nematode	*Tylenchus sp.*	Nematode	tomato
Nematode	*Xiphinema americanum*	Root gall nematode	Eggplant
Nematode	*Xiphinema sp.*	Dagger nematode	Hot pepper
Nematode	*Xiphinema vulgare*	Dagger nematode	All
Oomycete	*Albugo ipomoeae-panduratae*	White rust of sweet potato	Pepper
Oomycete	*Phytophthora infestans*	Phytophthora blight	All
Oomycete	*Phytophthora nicotianae*	black shank	All
Oomycete	*Phytophthora* sp.	Phytophthora Blight, foot rot	All
Oomycete	*Pythium butleri*	Damping off	tomato
Oomycete	*Pythium debaryanum*	damping-off	All
Virus	-	Unidentified	Pepper
Virus	-	Mosaic Virus	All
Virus	Cucumber Mosaic Virus	CMV	All
Virus	*Corythaicha cyathicollis*	Cucumber mosaic cucumovirus	Eggplant
Virus	*Cucumber Mosaic Virus*	Cucumber mosaic	All
Virus	Pepper vein banding virus	Pepper vein banding virus	Hot pepper
Virus	Potato leafroll virus	-	Pepper, tomato
Virus	Potato Virus Y	Potato Mottle	Tomato, hot pepper
Virus	Sweet potato leaf curl virus	Potato leaf curl	Tomato
Virus	TMV	-	All
Virus	Tobacco Etch Virus	Tobacco streak	Pepper
Virus	Tobacco Mosaic Virus	Tobacco Mosaic	Tomato, hot pepper
Virus	Tomato leaf curl begomovirus	-	All
Virus	Tomato Spotted Wilt Virus	Tomato spotted wilt	tomato

Pest Type	Scientific name	Common name(s)	Host[4]
Virus	Tomato Yellow Leaf Curl Virus	Leaf curl (TYLCV)	tomato
Weed	*Emilia sonchifolia*	Consumption weed	Tomato
Weed	*Parthenium hysterophorus*	Parthenium weed	Tomato
Weed	*Synedrella nodiflora*	Cinderella weed	Tomato

Appendix 2. List of pests of solanaceous vegetables regulated by countries in the Caribbean region

[Source: National Plant Protection Organisations of Member States]

Pest Type	Scientific name	Common name(s)	Host
Bacterium	*Clavibacter michiganensis subsp. michiganensis* (Smith) Davis *et al.*	Bacterial canker of tomato	Tomato
	Clavibacter michiganensis subsp. sepedonicus (Spieckermann & Kotthoff) Davis *et al.*	bacterial ring rot of potato	Tomato, Solanum sp.
	Erwinia carotovora pv. *atroseptica* (van Hall, 1902) Dye, 1962	Black leg	Euphorbia sp., Solanum sp.
Fungi	*Colletotrichum* spp.	Anthracnose	
Insect	*Agriotes lineatus*	wireworm	tomato
	Anastrepha suspensa (Loew)	Caribbean Fruit fly	Pepper, tomato
	Anthonomus eugenii (Cono)	Pepper weevil	All
	Aulacorthum solani (Kaltenbach)	Foxglove aphid	
	Bactrocera cucurbitae (Coquillett)	Melon fly	
	Bactrocera invadens (Drew *et al.*, 2005)	New polyphagous fruit fly species (Central Africa) Asian fruit fly	Tomato
	Bactrocera latifrons (Hendel)	Malaysian fruit fly	*Capsicum* spp.
	Bactrocera tryoni (Froggatt)	Queensland Fruit Fly	Pepper, tomato
	Batrocera carambolae (Drew & Hancock)	Carambola Fruit fly	
	Batrocera dorsalis (Hendel)	Oriental Fruit fly	*Capsicum* spp.
	Ceratitis capitata (Weidermann)	Mediterranean fruit fly	*Capsicum* spp.
	Chaetocnema confinis Crotch, 1873	Sweet potato flea beetle	Tomato
	Conoderus falli (Lane)	Potato wireworm	tomato
	Conoderus rudis (Brown)	Wireworm	
	Contarinia maculipennis Felt	Blossom midge	All
	Diabrotica balteata (leconte)	Banded cucumber beetle	
	Duponchelia fovealis (Zeller)	Moth	
	Faustinus cubae (Boheman)	Stem borer (Hot Pepper)	*Capsicum* spp.
	Frankliniella bispinosa (Morgan)	Florida flower thrips	
	Frankliniella occidentalis (Pergorde)	Western flower thrips	
	Keiferia lycopersicella (Walsingham)	Tomato pin worm	All
Insect	*Leptoglossus zonatus* (Dollas)	Leaf footed bug	Tomato, eggplant

Pest Type	Scientific name	Common name(s)	Host
	Listroderes costirostris obliquus (Schonherrr)	Vegetable weevil	
	Neoleucinodes elegantalis (Guenée) 1854	tomato fruit borer, eggplant moth (stem borer), cocona fruit borer	
	Ostrinia nubilalis	European corn borer	
	Othreis fullonia Linnaeus [*Preferred SN: *Eudocima fullonia* (Clerck, 1764)]	Pacific fruit-piercing moth	Pepper, tomato
	Paracoccus marginatus Williams & Granara de Willink, 1992	Papaya Mealy bug	Eggplant
	Phenacoccus manihoti	Cassava mealybug	
	Phthorimaea operculella (Zeller 1873)	Potato tuber moth	Eggplant, tomato
	Prodiplosis longifila Gagné	Citrus gall midge	Tomato, pepper
	Scapteriscus vicinus	Mole Cricket	tomato
	Solenopsis geminata (Fabricius)	Fire ant	tomato
	Spodoptera litura (Fabricius)	Cluster caterpillar	Tomato, pepper
	Spoladea recurvali (Fabricius)	Hawaiian beet webworm	Eggplant
	Thaumatotibia leucotreta (Meyrick)	False codling moth	
	Trialeurodes abutilonea Haldeman	Bandedwinged whitefly	*Capsicum* spp.
	Trialeurodes vaporariorum Westwood 1856	Greenhouse whitefly	Eggplant
	Tuta absoluta	South American tomato pinworm, Tomato leafminer, tomato stemborer	All
	Zonosemata electa	Pepper maggot	All
Mite	*Tetranychus cinnabarinus* (Boisduval)	Carmine spider mite	Tomato
Mollusc	*Veronicella cubensis* (Pfeiffer)	Two-striped slug	Pepper, eggplant
Nematode	*Globodera pallida* (Wollenweber) Behrens	White tip nematode Golden nematode- (G.p)	Eggplant
Phytomonad	*Phytomonas* spp.		Tomato
Virus	Gemini Virus Complex	Tomato Yellow Leaf Curl	Pepper, tomato
	Potato Virus Y		
	Tomato Brown Rugose Fruit Virus	Tomato Brown Rugose Fruit Virus	All
	Tomato Brown Rugose Virus		Tomato
Virus	Tomato bushy stunt tombusvirus (TBSV)	tomato bushy stunt virus	
	Tomato ringspot nepovirus	tomato ringspot virus	