# CHAPTER 1

## RISK ANALYSIS BACKGROUND AND PROCESS

### 1.1. Background

Pest Risk Analysis provides the rationale for phytosanitary measures for a specified PRA area. It evaluates scientific evidence to determine whether an organism is pest. If so, the analysis evaluates the probability of introduction and spread of the pest and the magnitude of potential economic consequences in a defined area, using biological or other scientific, economic and environmental evidences. If the risk is deemed unacceptable, the analysis may continue by the suggestions of management options that can reduce the risk to an acceptable level. Subsequently, pest risk management options may be used to establish phytosanitary regulations.

Brinjal or eggplant (*Solanum melongena* L.) is the most common, popular and principal vegetables in Bangladesh and other parts of the world (Nonnecke, 1989). Brinjal is the second most important vegetables crops after brinjal in relation to its total production (Anon., 1996). This useful crop is grown all the year round in Bangladesh and covers 46558 ha with a production of 341000 tons (BBS, 2010) with about 25.4% of the total vegetable area of the country. Brinjal is grown all over areas and seasons of Bangladesh. But the brinjal is intensively grown in winter season in Jessore, Mymensingh, Narsingdi, Comilla, Savar, Bogra, Jamalpur, Dinajpur, Rajshahi districts of Bangladesh. In the year of 2010-11, the brinjal production was about 339874 metric tons with acreage of about 115018 ha of land (BBS, 2012).

More than 100 horticultural crops including brinjal are exported from Bangladesh. Export of fresh fruits and vegetables (FFVs) from Bangladesh increased from 9,000 tons in 1992-93 to 48428 tons in 2010-2011. The major export market comprises UK (46%), Italy (8%), other EU countries (3%) and Middle East countries (43%). More than 50 fresh fruits and vegetables are exported to UK alone. Exports are targeted for ethnic market. Besides, fresh fruits and vegetables, frozen products about 250-300 tons at a value of about 3 million US$ are exported for both ethnic and mainstream markets. Among the fresh vegetable and fruit items, brinjal stands sixth position. The United Kingdom and Middle East are the main export market of brinjal from Bangladesh. Simultaneously, the brinjal used for seed in Bangladesh mostly imported from the India as well as from other countries such as Thailand. But for the quarantine importance, importing countries need intensive study findings on the insect pests, diseases and other pests associated with brinjal in Bangladesh.

The introduction of insect pests, plant diseases, weeds and other pest associated with the commodity is brought about mainly during the accelerated agricultural development in different countries, when plants and plant materials were brought into, or sent out with little or no concern for the insect pests, diseases, weeds and other pests that were transported along with them. There are many instances of accidental introductions of insect pests and destructive diseases from one country to another. Extensive damages, often sudden in nature, have been caused not by indigenous pests, but with exotic ones introduced along with plants, plant parts or seeds in the normal channel of trade or individual interest. Instances may be cited of the introduction of grape *phylloxera (Phylloxera vitifolia*) from the U.S.A. to France which caused destruction of French vineyards; Mexican boll weevil (*Anthonomus grandis)* whose original home was in Mexico or Central America, round about 1892 entered the U.S.A. and later to various countries in the world, causing extensive damage to cotton; European corn borer (O*strinia nubilalis)* which reached North America probably through broom corn from Italy or Hungary and has since become a major pest there. Pink ball worm (*Pectinophora gossypiella*) considered to be one of the six most destructive insects of the world probably a native of India is now established as a highly destructive pest in nearly all cotton growing areas of the world. Downy mildew of grape

(*Plasmopara viticola*) introduced in France from the U.S.A. was responsible for the destruction of grape vines till the discovery of Bordeaux mixture. Blight disease of chestnut (*Endothia parasitica*) introduced into the U.S.A. from Europe completely wiped out chestnut plants.

Brinjal is susceptible to attack of various insects from seedling to fruiting stage. This crop is infested by 18 different insect species including brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee; epilachna beetle, *Epilachna vigintioctopunctata* Fab. and aphid, *Aphis gossypii* Glover. In Bangladesh, about eight insect species are considered as major pests causing damage to the crop (Biswas *et al*., 1992). Hill (1983) reported 50 insect pests cause damage to brinjal. Besides, Red spider mite (*Tetranychus urticae)* also causes damage to the brinjal leaf. A number of diseases also cause damage of flowers, fruits, leaves, seedlings, and twigs of brinjal. Among these the important diseases are the Early blight (*Alternaria tomatophilia*), Cercospora leaf spot (*Cercospora melongenae*), Colletotrichum fruit rot (*Colletotrichum melongenae*), Phomopsis fruit rot (*Phomopsis vexans*), Root-knot Nematodes (*Meloidogyne incognita*), Damping off of brinjal (*Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp.), etc. There are several weeds found in the field of brinjal in Bangladesh. The major weeds are *Cynodon dactylon, Cyperus rotundus, Echinochloa crusgalli, Elusine indica* etc.

Due to imports of eggplant seeds and or plant stocks with tropical and subtropical countries of the world, the possibility for introduction and establishment of quarantine pests along with the consignment of the commodity remains as threat. Therefore, the pathway risk analysis of brinjal from exporting countries to Bangladesh is essential. In this context, the Pest Risk Analysis (PRA) of brinjal in Bangladesh is indispensable. Thus, the assignment on Pest Risk Analysis (PRA) of brinjal in Bangladesh was undertaken aiming to identify pests and/or pathways of quarantine concern for the brinjal grown areas and evaluate their risk, to identify endangered areas, as well as to identify risk management options.

### 1.2. Scope of the Risk Analysis

The scope of this analysis is to findout the potential hazard organisms or diseases associated with brinjal seeds and planting materials imported from different exporting countries named India, China, Thailand, Japan. Risk in this context is defined as the likelihood of the occurrence and the likely magnitude of the consequences of an adverse event.

### 1.3. Objective of the PRA study

The overall objective of a Pest Risk Analysis by the SPCB Project is to support National Plant Protection Organization (NPPO) to identify pests and/or pathways of quarantine pests to be associated with the commodity which brings along with them a certain risk of the introduction of diseases and pests that are harmful to agriculture. The consulting Firm is required to identify the pests, pathway/s, evaluate their risk, endangered areas, and risk management options etc.

The **Specific Objectives** of the recruitment of a Pest Risk Analysis Consulting Firm are:

- Listing of major and minor pests mentioning plant parts affected
- Listing of regulated pests
- Identification and categorization of pests likely to be associated with a pathway
- Identification of potentials for entry, establishment and spread of regulated pests
- Identification of probability of survival during transport or storage & transfer of hosts
- Identification of probability of pest surviving existing pest management procedures
- Identification of availability of suitable hosts, alternate hosts and vectors in the PRA areas
- Identification of potential economic and environmental impacts
- Assessment of potential loss by the pests

- Identification of management options/system approach for control of regulated pests
- Preparation of report on risk analysis of the pests following the relevant ISPMs &

### 1.4. Methods of Data Colletion

The methodology for the present PRA study used system-wide approach, which involved wide-ranging and sequenced discussion with relavent stakeholders aiming to identify the insect pests, diseases and other associated pests of mangoes, their potential hazards, quarantine concern of the pests, their risk and management options. The study involved the use of (i) field survey through structured questionnaire, (ii) semi-structured interviews by means of focus group discussions (FGD), (iii) formal and non-formal interviews through Key Informant Interview (KII); (iv) collection of primary and secondary information, reviewing the available reports and (v) physical field visits to the sampled area.

#### 1.4.1. Major Activities

**Field survey**

The study survey was conducted with the direct interview of farmers, field level DAE Officials, Seed Dealers/Traders and Pesticide Dealers/Traders in 24 major brinjal growing districts of Bangladesh for quantitative data aiming to identify insect pests, diseases, weeds and other pests, their status, damane severity, and management options; quarantine pests with their entry, establishment, risk and their management. The qualitative data were also collectected through focus group discussions (FGD) with farmers and through key informant interviews (KII) with extension personnel at field and headquarer level, Plant Quarantine Centres at Sea and land port, officials of Ministry of Agriculture, Entomologist and Plant Pathologist of Bangladesh Agricultural Research Institute (BARI), Agricultural Universities, and brinjal importers and Exporters.

**Collection and Review of Secondary Documents**

The current PRA related secondary data were collected and gathered from secondary sources such as journals, books, proceedings, CD-ROM search, internet browsing especially through websits of CAB International, EPPO Bulletin and others. The documents were then critically reviewed, synthesized in relation to identify the quarantine pests of brinjal available in the brinjal exporting counties such as India, China, Thailand and Japan as well as PRA related activities performed there. Ultimately, formulated all of these synthesized information based on the requirement of the current PRA.

**Listing of pests of brinjal**

The insect pests, diseases, weeds and other associated pests of brinjal were identified through the field survey, focus group discussion, Key Informant Interview and direct field visit and prepared a list of insect pests, diseases, weeds and other associated pests of the target crops following the framework for pest risk analysis adopted by the IPPC in International Standard for Phytosanitary Measures (ISPMs) and other related ISPMs. The quarantine pests of brinjal in Bangladesh were also listed.

#### 1.4.2. Study and Sampling Areas

The survey study sas conducted in 24 major brinjal growing districts of Bangladesh as selected by the client—Project Director, Stenghthening Phytosanitary Capacity in Bangladesh (SPCB) under Plant Quarantine Wing (PQW), DAE, Bangladesh. A total 71 upazilas were selected under the 24 sampled distrcts, where 10 agricultural blocks were covered under each upazilla and 10 brinjal farmers were interviewed in each block through pre-tested questionnaire. Thus, a total of 7100 farmers were interviewed from all of 24 sampled districts. Besides, local level officials of DAE, Pesticide Dealers and Seed Dealers were also interviewed for each district and upazilas through questionnaire. The district and upazila wise distribution of respondents is given below:

**Table-1: Distribution of the respondents in major flower growing districts of Bangladesh**

| SN | District | Upazilla | No. of Block | No. of Farmers | Field level officer | Policy Level Officer | Pesticide Dealer | Seed dealer | No. of FGD |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Norshingdi | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Shibpur | 10 | 100 | 2 | | | | |
| | | Raipura | 10 | 100 | 2 | | | | |
| | | Monohordi | 10 | 100 | 2 | | | | |
| | | Belabo | 10 | 100 | 2 | | | | |
| 2 | Manikgonj | Singair | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Saturia | 10 | 100 | 2 | | | | |
| | | Sadar | 10 | 100 | 2 | | | | |
| 3 | Gazipur | Kaligonj | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Kapasia | 10 | 100 | 2 | | | | |
| | | Sadar | 10 | 100 | 2 | | | | |
| | | Kaliakoir | 10 | 100 | 2 | | | | |
| 4 | Narayangonj | Soangaon | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Araihazar | 10 | 100 | 2 | | | | |
| 5 | Comilla | Chandina | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Daudkandi | 10 | 100 | 2 | | | | |
| | | Burichong | 10 | 100 | 2 | | | | |
| | | Barura | 10 | 100 | 2 | | | | |
| | | Debiddar | 10 | 100 | 2 | | | | |
| | | Sadar South | 10 | 100 | 2 | | | | |
| 6 | Chandpur | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Hajigonj | 10 | 100 | 2 | | | | |
| 7 | Jamalpur | Islampur | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Sadar | 10 | 100 | 2 | | | | |
| | | Sarishabari | 10 | 100 | 2 | | | | |
| 8 | Mymensingh | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Gafargaon | 10 | 100 | 2 | | | | |
| 9 | Kishorgonj | Hosenpur | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Pakundia | 10 | 100 | 2 | | | | |
| 10 | Tangail | Modhupur | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Ghatail | 10 | 100 | 2 | | | | |
| | | Dhanbari | 10 | 100 | 2 | | | | |
| 11 | Sherpur | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Nalitabari | 10 | 100 | 2 | | | | |
| 12 | Chittagong | Potia | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Shitakunda | 10 | 100 | 2 | | | | |
| | | Mirershorai, | 10 | 100 | 2 | | | | |
| | | Fatikchari | 10 | 100 | 2 | | | | |
| 13 | Bogra | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Gabtoli | 10 | 100 | 2 | | | | |
| | | Shibgonj | 10 | 100 | 2 | | | | |
| | | Shajhanpur | 10 | 100 | 2 | | | | |
| 14 | Pabna | Iswardi | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Atghoria | 10 | 100 | 2 | | | | |
| 15 | Rajshahi | Poba | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Puthia | 10 | 100 | 2 | | | | |
| | | Durgapur | 10 | 100 | 2 | | | | |
| 16 | Natore | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Baghatipara | 10 | 100 | 2 | | | | |
| 17 | Kustia | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Doulatpur | 10 | 100 | 2 | | | | |
| 18 | Jessore | Bagarpara | 10 | 100 | 2 | 1 | 2 | 2 | 1 |

| SN | District | Upazilla | No. of Block | No. of Farmers | Field level officer | Policy Level Officer | Pesticide Dealer | Seed dealer | No. of FGD |
|---|---|---|---|---|---|---|---|---|---|
| | | Chougacha | 10 | 100 | 2 | | | | |
| | | Sadar | 10 | 100 | 2 | | | | |
| | | Keshobpur | 10 | 100 | 2 | | | | |
| 19 | Chuadanga | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Alamdanga | 10 | 100 | 2 | | | | |
| 20 | Jhenidah | Kaligonj | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Court Chandpur | 10 | 100 | 2 | | | | |
| | | Shoilokupa | 10 | 100 | 2 | | | | |
| | | Harinakunda | 10 | 100 | 2 | | | | |
| 21 | Magura | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Mohammadpur | 10 | 100 | 2 | | | | |
| 22 | Barisal | Uzirpur | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Babugonj | 10 | 100 | 2 | | | | |
| 23 | Bhola | Sadar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Daulotkhan | 10 | 100 | 2 | | | | |
| 24 | Dhaka | Savar | 10 | 100 | 2 | 1 | 2 | 2 | 1 |
| | | Dhamrai | 10 | 100 | 2 | | | | |
| | | Keranigonj | 10 | 100 | 2 | | | | |
| **Total=24** | | **71** | **710** | **7100** | **142** | **24** | **48** | **48** | **24** |

### 1.4.3. Development of data collection tools

The most appropriate tools used in this field study are discussed below:

**Field survey questionnaire:** For quantitative analysis, the field survey was conducted in 24 major brinjal growing districts of Bangladesh through face to face interview with 7100 brinjal growers using a questionnaire encompassing the relevant study indicators. The 24 policy level officer (Additional Deputy Director (PP)) and 142 field level officers of DAE, 48 Pesticides Dealers/Traders and 48 Seed Dealers/Traders were also interviwed through questionnaire (**Appendix-1-5)**.

**Focus Group Discussion (FGD):** For qualitative analysis, 24 FGD meetings were organized considering one FGD for each sampled districts with the participantion of at least 10 flower growers for each. The FGD meetings were conducted using pre-designed FGD guidelines (**Appendix-6**).

**Field visit/physical observation:** In addition, the expert team of the study physically visited the sampled districts of the study area aiming to observe the physical status of the insect pests, diseases and other associated pest problems in field condition**.**

## 1.5. Pests of brinjal recorded in Bangladesh

The study for “Conducting Pest Risk Analysis (PRA) of Brinjal in Bangladesh” was done in 24 major brinjal growing districts of Bangladesh. From the field survey and review of sectondary documents, the precise findings of the study in-line with the presence of insect and mite pests, diseases and weed pests have been presented below:

### 1.5.1. Insect and mite pests of brinjal

A total number of 20 athropod pests of eggplants were reported in Banlgadesh, among which 19 were insect pests and one was mite pest.

The incidences of insect pests of eggplants recorded in Bangladesh were brinjal shoot and fruit borer (*Leucinodes orbonalis*), cut worm (*Agrotis* spp.), leaf roller (*Eublemma olivacea* Walker), cotton leaf worm (*Spodoptera litura*), cabbage caterpillar (*Helicoverpa armigera*), eggplant moth (*Neoleucinodes elegantalis*), jassid (*Amrasca biguttula biguttula*), cotton aphid (*Aphis gossypii* Glover ), whitefly (*Bemisia tabaci*), scale insect (*Aulacaspis* spp.), mealybug (*Coccidohystrix insolita*), potato psyllid (*Bactericera cockerelli*), lace bug (*Gargaphia solani*), epilachna beetle (*Epilachna vigintioctopunctata* and *Epilachna dodecastigma*), blister beetle (*Mylabris pustulata*), spotted cucumber beetle (*Diabrotica undecimpunctat*), thrips (*Thrips palmi* Karny), leaf miner (*Liriomyza sativae*), and one mite named two-spotted spider mite (*Tetranychus urticae* Koch).

Among these insect and mite pests of eggplants, brinjal shoot and fruit borer, leaf roller, jassid and epilachna beetle are more damaging than others. Of which, brinjal shoot and fruit borer caused damage eggplants with high intensity. Whereas, the pest status of all other insect and mite pests were minor and caused damage eggplants with low infestation intensity.

### 1.5.2. Diseases of eggplants recorded in Bangladesh

A total number of 18 diseases of eggplants were reported in Bangladesh, among which 12 diseases caused by fungi, 2 diseases caused by bacteria, 2 diseases caused by nematode, 1 disease was caused by virus and one caused by Phytoplasma.

The incidences of fungal diseases of eggplants reported in Bangladesh were early blight (*Alternaria tomatophilia*), cercospora leaf spot (*Cercospora melongenae*), colletotrichum fruit rot (*Colletotrichum melongenae*), anthracnose (*Colletotrichum coccodes*), phomopsis fruit rot (*Phomopsis vexans*), phytophthora blight (*Phytophthora capsici*), Verticillium wilt (*Verticillium* spp.), stem rot/damping off (*Fusarium solani*), root rot (*Pythium* spp.), damping off (*Rhizoctonia* spp.), powdery mildew (*Podosphaera pannosa*), downy mildew (*Peronospora sparsa*),

The incidence of bacterial diseases of eggplants recorded in Bangladesh were bacterial wilt (*Ralstonia solanacearum*), bacterial soft rot (*Erwinia carotovora* subsp*. carotovora*). The nemic diseases of eggplants were root knot nematode caused by *Meloidogyne incognita* and *M. javanica*. The incidences of viral disease of eggplants recorded in Bangladesh was *Tomato leaf curl New Delhi virus* and the disease caused by Phytoplasma was little leaf of brinjal caused by *Candidatus Phytopasma solani* But the incidences of golder cyst nematode (*Globodera rostochiensis*), and pale cyst nematode (*Globodera pallida*) were not reported as the diseases of eggplants in Bangladesh. No Potyvirus and Nucleorhabdovirus were found in the seeds of brinjal as tested by reverse transcription-polymerase chain reaction (RT-PCR) in Bangladesh **(Appendix 6)**.

Among these diseases, the phomopsis fruit rot, bacterial wilt and damping off of seedlings were more damaging than others. Bacterial wilt of eggplant was major disease caused damage with medium severity. All of other diseases were reported as minor diseases in Bangladesh with low infection intensity. Most of the cases, the damage severity was controlled by the routine application of fungicides in field condition.

### 1.5.3. Weeds of eggplants recorded in Bangladesh

A total number of 8 weeds were reported as the problem in the field of eggplants in Bangladesh. The incidences of weeds in the field of eggplants as reported were bermuda grass (*Cynodon dactylon*), nutsedge (*Cyperus esculentus*), goosefoot (*Chenopodium album* L.), pigweed (*Amaranthus acanthochiton*), spiny pigweed (*Amaranthus spinosus*), blacknightshade (*Solanum nigrum*), horsenettle (*Solanum carolinense* L.), parthenium weed (*Parthenium hysterophorus*) (Table 4). The parthenium weed (*Parthenium hysterophorus*) was recorded and found only some restricted areas of Bangladesh such as Rajshahi,

Natore, Pabna, Kustia, Jessore districts. It was also reported that the parthenium weed might be entered into Bangladesh through cross boundary pathway from India by the transportation system of border trading.

Among the eight weeds, the Parthenium was more damaging than other and caused damage in the whole season with low infestation intensity. As a newly introduced weed, though parthenium caused damage with low infestation intensity, but it could cause severe damage and spread to other areas, if not controlled properly. Other seven weeds were reported as minor weeds with low infestation intensity.

### 1.5.4. Management options for eggplants in Bangladesh

**Insect and mite pest management:** The most effective management practices commonly used by the farmers in Bangladesh against the insect pests of brinjal were spraying of insecticides followed by removal of infested plants from the field, seed treatment and use of balanced fertilizer. The use of pheromone traps against *Leucinodes orbonalis* was the most effective and eco-friendly management practice. The acaricides were also used for the controll of the infestation of mite.

**Disease management:** The most effective and commonly practiced management options against the diseases of eggplants were spraying of fungicides in the field, followed by removal of weeds and diseased plants/pruning of the diseased parts of the plants. Seed treatment was also the effective management of eggplant diseases. But the control of bacterial disease of brinjal was difficult.

**Weeds management:** The most effective and commonly practiced management options for weeds in the field of eggplants were weeding from the field, followed by removal of weeds during land preparation. Other options were earthing up at the base of plants and use of herbicides.

**Table 2. Insect and mite pests of eggplants, their status, plant parts affected and infestation severity**

| Sl. No. | Common name | Scientific name | Family | Order | Plant parts affected | Pest status | Infestation severity |
|---|---|---|---|---|---|---|---|
| 1 | Brinjal shoot and fruit borer | *Leucinodes orbonalis* | Pyralidae | Lepidoptera | Flower bud, leaf, twig | Major | High |
| 2 | Cut worm | *Agrotis spp.* | Noctuidae | Lepidoptera | Seedlings | Minor | Low |
| 3 | Leaf roller | *Eublemma olivacea* Walker | Noctuidae | Lepidoptera | Leaf and twigs | Minor | Low-medium |
| 4 | Cotton leaf worm | *Spodoptera litura* | Noctuidae | Lepidoptera | Leaf, twigs | Minor | Low |
| 5 | Cabbage caterpillar | *Helicoverpa armigera* | Noctuidae | Lepidoptera | Fruits, leaf | Minor | Low |
| 6 | Eggplant moth | *Neoleucinodes elegantalis* | Crambidae | Lepidoptera | Fruits, flowers | Minor | Low |
| 7 | Jassid of brinjal | *Amrasca biguttula biguttula* | Cicadellidae | Homoptera | Leaf, flowers | Minor | Low |
| 8 | Aphid | *Aphis gossypii Glover* | Aphididae | Homoptera | Leaf, flower, twig | Minor | Low |
| 9 | Whitefly | *Bemisia tabaci* | Aleurodidae | Homoptera | Leaf, twig | Minor | Low |
| 10 | Scale insect | *Aulacaspis* spp. | Margarodidae | Homoptera | Stem | Minor | Low |
| 11 | Mealybug | *Coccidohystrix insolita* | Pseudococcidae | Homoptera | Stem, leaf, twig, bud | Minor | Low |
| 12 | Potato psyllid | *Bactericera cockerelli* | Triozidae | Hemiptera | Leaf, twig | Minor | Low |
| 13 | Lace bug | *Gargaphia solani* | Tingidae | Hemiptera | Leaf, twig | Minor | Low |
| 14 | Epilachna beetle | *Epilachna vigintioctopunctata* | Coccinellidae | Coleoptera | Leaf, twig | Minor | Low |
| 15 | Epilachna beetle | *Epilachna dodecastigma* | Coccinellidae | Coleoptera | Leaf, twig | Minor | Low |
| 16 | Blister beetle | *Mylabris pustulata* | Meloidae | Coleoptera | Leaf, twig | Minor | Low |
| 17 | Spotted cucumber beetle | *Diabrotica undecimpunctata* | | Coleoptera | Leaf, twig | Minor | Low |
| 18 | Thrips | *Thrips palmi* Karny | Thripidae | Thysanoptera | Leaf, flower, twig | Minor | Low |
| 19 | Leaf miner | *Liriomyza sativae* | Agromyzidae | Diptera | Leaf | Minor | Low |
| 20 | Two-spotted spider mite | *Tetranychus urticae* Koch | Tetranychidae | Acarina | Leaf, twig | Minor | Low |

**Table 3. Diseases of eggplants, their status, plant parts affected and infestation severity**

| Sl. No. | Common name | Scientific name | Family | Order | Plant parts affected | Pest status | Infestation severity |
|---|---|---|---|---|---|---|---|
| **Causal organism: Fungi** | | | | | | | |
| 1 | Early blight | *Alternaria tomatophilia* | Pleosporaceae | Pleosporales | Leaf, twig | Minor | Low |
| 2 | Cercospora leaf spot | *Cercospora melongenae* | Mycosphaerellaceae | Capnodiales | Leaf, fruits | Minor | Low |
| 3 | Colletotrichum fruit rot | *Colletotrichum melongenae* | Glomerellaceae | Glomerellales | Fruit, leaf, twig | Minor | Low |
| 4 | Anthracnose | *Colletotrichum coccodes* | Glomerellaceae | Glomerellales | Leaf, stem, twig, fruit | Minor | Low |
| 5 | Phomopsis fruit rot | *Phomopsis vexans* | Diaportaceae | Diaporthales | Fruit, leaf | Minor | Low |
| 6 | Phytophthora blight | *Phytophthora capsici* | Pythiaceae | Peronosporales | Leaf, twig, fruit | Minor | Low |
| 7 | Verticillium wilt | *Verticillium* spp. | Plectosphaerellaceae | Incertae sedis | Seedling, whole plant | Minor | Low |
| 8 | Stem rot/damping off | *Fusarium solani*. | Nectriaceae | Hypocreales | Seedling, stem | Minor | Low |
| 9 | Root rot | *Pythium* spp. | Nectriaceae | Hypocreales | Seedling, stem | Minor | Low |
| 10 | Damping off | *Rhizoctonia* spp. | Nectriaceae | Hypocreales | Seedling, stem | Minor | Low |
| 11 | Powdery mildew | *Podosphaera pannosa* | Erysiphaceae | Erysiphales | Flower, leaf | Minor | Low |
| 12 | Downy mildew | *Peronospora sparsa* | Peronosporaceae | Peronosporales | Leaf | Minor | Low |
| **Causal organism: Bacteria** | | | | | | | |
| 13 | Bacterial wilt | *Ralstonia solanacearum* | Ralstoniaceae | Burkholderiales | Seedling, whole plant | Major | Medium |
| 14 | Bacterial soft rot | *Erwinia carotovora* subsp. *carotovora* | *Enterobacteriaceae* | *Enterobacteriales* | Fruit | Minor | Low |
| **Causal organism: Nematode** | | | | | | | |
| 15 | Root knot nematode | *Meloidogyne javanica* | Heteroderidae | Tylenchida | Root, stem | Minor | Low |
| 16 | Root knot nematode | *Meloidogyne incognita* | Heteroderidae | Tylenchida | Root, stem | Minor | Low |
| 17 | Golder cyst nematode | *Globodera rostochiensis* | Heteroderidae | Tylenchida | Not recorded in Bangladesh | | |
| 18 | Pale cyst nematode | *Globodera pallid* | Heteroderidae | Tylenchida | Not recorded in Bangladesh | | |
| **Virus** | | | | | | | |
| 19 | Tomato leaf curl New Delhi virus | *Tomato leaf curl New Delhi virus* | Geminivirdae | Unassigned ssDNA | Leaf | Minor | Low |
| 20 | Potyvirus | *Potyvirus* | Potyviridae | Unassigned (+) ssRNA | Not found in Bangladesh through RT-PCR test | | |
| 21 | Nucleorhabdovirus | *Nucleorhabdovirus* | Rhabdoviridae | Mononegavirales | Not found in Bangladesh through RT-PCR test | | |
| **Phytoplasma** | | | | | | | |
| 22 | Little leaf of brinjal | *Candidatus Phytopasma solani* | Acholeplasmataceae | Acholeplasmatales | Leaf, twig | Minor | Low |

**Table 4. Weeds of eggplants, their status, plant stage affected and infestation severity**

| Sl. No. | Common name | Scientific name | Family | Order | Plant stage affected | Pest status | Infestation severity |
|---|---|---|---|---|---|---|---|
| 1 | Bermuda grass | *Cynodon dactylon* | Poacegae | Poales | Seedling-Vegetative | Minor | Low |
| 2 | Nutsedge | *Cyperus esculentus* | Cyperaceae | Poales | | Minor | Low |
| 3 | Goosefoot | *Chenopodium album* L. | Chenopodioideae | Caryophyllales | Seedling-Vegetative | Minor | Low |
| 4 | Pigweed | *Amaranthus acanthochiton* | Amaranthaceae | Caryophyllales | Seedling-Vegetative | Minor | Low |
| 5 | Spiny pigweed | *Amaranthus spinosus* | Amaranthaceae | Caryophyllales | Seedling-Vegetative | Minor | Low |
| 6 | Blacknightshade | *Solanum nigrum* | Solanaceae | Solanales | Seedling-Vegetative | Minor | Low |
| 7 | Horsenettle | *Solanum carolinense* L. | Solanaceae | Solanales | Seedling-Vegetative | Minor | Low |
| 8 | Parthenium weed | *Parthenium hysterophorus* | Asteraceae | Asterales | Recorded in limited areas | Minor | Low |

### 1.6. Pathway Risk Analysis Process and Methodology

The overall pest risk analysis (PRA) process includes undertaking pest risk analysis, risk assessment and identify risk management of the pests. The process and methodology of the PRA are described below:

#### 1.6.1. Undertaking of Pest Risk Analysis (PRA)

The study followed a systematic process of pest risk analysis framed as per ISPM No. 2. As per the 3 stages (I) Initiation (II) Pest Risk Assessment (III) Pest Risk Management, the study team evaluated the commodity and regulated articles and detection of pest for initiation stages.

***PRA STAGE 1: INITIATION***

Initiation is the identification of organisms and pathways that may be considered for pest risk assessment in relation to the identified PRA area.

**Steps of initiation stage:** The initiation stage involves four steps:

- Step 1: Determination whether an organism is a pest
- Step 2: Defining the PRA area
- Step 3: Evaluating any previous PRA
- Step 4: Conclusion

***PRA STAGE 2: PEST RISK ASSESSMENT***

The process for pest risk assessment can be broadly divided into five interrelated steps:

- Step 1: Pest categorization
- Step 2: Assessment of the probability of introduction, establishment and spread
- Step 3: Impacts
- Step 4: Overall assessment of risk
- Step 5: Uncertainty

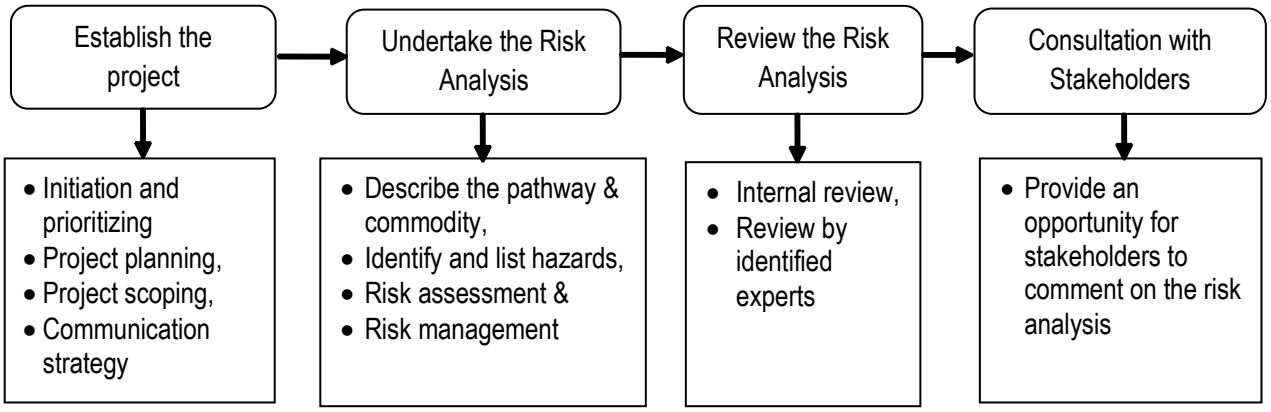
In most cases, these steps were applied sequentially in a PRA but it is not essential to follow a particular sequence. Pest risk assessment needs to be only as complex as is technically justified by the circumstances. This standard allows a specific PRA to be judged against the principles of necessity, minimal impact, transparency, equivalence, risk analysis, managed risk and non-discrimination set out in ISPM No. 1: Principles of plant quarantine as related to international trade (FAO, 1995).

***PRA STAGE 3: PEST RISK MANAGEMENT***

The conclusions from pest risk assessment are used to decide whether risk management is required and the strength of measures to be used. Since zero-risk is not a reasonable option, the guiding principle for risk management should be to manage risk to achieve the required degree of safety that can be justified and is feasible within the limits of available options and resources. Pest risk management (in the analytical sense) is the process of identifying ways to react to a perceived risk, evaluating the efficacy of these actions, and identifying the most appropriate options. The uncertainty noted in the assessments of economic consequences and probability of introduction should also be considered and included in the selection of a pest management option.

The following briefly describes the Biosecurity process and methodology for undertaking pathway risk analyses. The risk analysis process leading to the final risk analysis document is summarized in Figure 1 below:

**Figure 1: A summary of the risk analysis development process**




## 1.7. Pathway Description

### 1.7.1. Import pathways of brinjal

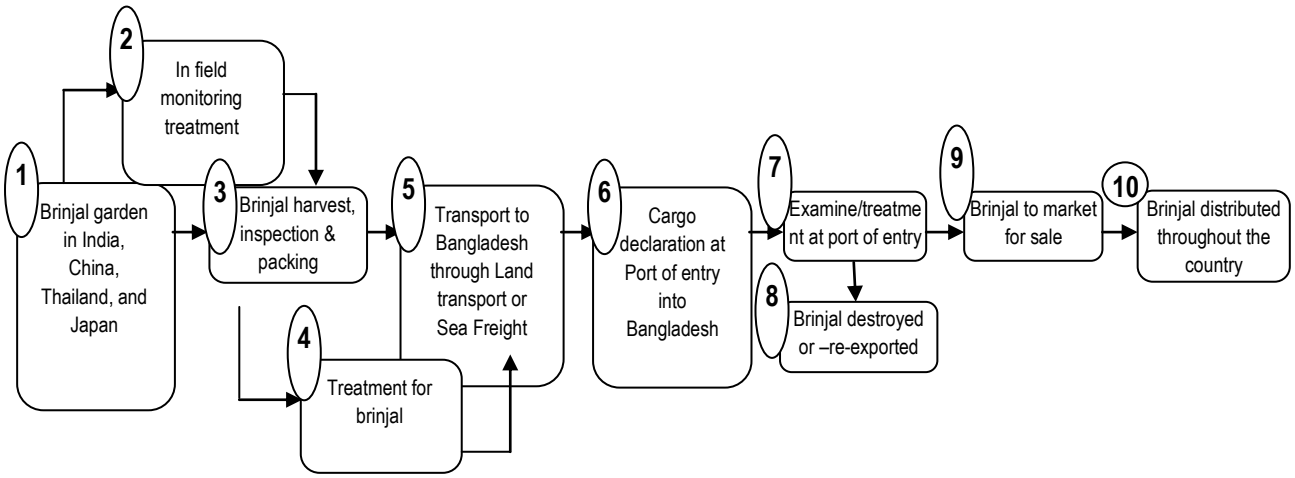
For the purpose of this risk analysis, brinajl are presumed to be from anywhere in exporting countries such as India, China, Japan, and Thailand.

To comply with existing Bangladesh import requirements for brinjal, the commodity would need to be prepared for export to Bangladesh by ensuring certain pests (insect pests, diseases and weeds) are not associated with the product. Commodity would then be sea or land or air freighted to Bangladesh where it will go to a holding facility before being distributed to dealers, distributors, markets, sellers and farmers for cultivation of the imported brinjal seeds, planting materials and or fruits.

### 1.7.2. Description

- Brinjal in India, China, Japan, and Thailand are being grown in the field, either as a single crop or beside other field or horticultural crops.
- Monitoring of the insect pests, disease and weed pests of brinjal is undertaken, with appropriate controls applied.
- Brinjal are being harvested, inspected and the best quality seeds, planting materials and or fruits pre-treated and packed in boxes.
- Post harvest disinfestations including fumigation or cold disinfestations are being undertaken either before or during transport of the brinjal and seeds to Bangladesh.
- Transport to Bangladesh is by air or sea.
- Each shipment must be accompanied by the appropriate certification, e.g. a phytosanitary certificate attesting to identity the brinjal, any treatments completed, or other information required to help mitigate risks.
- Brinjal is examined at the border to ensure compliance.
- Any brinjal not complying with Bangladesh biosecurity requirements (e.g. found harboring pest organisms) are either treated re-shipped or destroyed.
- Brinal and or seeds are stored before being distributed to market for sale.
- Dealers and sellers of brinjal seeds and or planting materials or fruits of brinjal stock and these are bought by users and or farmers within the local area these are sold in.The linear pathway diagram of import risk of brinjal is furnished below:

**Figure 2: Linear Pathway Diagram**

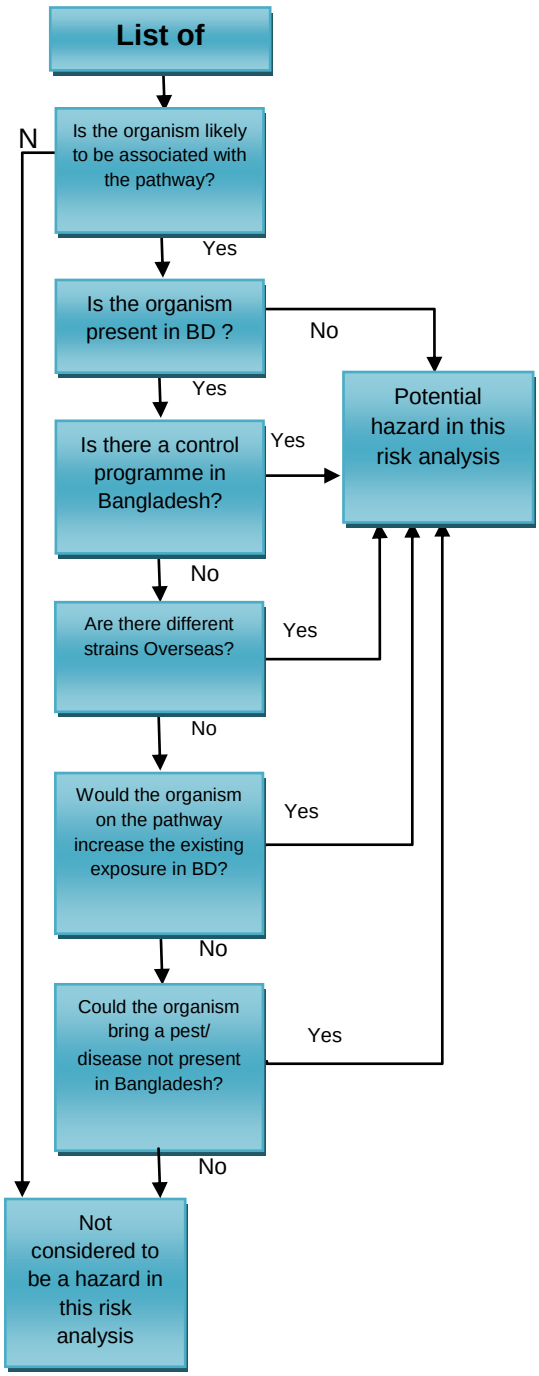



### 1.8. Hazard Identification

The first step for any risk assessment is to identify the hazard as the risk is related to hazard. Hazards are the unwanted insect pests, diseases (pathogen) or weeds of flowers and foliages which could be introduced into Bangladesh by risk goods, and are potentially capable of causing harm to brinjal production, must be identified. This process begins with the collection of information on insect pests, diseases (pathogen) or weed present in the country of origin. Such list is compared with the existing pests present in Bangladesh to prepare a list of exotic pests that might be associated with the commodity harmful for Bangladesh, if introduce.

This list is further refined and species removed or added to the list depending on the strength of the association and the information available about its biology and life cycle. Each pest or pathogen is assessed mainly on its biological characteristics and its likely interaction with the Bangladesh environment and climate. Hitch-hiker organisms sometimes associated with a commodity, but which do not feed on it or specifically depend on that commodity in some other way are also included in the analysis. This is because there may be economic, environmental and human health consequences of these organisms entering and/or establishing. Diagrammatic representation of hazard identification is shown in Figure 3.

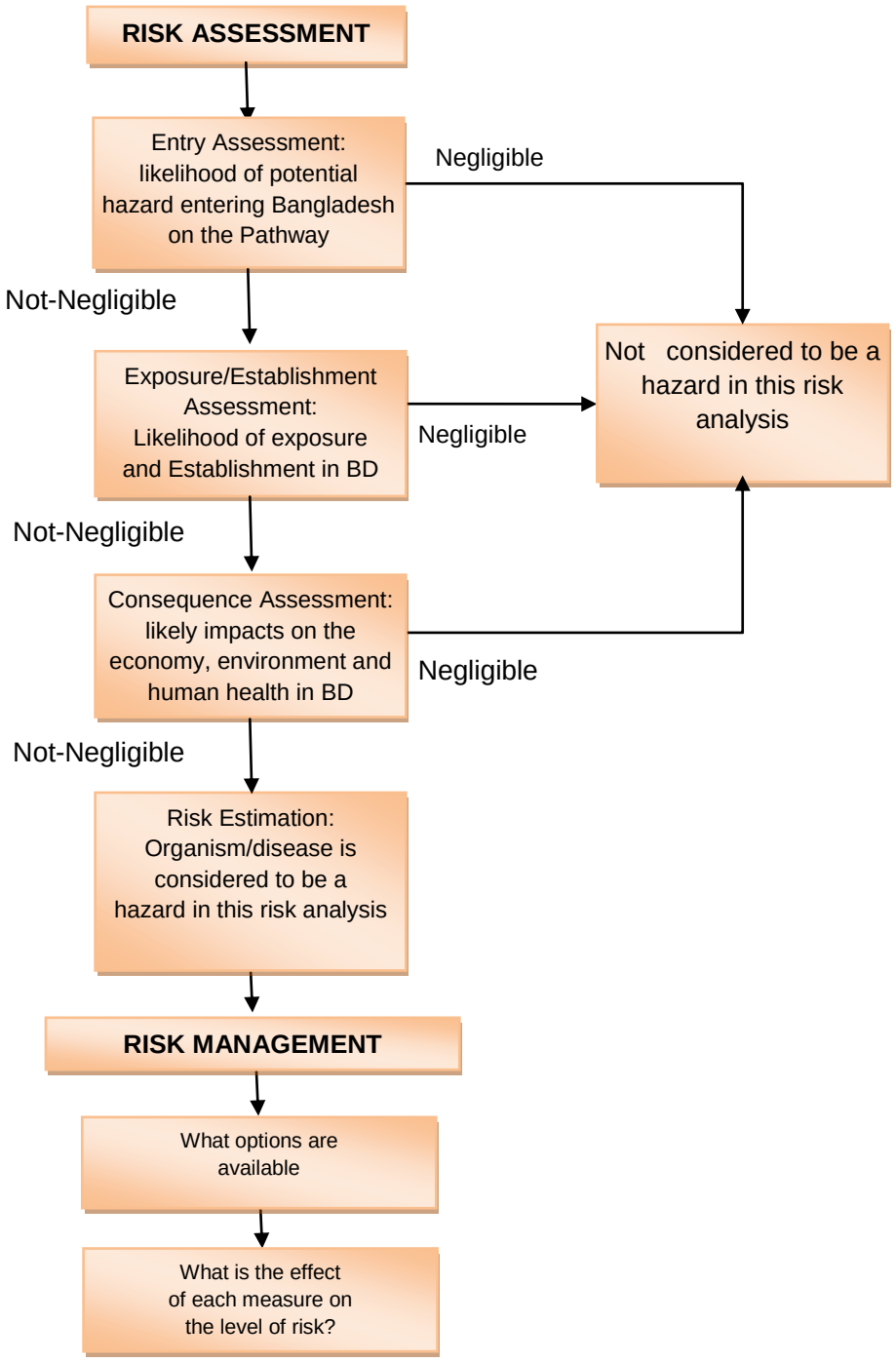
**Figure 3:** Diagrammatic representation of hazard identification




### 1.9. Risk Assessment of Potential Hazards

Risk assessment is the evaluation of the likelihood of entry, exposure and establishment of a potential hazard, and the environmental, economic, human and animal health consequences of the entry within Bangladesh. The aim of risk assessment is to identify hazards which present an unacceptable level of risk, for which risk management measures are required. Descriptors are used in assessing the likelihood of entry, exposure and establishment, and the economic, environmental, social and human health consequences. The approach taken in this Risk Analysis is to assume the commodity is imported without any risk management. In this risk analysis hazards have been grouped where appropriate to avoid unnecessary duplication of effort in the assessment stage of the project. Diagrammatic representation of risk assessment and risk management is shown in Figure 4.

**Figure 4:** Diagramatic representation of the process followed for risk assessment and management




### 1.10. Assessment of Uncertainties

The purpose of this section is to summarize the uncertainties and assumptions identified during the preceding hazard identification and risk assessment stages. An analysis of these uncertainties and assumptions can then be completed to identify which are critical to the outcomes of the risk analysis. Critical uncertainties or assumptions are considered for further research with the aim of reducing uncertainty or removing the assumption. Where there is significant uncertainty in the estimated risk, a precautionary approach to managing risk may be adopted. In these circumstances the measures should be consistent with other measures where equivalent uncertainties exist and be reviewed as soon as additional information becomes available.

### 1.11. Analysis of Measures to Mitigate Biosecurity Risks

Risk management in the context of risk analysis is the process of identifying measures to effectively manage the risks posed by the hazard(s) associated with the commodity or organisms under consideration.

Since zero-risk is not a reasonable option, the guiding principle for risk management should be to manage risk to achieve the required level of protection that can be justified and is feasible within the limits of available options and resources. Risk management identifies ways to react to a risk, evaluating the efficacy of these actions, and presenting the most appropriate options.

The uncertainty noted in the assessments of economic consequences and probability of introduction should also be considered and included in the consideration of risk management options. Where there is significant uncertainty, a precautionary approach may be adopted. However, the measures selected must nevertheless be based on a risk assessment that takes account of the available scientific information. In these circumstances the measures should be reviewed as soon as additional information becomes available. It is not acceptable to simply conclude that, because there is significant uncertainty, measures will be selected on the basis of a precautionary approach. The rationale for selecting measures must be made apparent.

Each hazard or group of hazards will be dealt with separately using the following framework:

### 1.12. Risk Evaluation

If the risk estimate determined in the risk assessment is significant, measures can be justified.

### 1.13. Option Evaluation

Measures that are expected to be effective against the hazard species are considered. A package of risk management measures is likely to be required to address the risk from all identified hazards. While there are currently six established pathways (India, China, Thailand, and Japan) for brinjal coming into Bangladesh, border interception for these pathways cannot be extrapolated to predict any possible level of slippage or efficacy of treatments. However, border interceptions can be used as evidence of hazard organism association with the commodity. Each new pathway must be regarded as unique, given differing pre and post harvest practices and treatment measures. Different pest species are associated with each pathway and measures therefore must be tailored to the individual organisms.

### 1.14. Review and Consultation

Peer review is a fundamental component of a risk analysis to ensure it is based on the most up-to-date and credible information available. Each analysis must be submitted to a peer review process involving appropriate staff within those government departments with applicable biosecurity responsibilities, plus recognized and relevant experts fromBangladesh. The critique provided by the reviewers where appropriate, is incorporated into the analysis. If suggestions arising from the critique were not adopted the rationale must be fully explained and documented.

# CHAPTER 2

## IMPORT RISK ANALYSIS

### 2.1. Introduction

This chapter provides information on the commodity that is relevant to the analysis of biosecurity risks and common to all organisms or diseases potentially associated with the brinjal. It also provides information on climate and geography of the country of origin as well as Bangladesh for assessing the likelihood of establishment and spread of potential hazard organisms when enter and exposed to Banladesh.

### 2.2. Commodity Description

Brinjal or eggplant (*Solanum melongena* L.) is an important solanaceous crop of sub-tropics and tropics. The name brinjal is popular in Indian subcontinents and is derived from Arabic and Sanskrit whereasthe name eggplant has been derived from the shape of the fruit of some varieties, which are white and resemble in shape to chicken eggs. It is also called aubergine (French word) in Europe. The brinjal is of much importance in the warm areas of Far East, being grown extensively in India, Bangladesh, Pakistan, China and the Philippines. It is also popular in Egypt, France, Italy and United

States. In India, it is one of the most common, popular and principal vegetable crops grown throughout the country except higher altitudes. It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year. It is a perennial but grown commercially as an annual crop. A number of cultivars are grown in India, consumer preference being dependent upon fruit color, size and shape.

**Characteristics:** The eggplant is a delicate perennial that often is cultivated as an annual. It grows 40 to 150 centimeters (16 to 57 inches) tall, with large coarsely lobed leaves that are 10 to 20 centimeters (4-8 inches) long and 5 to 10 centimeters (2-4 inches) broad. (Semi-) wild types can grow much larger, to 225 centimeters (7 feet) with large leaves over 30 centimeters (12 inches) long and 15 centimeters (6 inches) broad. The stem is often spiny. The flowers are white to purple, with a five-lobed corolla and yellow stamens. The fruit is fleshy, less than 3 centimeters in diameter on wild plants, but much larger in cultivated forms.

**Cultivation:** The mango is now cultivated in most frost-free tropical and warmer subtropical climates; almost half of the world's mangoes are cultivated in India alone, with the second-largest source being China (Jedele *et al.,* 2003; Rediff.com, 2004). Other cultivators include North America (in South Florida and California's Coachella Valley), South and Central America, the Caribbean, Hawai'i, south, west, and central Africa, Australia, China, Pakistan, Bangladesh, and Southeast Asia. Though India is the largest producer of mangoes, it accounts for less than 1% of the international mango trade; India consumes most of its own production.

**Varieties:** The most widely grown cultivated varieties in Europe and North America today are elongated ovoid, 12-25 centimeters long (4 1/2 to 9 inches) and 6-9 centimeters broad (2 to 4 inches) with a dark purple skin. A much wider range of shapes, sizes, and colors is grown in India and elsewhere in Asia. Larger varieties weighing up to a kilogram (2 pounds) grow in the region between the Ganges and Yamuna rivers, while smaller varieties are found elsewhere. Colors vary from white to yellow or green as well as reddish-purple and dark purple. Some cultivars have a color gradient, from white at the stem to bright pink to deep purple or even black. Green or purple cultivars with white striping also exist. Chinese eggplants are commonly shaped like a narrower, slightly pendulous cucumber and sometimes were called Japanese eggplants in North America.

Oval or elongated oval-shaped and black-skinned cultivars include 'Harris Special Hibush', 'Burpee Hybrid', 'Black Magic', 'Classic', 'Dusky', and 'Black Beauty'. Long, slim cultivars with

purple-black skin include 'Little Fingers', 'Ichiban', 'Pingtung Long', and 'Tycoon'. Those with green skin include 'Louisiana Long Green' and 'Thai (Long) Green', while 'Dourga' is a white skin cultivar, and traditional, white-skinned, oval-shaped cultivars include 'Casper' and 'Easter Egg'.

Bicolored cultivars with a color gradient include 'Rosa Bianca', and 'Violetta di Firenze'.

Bicolored cultivars with striping include 'Listada de Gandia' and 'Udumalapet'. In some parts of India, miniature varieties of eggplants (most commonly called *Vengan*) are very popular.

In Bangladesh, Islampuri, Khat Khatia, Dohazari, Volanath and Singnath are some of the popular local varieties of brinjal.

Recently the Bangladesh agricultural research institute developed 5 varieties ie, Uttara, Shuktara (hybrid), Tarapuri (hybrid), Nayantara and Kazla. The variety grown in Gaffargaon area is famous for its size and taste.

**Production:** Production of eggplant is highly concentrated, with 90 percent of output coming from five countries in 2010. China is the top producer (58 percent of world output) and India is second (25 percent), followed by Egypt, Iran and Turkey. More than 4,000,000 acres (1,600,000 hectares) are devoted to the cultivation of eggplant in the world (Food And Agricultural Organization of United Nations 2010).

**Consumption:** The raw fruit can have a somewhat bitter taste, but becomes tender when cooked and develops a rich, complex flavor. Salting and then rinsing the sliced eggplant (known as "degorging") can soften and remove much of the bitterness. Some modern varieties do not need this treatment, as they are less bitter. The eggplant is capable of absorbing large amounts of cooking fats and sauces, allowing for very rich dishes, but the salting process will reduce the amount of oil absorbed. The fruit flesh is smooth; as in the related tomato, the numerous seeds are soft and edible along with the rest of the fruit. The thin skin is also edible, so that the eggplant need not be peeled.

**Insect pests:** Brinjal is susceptible to attack of various insects from seedling to fruiting stage. This crop is infested by 18 different insect species including brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee; epilachna beetle, *Epilachna vigintioctopunctata* Fab. and aphid, *Aphis gossypii* Glover. In Bangladesh, about eight insect species are considered as major pests causing damage to the crop (Biswas et al., 1992). Hill (1983) reported 50 insect pests cause damage to brinjal. The losses caused by these pests vary from season to season depending upon environmental factors as reported by Gangwar and Sachan (1986) and Patel et al. (1988). Various insect pests cause enormous losses to brinjal in every season and every year in Bangladesh (Alam, 1969). The yield loss caused by this pest has been estimated up to 67% in Bangladesh. Among them, brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Gueneeis one of the most destructive insect pest of brinjal in Bangladesh (Alam, 1969). The genus Leucinodes includes three species namely *Leucinodes orbonalis* Guenee, *Leucinodes diaphana* Hampson and *Leucinodes opicalis* Hampson (Alam et al., 1964).

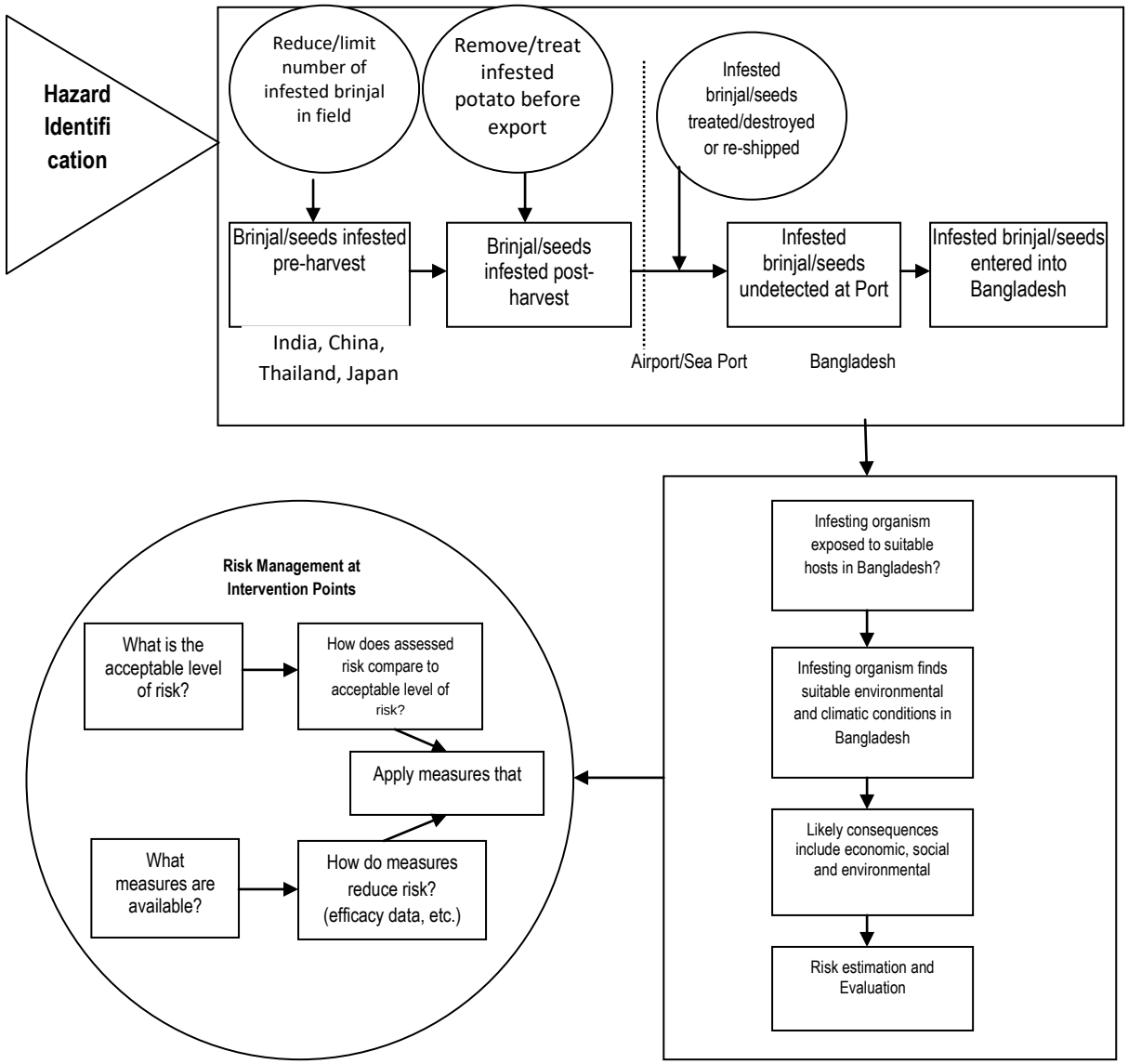
**Diseases:** A number of diseases also cause damage of flowers, fruits, leaves, seedlings, and twigs of brinjal. Among these the important diseases are the Early blight (*Alternaria tomatophilia*), Cercospora leaf spot (*Cercospora melongenae*), Colletotrichum fruit rot (*Colletotrichum melongenae*), Phomopsis fruit rot (*Phomopsis vexans*), Root-knot Nematodes (*Meloidogyne incognita*), Damping off of brinjal (*Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp.), etc

### 2.3. Description of the Proposed Import Pathway

For the purpose of this risk analysis, brinjal are presumed to be from anywhere in India, China, Thailand, and Japan. To comply with existing Bangladesh import requirements for brinjal, the commodity would need to be prepared for export to Bangladesh by ensuring certain pests are not associated with the product. Brinjal seeds, planting matersials and or fruits would then be sea or air freighted to Bangladesh where it will go to a holding facility

before being distributed to dealers, distributors, markets, sellers and farmers for cultivation and uses of the imported brinjal seeds, planting matersials and or fruits. The proposed import pathway of brinjal and foliages indicating how the risk analysis process applied at the pathway level is given below:

**Figure 5. Proposed import pathway of brinjal**




## 2.4. Exporting Countries—Climate and Geography

### *2.4.1. India*

India's climate can be classified as a hot tropical country, except the northern states of Himachal Pradesh and Jammu & Kashmir in the north and Sikkim in the northeastern hills, which have a cooler, more continental influenced climate.

In most of India summer is very hot. It begins in April and continues till the beginning of October, when the monsoon rains start to fall. The heat peaks in June with temperatures in the northern plains and the west reach 45° C and more. The monsoons hit the country during this period too, beginning 1st of June when they are supposed to find the Kerala

coast, moving further inland from day to day. Moisture laden trade winds sweep the country bringing heavy rains and thunderstorms; sometimes these monsoon rains can be very heavy, causing floodings and damage, especially along the big Rivers of India, Bramaputhra and Ganges.

The plains in the north and even the barren countryside of Rajasthan have a cold wave every year in December-January. Minimum temperatures could dip below 5°C but maximum temperatures usually do not fall lower than 12°C. In the northern high altitude areas of the northern mountains it snows through the winter and even summer months are only mildly warm.

Typhoons are usually not an danger, these tropical storms are quite seldom in India. The Typhoon Season is from August to November; the East coast of India has the highest Typhoon risk.

**Koeppen-Geiger classification:** The Climate of India can be divided in different climate zones. The eastern part of India and the west coast can be classified as Aw climate, a hot, tropical climate with all months above 18°C and a dry period in the winter. The southern Tip of india can be classified as Am climate, a hot tropical Rainforest climate with monsoon rains and all months above 18°C. Central and Northwest India have a BSh climate, a dry Steppe climate with an annual average Temperature above 18°C. Finally, The northern mountainous areas can be classified as Cfa climate; a Temperated, humid climate with tha warmest month above 22°C (WeatherOnline, 2015a)

### *2.4.2. Thailand*

Thailand's Climate can be described as tropical monsoon climate. It is characterized by strong monsoon influences, has a considerable amount of sun, a high rate of rainfall, and high humidity that makes it sometimes feel quite uncomfortable.

The annual average temperature ranges from 22°C to 27°C year-round. There are two distinguishable seasons in Thailand, a dry period in the winter and a humid rain period in the summer.

**Koeppen-Geiger classification:** The Climate of Thailand can be classified as Aw climate, a hot, tropical climate with all months above 18°C and a dry period in the winter. The southern coast of Thailand has an Af climate, a hot, humid climate with all months above 18°C (WeatherOnline, 2015c).

### *2.4.3. China*

China's extreme size means it has a great diversity of climates, but being located entirely in the northern hemisphere means its seasonal timings are broadly comparable to those in Europe and the US.

The northeast experiences hot and dry summers and bitterly cold harsh winters, with temperatures known to reach as low as -20°C (-4°F). The north and central region has almost continual rainfall, temperate summers reaching 26°C (79°F) and cool winters when temperatures reach 0C (32°F). The southeast region has substantial rainfall, and can be humid, with semi-tropical summer. Temperatures have been known to reach over 40°C (104°F) although this is highly unusual, but during summer temperatures over 30°C (86°F) are the norm. Winters are mild, with lows of around 10°C (50°F) in January and February. Central, southern and western China are also susceptible to flooding, and the country is also periodically subject to seismic activity.

Early autumn around September and October, when temperatures are pleasant and rainfall is low, is generally seen as an optimum time to visit. Spring is also popular, for similar reasons, and the many tourists visit in March or April.

### *2.4.4. Japan*

Japan is located at the northeastern edge of the Asian monsoon climate belt, which brings much rain to the country. The weather is under the dual influence of the Siberian weather system and the patterns of the southern Pacific; it is affected by the Japan Current (Kuroshio), a warm stream that flows from the southern Pacific along much of Japan's Pacific coast, producing a milder and more temperate climate than is found at comparable latitudes elsewhere. Northern Japan is affected by the Kuril Current (Oyashio), a cold stream flowing along the eastern coasts of Hokkaido and northern Honshu. The junction of the two currents is a bountiful fishing area. The Tsushima Current, an offshoot of the Japan Current, transports warm water northward into the Sea of Japan / East Sea.

Throughout the year, there is fairly high humidity, with average rainfall ranging by area from 100 cm to over 250 cm (39–98 in). Autumn weather is usually clear and bright. Winters tend to be warmer than in similar latitudes except in the north and west, where snowfalls are frequent and heavy. Spring is usually pleasant, and the summer hot and humid. There is a rainy season that moves from south to north during June and July.

Average temperature ranges from 17° C (63° F ) in the southern portions to 9° C (48° F ) in the extreme north. Hokkaido has long and severe winters with extensive snow, while the remainder of the country enjoys milder weather down to the southern regions, which are almost subtropical. The Ryukyus, although located in the temperate zone, are warmed by the Japan Current, giving them a subtropical climate. The typhoon season runs from May through October, and each year several storms usually sweep through the islands, often accompanied by high winds and heavy rains.

## 2.5. Bangladesh—Climate and Geography

**Bangladesh** has a subtropical monsoon climate characterized by wide seasonal variations in rainfall, high temperatures and humidity. There are three distinct seasons in Bangladesh: a hot, humid summer from March to June; a cool, rainy monsoon season from June to October; and a cool, dry winter from October to March. In general, maximum summer temperatures range between 30°C and 40°C. April is the warmest month in most parts of the country. January is the coldest month, when the average temperature for most of the country is about 10°C. http://www.weatheronline.co.uk/reports/climate/Bangladesh.htm

The minimum termperature in different locations of the country ranges from 10.0$^{o}$C to 15.40$^{o}$C and lowest recorded Srimangal under Habiganj district and highest recorded in Cox’s Bazar district on the bank of Bay of Bengal. The maximum normal temperature in different locations of the country ranges from 31.80$^{o}$C in Mymenshing district to 36.10$^{o}$C in Chuadanga district.

Heavy **rainfall** is characteristic of Bangladesh. Most rains occur during the monsoon (June-September) and little in winter (November-February). With the exception of the relatively dry western region of Rajshahi, where the annual rainfall is about 1600 mm, most parts of the country receive at least 2000 mm of rainfall per year. Because of its location just south of the foothills of the Himalayas, where monsoon winds turn west and northwest, the regions in northeastern Bangladesh receives the greatest average precipitation, sometimes over 4000 mm per year. About 80 percent of Bangladesh's rain falls during the monsoon season (WeatherOnline, 2015). http://www.weatheronline.co.uk/reports/climate/Bangladesh.htm

**Köppen climate classification**

The Climate of Bangladesh can be divided in different climate zones. The central and southern part can be classified as **Aw** climate, a hot, tropical climate with all months above 18°C and a dry period in the winter. The northern mountainous areas can be classified as **Cwa** climate; a Temperated, humid climate with the warmest month above 22°C and a dry period in the winter (Arnfield, 2014). http://www.weatheronline.co.uk/reports/climate/Bangladesh.htm

# CHAPTER 3

## HAZARD IDENTIFICATION

### 3.1. Introduction

This chapter outlines the potential hazards associated with brinjal seeds, planting materials or fruits in India, China, Thailand, and Japan, and considers some of the major risk characteristics of the commodity and its hazards.

An initial hazard list was made of all pests and pathogens associated with brinjal seeds, planting materials or fruits found in India, China, Thailand, and Japan. The Plant Quarantine Wing of the Department of Agriculture Extension (DAE) in Bangladesh list for pests of brinjal from India, China, Thailand, and Japan was used as its basis, with various species added or excluded after considerations of association. This original list was later refined to include only those organisms directly associated with brinjal seeds, planting materials or fruits and found to be present in India, China, Thailand, and Japan. Some hitch-hiker pests are included in the pest analyses where entry and establishment of a species into the country would cause potential economic, environmental or health consequences. The following a list of those organisms assessed and discarded as likely hazards based on biology, and lack of association with the commodity. Then all potential hazards and individual pest risk assessments and recommend measures where required.

### 3.2. Potential Hazard Groups

Pests and pathogens can be grouped in two main ways regarding their association with the commodity. Under their taxonomic category, i.e. Lepidoptera, Coleoptera, Acari, Fungi etc, or within the trophic role they play in their association, and what structures or part of the flower plants they attack, e.g. surface feeder, seed feeder, pathogen. In this risk analysis hazard organisms are grouped according to their general taxonomic category. Where a genus contains more than one species, information on all species is contained within one pest risk assessment. If organisms that are hitch hikers or vectors this is noted in the individual pest risk assessment.

The following categories are used are as follows:

Insect pests
Mite pests
Fungi
Bacteria
Nematode
Virus
Weeds

### 3.3. Pests and Pathogens of brinjal in exporting countries

The most common pests and pathogens affecting brinjal seeds, planting materials or fruits found in India, China, Thailand, and Japan are shown in the following Table below. Among which several pests were identified as quarantine pests likely to be imported with unmitigated shipments of brinjal seeds, planting materials or fruits, possibly requiring phytosanitary measures to mitigate risk. Further analysis of these quarantine pests have been done in the following chapter with recommendation of phytosanitary measures.

## Table 6. Pests likely to be associated with eggplant in the exporting countries

| Sl. No. | Common name | Scientific name | Distributionnt eggplan exporting countries | Plant parts likely to carry the pest | References |
|---|---|---|---|---|---|
| **Arthropod** | | | | | |
| **Insect pests** | | | | | |
| 1 | Malaysian fruit fly | *Bactrocera latifrons* | India, China, Japan, Malaysia | Fruit, stem | EPPO, 2015 |
| 2 | Serpentine leaf miner | *Liriomyza trifolii* | India, China, Japan | Leaf, stem, flower | EPPO, 2014; CABI/EPPO, 1997; Minkenberg (1988 |
| 3 | Pea leaf miner | *Liriomyza huidobrensis* | India, Thailand, Japan | Leaf, stem, flower | CABI/EPPO, 2002; EPPO, 2014 |
| 4 | Silver leaf whitfly | *Bemisia tabaci (B biotype)* | India, China, Japan, Malaysia | Leaf, stem, flower | CABI & EPPO, 1999; EPPO, 2014 |
| 5 | Vegetable weevil | *Listroderes costirostris* | Japan | Fruit, stem, plant stock | CABI & EPPO, 2000; EPPO, 2014; Morrone, 1993 |
| 6 | Alfafa thrips | *Frankliniella occidentalis* | India, Thailand, China | Leaf, fruit, plant stock | EPPO, 2014; CABI/EPPO, 1999; Reitz et al., 2011; Zhang et al., 2003; Nakahara, 1997 |
| 7 | Cotton leaf worm | *Spodoptera littoralis* | Japan, Pakistan, Indonesia | Stem, fruit,leaf, flower | CIE, 1967; CABI/EPPO, 1997; OEPP/EPPO, 1981 |
| **Mite pest** | | | | | |
| 8 | Red tomato spider mite | *Tetranychus evansi* | Japan, Taiwan | Leaf, stem, cutting, flower | EPPO, 2006; CABI, 2015; EPPO, 2016 |
| **Disease causing organisms** | | | | | |
| **Fungi** | | | | | |
| 9 | Phytopthora root rot | *Phytophthora megasperma* | Japan, Philippines | Leaf, stem, cutting, | CABI, 2006 |
| **Nematode** | | | | | |
| 10 | Golden cyst nematode | *Globodera rostochiensis* | India, Japan, Pakistan, Sri Lanka | Tuber, bulb, corm | EPPO, 1997; CABI, 2007 |
| 11 | Pale cyst nematode | *Globodera pallid* | India, Japan, Pakistan, Sri Lanka | Tuber, bulb, corm | EPPO, 1997; CABI, 2007 |
| **Virus** | | | | | |
| 12 | Tobacco ringspot virus | *Tobacco ringspot nepovirus* | India, China, Japan | Seed, leaf, cutting | EPPO, 2006 |
| 13 | Pepper vein mottle virus | *Pepper veinal mottle virus* | India, Afganistan, Taiwan | Seed, cuttings | CABI,2007; Jagadeeshwar *et al*., 2005 |
| **Weeds** | | | | | |
| 14 | Parthenium weed | *Parthenium hysterophorus* | Bangladesh (restricted areas), India, China, Japan | Seed, equipment | EPPO, 2014; CABI/EPPO, 1999 |

## References


CABI (2004). *Crop Protection Compendium*. http://www.cabicompendium.org/ (9 June 2005).

CABI, (2006): Crop Protection Compendium, CD-ROM Search: 2006 Edition. Commonwealth Agricultural Bureau International (CABI). Wallingford, UK.

CABI, (2007): Crop Protection Compendium, CD-ROM Search: 2007 Edition. Commonwealth Agricultural Bureau International (CABI). Wallingford, UK.

CABI. 2011. Crop Protection Compendium. Commonwealth Agricultural Bureau International (CABI). http://www.cabi.org/cpc/. (Archived at PERAL).

CABI/EPPO , 1999. *Frankliniella occidentalis*. [Distribution map]. Distribution Maps of Plant Pests, December (1st revision). Wallingford, UK: CAB International, Map 538.

CABI/EPPO, 1997. Distribution maps of quarantine pests for Europe (edited by Smith, I. M. and Charles, L. M. F.). Wallingford, UK: CAB International, xviii + 768 pp.

CABI/EPPO, 1997. Distribution maps of quarantine pests for Europe (edited by Smith, I. M. and Charles, L. M. F.). Wallingford, UK: CAB International, xviii + 768 pp.

CABI/EPPO, 2014. *Cacoecimorpha pronubana*. [Distribution map]. Distribution Maps of Plant Pests, No.June. Wallingford, UK: CABI, Map 340 (1st revision).

Carter DJ, 1984. Pest Lepidoptera of Europe with special reference to the British Isles. Dordrecht, Netherlands: Dr. W. Junk.

CIE (1967a) *Distribution Maps of Pests, Series A* No. 232. CAB International, Wallingford, UK.

CIE (1978) *Distribution Maps of Pests, Series A* No. 16 (revised). CAB International, Wallingford, UK.

EPPO (2016). Report of a Pest Risk Analysis for *Tetranychus evansi.* European and Mediterranean Plant Protection Organization. https://www.eppo.int/QUARANTINE/Alert.../Tetranychus_evansi.doc

EPPO, 2006. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2016. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO/CABI (1996). *Burkholderia caryophylli*. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith, I.M., McNamara, D.G., Scott, P.R., Holderness, M.). CAB INTERNATIONAL, Wallingford, UK.

EPPO/CABI (2002) *Amauromyza maculosa*, *Liriomyza sativae*, *Liriomyza trifolii*. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Holderness, M.). CAB INTERNATIONAL, Wallingford, UK.

Minkenberg, O.P.J.M. (1988) Dispersal of *Liriomyza trifolii*. *Bulletin OEPP/EPPO Bulletin* **18**, 173-182.

OEPP/EPPO (1981) Data sheets on quarantine organisms No. 120, *Spodoptera littoralis*. *Bulletin OEPP/EPPO Bulletin* **11** (1).

Sankaran T, Nagaraja H, Narasimham AU, 1984. On some South Indian armoured scales and their natural enemies. Proceedings of the 10th International Symposium of Central European Entomofaunistics, Budapest, 15-20 August 1983, 409-411.

Tao C, 1999. List of Coccoidea (Homoptera) of China. Taichung, Taiwan: Taiwan Agricultural Research Institute, Wufeng, 1-176.

TARI. 2009. Pest List. Taiwan Agricultural Research Institute

### 3. 4. Organism Interception on Commodity from Existing Pathways

In the past, there was no previous pest risk assessment on brinjal from any of the exporting countries including the India, China, Thailand, and Japan. As reported by the Plant Quarantine Wing (PQW) under Department of Agriculture Extension (DAE), Bangladesh, during inspection in port of entry of brinjal seeds, planting materials or fruits from these exporting counties, not a pest had been intercepted yet today on the commodity imported into Bangladesh.

### 3.5. Other Risk Characteristics of the Commodity

Although many pests dealt with in this risk analysis have adequate information for assessment, we can not predict future or present risks that currently escape detection for a variety of reasons.

#### 3.5.1 Unlisted Pests

These include pests that are not yet identified. With a trend towards decreasing use of chemical products in agriculture and further reliance on Integrated Pest Management strategies it is assumed that new pests will enter the system at some time in the future.

Prolonged use of large doses of pesticides and fertilizers can lead to previously non pest species becoming economically important through resistance to pest treatments. Any of these types of organism could initially appear in very small numbers associated with the commodity, and may not be identified as hazards before their impacts become noticeable.

#### 3.5.2 Symptomless Micro-organisms

Pests such as microbes and fungi infect brinjal seeds, planting materials or fruits before transit and may not produce symptoms making them apparent only when they reach a suitable climate to sporulate or reproduce.

Many fungi can infect brinjal seeds, planting materials or fruits after arrival making it difficult to distinguish the origin of saprobes and pathogens without adequate identification. Consumers tend to throw away moulded eggplants rather than take it to a diagnostic laboratory so there is little data on post entry appearance of “invisible organisms”.

### 3.6 Assumptions and Uncertainties

The purpose of this section is to summarise the uncertainties and assumptions identified during the preceding hazard identification and risk assessment stages. An analysis of these uncertainties and assumptions can then be completed to identify which are critical to the outcomes of the risk analysis. Critical uncertainties or assumptions are considered for further research with the aim of reducing uncertainty or removing the assumption. Where there is significant uncertainty in the estimated risk, a precautionary approach to managing risk may be adopted. In these circumstances the measures should be consistent with other measures where equivalent uncertainties exist and be reviewed as soon as additional information becomes available.

There is a major uncertainty concern regarding the prevalence of above mentioned high and moderate rated insect pests, diseases and weed of brinjal in India, China, Thailand, and Japan and other countries of brinjal export.

The assessment should have included information on export volumes and frequency to other countries, the average size of export lots, the number of lots found infested with pests of

brinjal seeds, planting materials or fruits in the importing countries, and preferably, any information on incidence level in pests infested brinjal seeds, planting materials or fruits consignments or lots would be valuable.

Thus, the assessment of uncertainties and assumptions for each organism often covers similar areas of information or lack of information, with key factors or variables being relevant across different organism groups. The following sections outline these considerations. The uncertainties and assumptions are covered in these sections rather than individually in each pest risk assessment.

### 3.7. Assumptions and Uncertainties around hazard biology

- The species of mealybug (*Pseudococcus* spp.) are the well known hitch-hiker species, and has been associated with flowers in India, Thailand, China, and Japan. Currently there are no data demonstrating this association between this hitch-hiker pest and the pathway imported from these countries into Bangladesh. Interception data rather than biological information would be required to clarify this issue.
- The biology of insects that have been reared in the laboratory for several generations is often different to wild counterparts established in greenhouses or in field conditions (Mangan & Hallman 1998). Aspects such as life cycle, preovipositional period, fecundity and flight ability (Chambers 1977), as well as cold or heat tolerance can be influenced by the highly controlled laboratory environment. Laboratory reared insects may differ in their responses to environmental stress and exhibit tolerances that are exaggerated or reduced when compared with wild relatives.
- If a pest species occurs in Bangladesh often its full host range, or behaviour in the colonised environment remains patchy. It is difficult to predict how a species will behave in a new environment, particularly if it has not become established as a pest elsewhere outside its natural range. Therefore there will be considerable uncertainty around the likelihood of an organism colonising new hosts or the consequences of its establishment and spread on the natural environment. Where indigenous plants are discussed as potential hosts this is extrapolated from the host range (at genus and family level) overseas and is not intended as a definitive list.

### 3.8. Assumption and Uncertainties Around the Inspection Produre

- There are distinct temperature requirements for optimum development and reproduction for the different biotype of pests like *Bemisia tabci* (Silver leaf whitefly). Therefore, the molecular data on race detection of the insect pests rather than occurrence of biological information would be required to clarify this issue.

### 3.9. Assumption Around Transit Time of Commodity on the Air Pathway

- An assumption is made around the time the brinjal seeds, planting materials or fruits take to get from the field in India, China, Thailand, and Japan to Bangladesh ready for wholesale if it is transported by Landport or Sea shipment.

### 3.10. Assumption around Commodity Grown in Bangladesh

| Section of PRA | Uncertainties | Further work that would reduce uncertainties |
|---|---|---|
| Taxonomy | None | - |
| Pathway | Presence of a pathway from imported produce to suitable protected environments, such as botanical gardens. | • Monitor all suitable protected environments which are near points of entry of infested produce.<br>• Check reports of finds by other brinjal exporting countries |
| Distribution | None | - |
| Hosts | None | - |
| Establishment | Establishment potential under glasshouse in the PRA area. | Continue to monitor the literature for reports of establishment in protected environments. |
| Spread | Rate of potential spread in areas at risk within the PRA area | Continue to monitor the literature for reports on ability to spread. |
| Impact | Potential to cause damage in protected environments | Continue to monitor the literature for reports on damage caused in protected environments |
| Management | None | - |

# CHAPTER 4

## REVIEW OF MANAGEMENT OPTIONS

### 4.1. Introduction

The following assessment of pre- and post-harvest practices reflects the current systems approach for risk management employed for commercially produced cut flowers. It is proposed that these practices combined with specific post-harvest treatment (such as fumigation and other requirements e.g. phytosanitary inspection) are used to manage the risks to importing countries posed by regulated organisms associated with the importation of cut flowers from exporting countries.

### 4.2. Pre-harvest Management Options

The in-field pest management practises for the production of brinjal are

a. Annual flooding of gardens to soil dwelling insects;
b. Pre-flowering pesticide treatments for arthropods and fungi above threshold levels;
c. Post-flowering pesticide treatments above threshold levels for specific pests such as aphids, whiteflies, mealy bugs, mites and anthracnose, blight etc;
d. Flower gardent hygiene which involves removal of fallen leaves and crop residues under a Good Agricultural Practise (GAP) scheme administered by Department of Agriculture Extension (DAE);

### 4.3. Post-Harvest Procedures

The procedure is to sorting/grading to remove damaged/overripe/infested/infected brinjal. The grading process is likely to remove flowers showing obvious signs of fungal and bacterial disease as well as the presence of aphids, mealybugs, scale insects, caterpillars etc.

### 4.4. Visual Inspection

Visual inspection of flowers occurs at several points during the routine production and post-harvest pathway for flowers and foliage. These include:

- In-field monitoring during the growing season
- Harvesting
- Post-harvesting sorting and grading
- Packaging flowers for treatment
- Packaging of flowers for export
- Visual phytosanitary inspection

A visual inspection at multiple points of the pathway provides opportunities to remove infested/infected flowers and is considered an appropriate risk management option for regulated organisms such as aphids, mealybugs and scale insects as they are easily detected on the surface of brinjal seeds, planting materials and or fruits.

### 4.5. Application of phytosanitary measures

A number of different phytosanitary measures may be applied to pests based on the outcome of an import or pest risk analysis. Required measures may include:

- Surveillance for pest freedom;
- Testing prior to export for regulated pests which cannot be readily detected by inspection (e.g. viruses on propagating material);
- Specific pre-shipment pest control activities to be undertaken by the supply contracting party;
- The application of a pre-shipment treatment;
- Inspection of the export consignment;
- Treatment on arrival in Bangladesh.

### 4.6. General conditions for fresh fruit/vegetables for consumption

Eggplant includes fresh fruit/vegetables intended for comsumption and not for planting. For the purposes of this standard eggplant excludes roots or viable seeds.

- Only clean, inert/synthetic material may be used for the protection, packaging and shipping of fresh fruit/vegetables.
- A completed phytosanitary certificate issued by the exporting country's NPPO must accompany all consignments of fresh fruit and vegetables exported to Bangladesh.
- Where it has been determined through pest risk assessment that high impact pests are associated with a particular commodity more specific phytosanitary measures must be met.

### 4.7. Specific Conditions for eggplant

#### 4.7.1. Pre-shipment requirements

**Inspection of the consignment:** Bangladesh requires that the NPPO of the country of origin sample and inspect the consignment according to official procedures for all the visually detectable regulated pests specified by Plant Quarantine Wing (PQW) of the Departemnt of Agiculture Extension of Bangladesh.

**Treatment of the consignment**

The PQW of Bangladesh requires that the NPPO of the country of origin ensure that the cut flowers and foliages from which the eggplant and other planting materials were collected, have been treated.

**Documentation**

- Bilateral quarantine arrangement: Required.
- Phytosanitary certificate: Required.
- Import permit/Authorisation to import: Required.

#### 4.7.2. Phytosanitary certification

A completed phytosanitary certificate issued by the NPPO of the country of origin must accompany all eggplant consignment exported to Bangladesh.

Before a phytosanitary certificate is to be issued, the NPPO of the country of origin must be satisfied that the following activities required by Ministry of Agiculture of Bangladesh have been undertaken.

The eggplants have:

i) been visually inspected in accordance with appropriate official procedures and found to be free from any regulated pests

AND,

ii) undergone appropriate pest control activities that are effective against: *Bemisia tabaci*

OR

iii) been sourced from a pest free area (verified by an official detection survey) free from a regulated pest(s).

AND

iv) undergone an agreed measure that is effective against associated fruit fly species of economic significance

### 4.7.3. Additional declarations to the phytosanitary certificate

If satisfied that the pre-shipment activities have been undertaken, the NPPO of the country of origin must confirm this by providing the following additional declarations to the phytosanitary certificate:

"The eggplants in this consignment have been:

- inspected according to appropriate official procedures and are considered to be free from the regulated pests specified by Plant Quarantine Wing under Department of Agriculture of Bangladesh, and to conform with Banglasesh's current phytosanitary requirements".

AND

- have undergone appropriate pest control activities that are effective against those regulated high impact pests

AND;

- have been sources from an area free from those regulated high impact pests;

### 4.7.4. Transit requirements

The eggplants must be packed and shipped in a manner to prevent infestation and/or contamination by regulated pests.

Where a consignment is split or has its packaging changed while in another country (or countries) *en route* to Bangladesh, a "Re-export Certificate" is required. Where a consignment is held under bond as a result of the need to change conveyances and is kept in the original shipping container, a "Re-export Certificate" is not required.

### 4.7.5. Inspection on arrival in Bangladesh

Plant Quarantine Wing of DAE of Bangladesh will check the accompanying documentation on arrival to confirm that it reconciles with the actual consignment.

### 4.7.6. Testing for regulated pests

PQW of DAE of Bangladesh may, on the specific request of the Director, PQW, test the consignment for regulated pests.

### 4.7.7. Actions undertaken on the interception/detection of organisms/contaminants

If regulated pests are intercepted/detected on the commodity, or associated packaging, the following actions will be undertaken as appropriate (depending on the pest identified):

- Treatment (where possible) at the discretion of the Director, PQW of Bangladesh;
- Reshipment of the consignment;
- Destruction of the consignment;
- The suspension of trade, until the cause of the non-compliance is investigated, identified and rectified to the satisfaction of PQW of DAE of Bangladesh.

Actions for the interception/detection of regulated non-plant pests will be in accordance with the actions required by the relevant government department.

### 4.7.8. Biosecurity clearance

If regulated pests are not detected, or are successfully treated following interception/detection, and there is no evidence to suggest the plant material is propagatable, biosecurity clearance will be given.

### 4.7.9. Feedback on non-compliance

The NPPO will be informed by the Director, Plant Quarantine Wing of Bangladesh, of the interception (and treatment) of any regulated pests, “unlisted” pests, or non-compliance with other phytosanitary requirements.

# CHAPTER 5

## POTENTIAL HAZARD ORGANISM: RISK ANALYSES

### 5.1. Introduction

The pest risk assessment was done with the aim to determine Bangladesh's phytosanitary measure regarding the eggplants imported from any eggplant exporting countries including India, China, Thailand, and Japan into Bangladesh.

### 5.2. Pest Categorization: Identification of Quarantine Pests Likely to Follow the Pathway

#### 5.2.1. Pests of eggplants in the world

The pests associated with fresh cutflower and foliages in the world have been categorized and listed below based on their scientific name, taxonomic position, common name, infective phase, plant parts affected, geographical distribution and their quarantine status for Bangladesh.

Sixty one species of pests were recorded for eggplants in the world of which 26 species were insect pests and two species were mite pests; the species of disease causing fungi were 13, bacteria two, nematode four, and virus were five and Phytoplasma one species. Whereas eight species of weeds for eggplants were recorded in the world.

Among Table 7 depicted the lists of pests associated with the eggplants in the world including in India, China, Thailand, Japan and the absence or presence of these pests in Bangladesh. Based on Table 7, any pest that meets all above criteria will be selected for further risk assessment (Table 8).

#### 5.2.2. Quaratine pests of eggplants for Bangladesh

Fourteen species of quarantine pests of eggplants for Bangladesh had been identified those were present in India, China, Thailand, and or Japan, but not in Bangladesh. Among these 14 species of pests, 7 were insect pests, one species was mite pest, one fungus, none of bacteria, nematode two species, virus three and weed was one species (Table 8).

The quarantine insect pests are Malaysian fruit fly (*Bactrocera latifrons*), serpentine leaf miner (*Liriomyza trifolii*), pea leaf miner (*Liriomyza huidobrensis*), silver leaf whitfly (*Bemisia tabaci (B biotype))*, vegetable weevil (*Listroderes costirostris*), Alfafa thrips (*Frankliniella occidentalis*), and cotton leaf worm (*Spodoptera littoralis*). The quarantine mite pest of brinjal for Bangladesh is red tomato spider mite (*Tetranychus evansi*) (Table 8).

On the other hand, seven disease causing micro-organisms and viruses have been identified as quarantine pests of eggplants for Bangladesh. Among these quarantine diseaes, one fungus named Phytopthora root rot (*Phytophthora megasperma*); two species of nematode named Golden cyst nematode (*Globodera rostochiensis*), and Pale cyst nematode (*Globodera pallid*); two viruses named *Tobaccor ringspot virus* and *Pepper veinal mottle virus* (Table 8).

One species of quarantine weed has been identified Bangladesh named Parthenium weed (*Parthenium hysterophorus*) (Table 8).

**Table 7. Pests associated with eggplants in the world and identification of quarantine organisms**

| Sl. No. | Common name | Scientific name | Family | Order | Presence in Bangladesh | Qurantine status | Follow pathway |
|---|---|---|---|---|---|---|---|
| **ARTHROPODS** | | | | | | | |
| **Insect pests** | | | | | | | |
| 1 | Brinjal shoot and fruit borer | *Leucinodes orbonalis* | Pyralidae | Lepidoptera | Yes | No | Yes |
| 2 | Cut worm | *Agrotis spp.* | Noctuidae | Lepidoptera | Yes | No | Yes |
| 3 | Leaf roller | *Eublemma olivacea* Walker | Noctuidae | Lepidoptera | Yes | No | Yes |
| 4 | Cotton leaf worm | *Spodoptera litura* | Noctuidae | Lepidoptera | Yes | No | Yes |
| 5 | Cabbage caterpillar | *Helicoverpa armigera* | Noctuidae | Lepidoptera | Yes | No | Yes |
| 6 | Eggplant moth | *Neoleucinodes elegantalis* | Crambidae | Lepidoptera | Yes | No | Yes |
| 7 | Jassid of brinjal | *Amrasca biguttula biguttula* | Cicadellidae | Homoptera | Yes | No | Yes |
| 8 | Aphid | *Aphis gossypii Glover* | Aphididae | Homoptera | Yes | No | Yes |
| 9 | Whitefly | *Bemisia tabaci* | Aleurodidae | Homoptera | Yes | No | Yes |
| 10 | Silver leaf whitfly | *Bemisia tabaci (B biotype)* | Aleurodidae | Homoptera | No | Yes | Yes |
| 11 | Scale insect | *Aulacaspis* spp. | Margarodidae | Homoptera | Yes | No | Yes |
| 12 | Mealybug | *Coccidohystrix insolita* | Pseudococcidae | Homoptera | Yes | No | Yes |
| 13 | Potato psyllid | *Bactericera cockerelli* | Triozidae | Hemiptera | Yes | No | Yes |
| 14 | Lace bug | *Gargaphia solani* | Tingidae | Hemiptera | Yes | No | Yes |
| 15 | Epilachna beetle | *Epilachna vigintioctopunctata* | Coccinellidae | Coleoptera | Yes | No | Yes |
| 16 | Epilachna beetle | *Epilachna dodecastigma* | Coccinellidae | Coleoptera | Yes | No | Yes |
| 17 | Blister beetle | *Mylabris pustulata* | Meloidae | Coleoptera | Yes | No | Yes |
| 18 | Spotted cucumber beetle | *Diabrotica undecimpunctata* | | Coleoptera | Yes | No | Yes |
| 19 | Vegetable weevil | *Listroderes costirostris* | Curculionidae | Coleoptera | No | Yes | Yes |
| 20 | Thrips | *Thrips palmi* Karny | Thripidae | Thysanoptera | Yes | No | Yes |
| 21 | Vegetable leaf miner | *Liriomyza sativae* | Agromyzidae | Diptera | Yes | No | Yes |
| 22 | Serpentine leaf miner | *Liriomyza trifolii* | Agromyzidae | Diptera | No | Yes | Yes |
| 23 | Pea leaf miner | *Liriomyza huidobrensis* | Agromyzidae | Diptera | No | Yes | Yes |
| 24 | Malaysian fruit fly | *Bactrocera latifrons* | Tephritidae | Diptera | No | Yes | Yes |
| 25 | Alfafa thrips | *Frankliniella occidentalis* | Thripidae | Thysanoptera | No | Yes | Yes |
| 26 | Cotton leaf worm | *Spodoptera littoralis* | Noctuidae | Lepidoptera | No | Yes | Yes |

| Sl. No. | Common name | Scientific name | Family | Order | Presence in Bangladesh | Qurantine status | Follow pathway |
|---|---|---|---|---|---|---|---|
| **Mite pests** | | | | | | | |
| 27 | Two-spotted spider mite | *Tetranychus urticae* | Tetranychidae | Acarina | Yes | No | Yes |
| 28 | Red spider mite | *Tetranychus evansi* | Tetranychidae | Acarina | No | Yes | Yes |
| **DISEASES** | | | | | | | |
| **Causal organism: Fungi** | | | | | | | |
| 29 | Early blight | *Alternaria tomatophilia* | Pleosporaceae | Pleosporales | Yes | No | Yes |
| 30 | Cercospora leaf spot | *Cercospora melongenae* | Mycosphaerellaceae | Capnodiales | Yes | No | Yes |
| 31 | Colletotrichum fruit rot | *Colletotrichum melongenae* | Glomerellaceae | Glomerellales | Yes | No | Yes |
| 32 | Anthracnose | *Colletotrichum coccodes* | Glomerellaceae | Glomerellales | Yes | No | Yes |
| 33 | Phomopsis fruit rot | *Phomopsis vexans* | Diaportaceae | Diaporthales | Yes | No | Yes |
| 34 | Phytophthora blight | *Phytophthora capsici* | Pythiaceae | Peronosporales | Yes | No | Yes |
| 35 | Verticillium wilt | *Verticillium* spp. | Plectosphaerellaceae | Incertae sedis | Yes | No | Yes |
| 36 | Stem rot/damping off | *Fusarium solani*. | Nectriaceae | Hypocreales | Yes | No | Yes |
| 37 | Root rot | *Pythium* spp. | Nectriaceae | Hypocreales | Yes | No | Yes |
| 38 | Damping off | *Rhizoctonia* spp. | Nectriaceae | Hypocreales | Yes | No | Yes |
| 39 | Powdery mildew | *Podosphaera pannosa* | Erysiphaceae | Erysiphales | Yes | No | Yes |
| 40 | Downy mildew | *Peronospora sparsa* | Peronosporaceae | Peronosporales | Yes | No | Yes |
| 41 | Phytopthora root rot | *Phytophthora megasperma* | Pythiaceae | Pythiales | No | Yes | Yes |
| **Causal organism: Bacteria** | | | | | | | |
| 42 | Bacterial wilt | *Ralstonia solanacearum* | Ralstoniaceae | Burkholderiales | Yes | No | Yes |
| 43 | Bacterial soft rot | *Erwinia carotovora* subsp. *carotovora* | *Enterobacteriaceae* | *Enterobacteriales* | Yes | No | Yes |
| **Causal organism: Nematode** | | | | | | | |
| 44 | Root knot nematode | *Meloidogyne javanica* | Heteroderidae | Tylenchida | Yes | No | Yes |
| 45 | Root knot nematode | *Meloidogyne incognita* | Heteroderidae | Tylenchida | Yes | No | Yes |
| 46 | Golder cyst nematode | *Globodera rostochiensis* | Heteroderidae | Tylenchida | No | Yes | Yes |
| 47 | Pale cyst nematode | *Globodera pallid* | Heteroderidae | Tylenchida | No | Yes | Yes |
| **Virus and viroid** | | | | | | | |
| 48 | Tomato leaf curl New Delhi virus | *Tomato leaf curl New Delhi virus* | Geminivirdae | Unassigned ssDNA | Yes | No | Yes |
| 49 | Potyvirus | *Potyvirus* | Potyviridae | Unassigned (+) ssRNA | No | Yes | Yes |
| 50 | Nucleorhabdovirus | *Nucleorhabdovirus* | Rhabdoviridae | Mononegavirales | No | Yes | Yes |
| 51 | Tobacco ringspot virus | *Tobacco ringspot nepovirus* | *Secoviridae* | *Picornavirales* | No | Yes | Yes |
| 52 | Pepper vein mottle virus | *Pepper veinal mottle virus* | Potyviridae | Unassigned (+)ssRNA | No | Yes | Yes |
| | | | | | | | |

| Sl. No. | Common name | Scientific name | Family | Order | Presence in Bangladesh | Qurantine status | Follow pathway |
|---|---|---|---|---|---|---|---|
| **Phytoplasma** | | | | | | | |
| 53 | Little leaf of brinjal | *Candidatus Phytopasma solani* | Acholeplasmataceae | Acholeplasmatales | Yes | No | Yes |
| **WEEDS** | | | | | | | |
| 54 | Bermuda grass | *Cynodon dactylon* | Poacegae | Poales | Yes | No | Yes |
| 55 | Nutsedge | *Cyperus esculentus* | Cyperaceae | Poales | Yes | No | Yes |
| 56 | Goosefoot | *Chenopodium album* L. | Chenopodioideae | Caryophyllales | Yes | No | Yes |
| 57 | Pigweed | *Amaranthus acanthochiton* | Amaranthaceae | Caryophyllales | Yes | No | Yes |
| 58 | Spiny pigweed | *Amaranthus spinosus* | Amaranthaceae | Caryophyllales | Yes | No | Yes |
| 59 | Blacknightshade | *Solanum nigrum* | Solanaceae | Solanales | Yes | No | Yes |
| 60 | Horsenettle | *Solanum carolinense* L. | Solanaceae | Solanales | Yes | No | Yes |
| 61 | Parthenium weed | *Parthenium hysterophorus* | Asteraceae | Asterales | Yes (restricted areas | Yes | Yes |

## References


Aheer GM, Akbar S, Chaudhri WM, 1997. New species of the genera Cheletomorpha and Ker (Acarina: Cheyletidae) from Pakistan. Acarologia, 38(2):117-121; 5 ref.

Akanda AM, Tsuno K, Wakimoto S, 1991. Serodiagnosis of viruses infecting some crops of Bangladesh. Journal of the Faculty of Agriculture, Kyushu University, 35(3-4):121-129

Alavi SV, Rezvani A, 2007. Seasonal fluctuations of citrus aphids in the East of Mazandaran and Citrus tristeza virus transmissibility by the major species. Applied Entomology and Phytopathology, 75(1):14 (En), 39-50 (Pe).

Ali MI, 1990. The development of symptoms due to attack of the cotton jassid, Amrasca biguttula (Shir.) (Homoptera: Jassidae) on cotton. Bangladesh Journal of Zoology, 18(2):211-214

Ali MI, Karim MA, 1990. Threshold sprays of insecticides: its advantages on conservation of arthropod predators and parasites in cotton ecosystem in Bangladesh. Bangladesh Journal of Zoology, 18(1):17-22

APPPC, 1987. Insect pests of economic significance affecting major crops of the countries in Asia and the Pacific region. Technical Document No. 135. Bangkok, Thailand: Regional Office for Asia and the Pacific region (RAPA).



APPPC, 1987. Insect pests of economic significance affecting major crops of the countries in Asia and the Pacific region. Technical Document No. 135. Bangkok, Thailand: Regional Office for Asia and the Pacific region (RAPA).



Avidov Z, Harpaz I, 1969. Plant pests of Israel. Jerusalem, Israel: Israel Universities Press.

Bashir M, Qureshi SH, Alam SS, Malik BA, 1985. Choanephora pod-rot of cowpea - a new disease record in Pakistan. Pakistan Journal of Agricultural Research, 6(3):240

Basu RC, Mitra SC, 1977. New records of Coreidae (Insecta: Hemiptera) from Kameng Division (Arunachal Pradesh), India. News Letter. Zoological Survey of India, 3(6):415-418

Basu RC, Mitra SC, 1977. New records of Coreidae (Insecta: Hemiptera) from West Bengal (India). News Letter, Zoological Survey of India, Calcutta, 3(4):206-209

Basu RC, Mitra SC, 1977. Some Coroidea (Insecta: Hemiptera) from Subansiri and Lohit district of Arunachal Pradesh (NEFA), India. News Letter. Zoological Survey of India, 3(6):431-433

Bedford ID, Briddon RW, Brown JK, Rosell RC, Markham PG, 1994. Geminivirus transmission and biological characterisation of Bemisia tabaci (Gennadius) biotypes from different geographic regions. Annals of Applied Biology, 125(2):311-325.

Bhattacharyya G, Pandya SM, 1996. Ecological assessment on agroecosystems of Saurashtra with special reference to weeds. Advances in Plant Sciences, 9(1):153-158; 11 ref.

CAB International, 1983. Alternaria solani. [Distribution map]. Distribution Maps of Plant Diseases, April (Edition 5). Wallingford, UK: CAB International, Map 89.

CAB International, 1985. Aulacorthum solani. [Distribution map]. Distribution Maps of Plant Pests, December. Wallingford, UK: CAB International, Map 86 (Revised).

CABI/EPPO, 1998. Distribution maps of quarantine pests for Europe (edited by Smith, I. M. and Charles, L. M. F.). Wallingford, UK: CAB International, xviii + 768 pp.

CABI/EPPO, 2004. Broad bean wilt virus. Distribution Maps of Plant Diseases, No. 925. Wallingford, UK: CAB International.

CABI/EPPO, 2008. Choanephora cucurbitarum. [Distribution map]. Distribution Maps of Plant Diseases, October (Edition 1). Wallingford, UK: CABI, Map 1034.

CABI/EPPO, 2013. Bactrocera dorsalis. [Distribution map]. Distribution Maps of Plant Pests, No.June. Wallingford, UK: CABI, Map 109 (4th revision).

Chang MU, Chung JD, 1987. Studies on viruses isolated from Lilium spp. in Korea. I. Broad bean wilt virus and cucumber mosaic virus. Korean Journal of Plant Pathology, 3(3):233-235

Distant WL, 1904. The Fauna of British India including Ceylon and Burma. Rhynchota, Published under the Authority of the State for India in Council. London, UK: Taylor and Francis.

Drew RAI, Hancock DL, 1994. The Bactrocera dorsalis complex of fruit flies (Diptera: Tephritidae: Dacinae) in Asia. Bulletin of Entomological Research, 84(2(Suppl.)):68 pp.

Enns WR. 1956. A revision of the genera *Nemognatha*, *Zonitis*, and *Pseudozonitis* (Coleoptera, Meloidae) in America north of Mexico, with a proposed new genus. University of Kansas Scientific Bulletin 37: 685-909

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

Farahbakhsh G, 1961. A Checklist of Economically Important Insects and other Enemies of Plants and Agricultural Products in Iran. Tehran, Iran: Department of Plant Protection, Ministry of Agriculture.

Gardenhire RQ, 1959. Summary of insect conditions in Iran. Cooperative Economic Insect Report, 9:70-74.

He YuXian, Huang Jian, Weng QiYong, Liang ZhiSheng, 2008. Biochemical mechanisms of resistance to chlorpyrifos and dichlorvos in field populations of Bemisia tabaci (Gennadius) B-biotype. Acta Entomologica Sinica, 51(4):384-389. http://www.insect.org.cn

Heimoana V, Nemeye P, Langi T, Allwood AJ, 1997. Assessment of protein bait sprays for the control of fruit flies in chilli and capsicum crops in Tonga, In: Allwood AJ, Drew RAI, eds. Management of Fruit Flies in the Pacific. A Regional Symposium, Nadi, Fiji. ACIAR Proceedings, 76: 179-182.

Holm LG, Pancho JV, Herberger JP, Plucknett DL, 1991. A Geographic Atlas of World Weeds. Malabar, Florida, USA: Krieger Publishing Company.

Jiang YongDong, Li HuMing, Tan JiCai, 2008. The relationship between the occurrence of Aulacorthum solani Kaltenbach on Swertia dividii Franch and temperature in western Hunan. Acta Phytophylacica Sinica, 35(4):356-360. http://www.wanfangdata.com.cn

Jiang YongDong, Li HuMing, Tan JiCai, 2008. The relationship between the occurrence of Aulacorthum solani Kaltenbach on Swertia dividii Franch and temperature in western Hunan. Acta Phytophylacica Sinica, 35(4):356-360. http://www.wanfangdata.com.cn

Kapur, A.P., (1950). The biology and external morphology of larvae of Epilachninae (Coleoptera:Coccinellidae). Bull. Ent. Res., 41: 161-208.

Krishnamurti, B., 1932. The potato Epilachna beetle *Epilachna vigintioctopunctata* (Fabr.) bulletin department of agriculture mysore State, Entomological Series No 9: 16. http://ecoport.org/ep?SearchType=reference&ReferenceID=487539.

Leblanc L, Hossain MA, Khan SA, San Jose M, Rubinoff D, 2013. A preliminary survey of the fruit flies (Diptera: Tephritidae: Dacinae) of Bangladesh. Proceedings of the Hawaiian Entomological Society, 45:51-58.

Mali VR, Vyanjane NT, Ekbote AU, 1977. Petunia ringspot virus disease - a new record for India. Current Science, 46(16):567-568

Mathur, A.C. and J.B. Srivastava, 1964. *Epilachna vigintioctopunctata* F. (Coccinellidae: Coleoptera) as a defoliator of some Solanaceous medicinal plants. Indian J. Entomol., 26: 246-246.

Meah MB, Mian MAW, 1981. Pathogenicity of Choanephora cucurbitarum on chilli (Capsicum annuum) and possibility of its chemical control. Acta Phytopathologica Academiae Scientiarum Hungaricp, 16(1/2):1-7

Ono T, Kidokoro T, Hoshi N, 2005. Damage analysis of outbreak of foxglove aphid, Aulacorthum solani, in mature soybean plants. Annual Report of the Society of Plant Protection of North Japan, No.56:131-133. http://njp.ac.affrc.go.jp/index.html

Park JH, Cho SE, Han KS, Kim BS, Shin HD, 2015. First report of choanephora rot caused by Choanephora cucurbitarum on Hosta plantaginea in Korea. Plant Disease, 99(1):158. http://apsjournals.apsnet.org/loi/pdis

Park JH, Cho SE, Park MJ, Han KS, Shin HD, 2015. First report of Choanephora cucurbitarum causing Choanephora blight on Phlox paniculata in Korea. Plant Disease, 99(8):1180. http://apsjournals.apsnet.org/loi/pdis

Parvin S, Izadpanah K, 1978. Broadbean wilt virus - identification, host range and distribution in the Fars province of Iran. Iranian Journal of Agricultural Research, 6(2):81-90

Prabhavathy KG, Reddy SR, 1995. Post-harvest fungal diseases of chilli (Capsicum annuum) from Andhra Pradesh. Indian Phytopathology, 48(4):492.

Prasad D, Singh KM, Katiyar RN, 1983. Succession of insect pests in early maturing high yielding variety of pea, Pisum sativum Linn. Indian Journal of Entomology, 45(4):451-455

Rajagopal, D. and T.P. Trivedi, 1989. Status, bioecology and management of Epilachna beetle, *Epilachna vigintioctopunctata* (Fab.) (Coleoptera: Coccinellidae) on potato in India: A review. Trop. Pest Manage., 35: 410-413.

Rashmi Pandey, Kuldeep Sharma, Deepti Chaudhari, Mayank Rai, 2008. Effect of weather parameters on incidence of Bemisia tabaci and Myzus persicae on potato. Annals of Plant Protection Sciences, 16(1):78-80. http://www.indianjournals.com/ijor.aspx?target=ijor:apps&type=home

Roy AK, Deka KC, 1989. Outbreaks and new records. India. Top rot, Choanephora cucurbitarum (Berk. & Rav.) Thaxter, of a grain amaranth. FAO Plant Protection Bulletin, 37(2):96

Saha NN, Saharia D, 1983. Insects injurious to soybean in Assam. Journal of Research, Assam Agricultural University, 4(2):167-169

Selander RB, Bouseman JK. 1960. Meloid beetles (Coleoptera) of the West Indies. Proceedings of the U.S. National Musuem 111: 197-226.

Stephan ZA, 1988. Newly reported hosts of root-knot nematodes in Iraq. International Nematology Network Newsletter, 5(3):36-43

Tag-El-Din A, Ghandorah MO, Al-Rajhi D, Meneesy F, 1989. Evaluation of herbicides for weed control in irrigated wheat in Saudi Arabia. Tropical Pest Management, 35(3):321-325

Tora Vueti E, Allwood AJ, Leweniqila L, Ralulu L, Balawakula A, Malau A, Sales F, Peleti K, 1997. Fruit fly fauna in Fiji, Tuvalu, Wallis and Futuna, Tokelau and Nauru. In: Allwood AJ, Drew RAI, eds. Management of Fruit Flies in the Pacific. A Regional Symposium, Nadi, Fiji. ACIAR Proceedings, 76:60-63.

Wang SB, Pu ZQ, 1993. Identification of celery staple viruses in Nanjing. Acta Agriculturae Shanghai, 9(3):76-82

Waterhouse DF, 1993. The Major Arthropod Pests and Weeds of Agriculture in Southeast Asia. ACIAR Monograph No. 21. Canberra, Australia: Australian Centre for International Agricultural Research, 141 pp.

Williams MAJ, 1987. Cercospora melongenae. [Descriptions of Fungi and Bacteria]. IMI Descriptions of Fungi and Bacteria, No. 94. Wallingford, UK: CAB International, Sheet 936.

Yamashita K, 1990. Mosaic diseases occurred on gentian and prairie gentian in Aomori Prefecture. Annual Report of the Society of Plant Protection of North Japan, No. 41:80-82

**Table 8. Quarantine pests for Bangladesh likely to be associated with eggplants imported from exporting countries selected for further analysis**

| Sl. #. | Common name | Scientific name | Family | Order |
|---|---|---|---|---|
| **Arthropod** | | | | |
| **Insect pests** | | | | |
| 1 | Malaysian fruit fly | *Bactrocera latifrons* | Tephritidae | Diptera |
| 2 | Serpentine leaf miner | *Liriomyza trifolii* | Agromyzidae | Diptera |
| 3 | Pea leaf miner | *Liriomyza huidobrensis* | Agromyzidae | Diptera |
| 4 | Silver leaf whitfly | *Bemisia tabaci (B biotype)* | Aleurodidae | Homoptera |
| 5 | Vegetable weevil | *Listroderes costirostris* | Thripidae | Thysanoptera |
| 6 | Alfafa thrips | *Frankliniella occidentalis* | Thripidae | Thysanoptera |
| 7 | Cotton leaf worm | *Spodoptera littoralis* | Noctuidae | Lepidoptera |
| **Mite pest** | | | | |
| 8 | Red tomato spider mite | *Tetranychus evansi* | Tetranychidae | Acarina |
| **Disease causing organisms** | | | | |
| **Fungi** | | | | |
| 9 | Phytopthora root rot | *Phytophthora megasperma* | Pythiaceae | Pythiales |
| **Nematode** | | | | |
| 10 | Golden cyst nematode | *Globodera rostochiensis* | Heteroderidae | Tylenchida |
| 11 | Pale cyst nematode | *Globodera pallid* | Heteroderidae | Tylenchida |
| **Virus** | | | | |
| 12 | Tobacco ringspot virus | *Tobacco ringspot nepovirus* | *Secoviridae* | *Picornavirales* |
| 13 | Pepper vein mottle virus | *Pepper veinal mottle virus* | Potyviridae | Unassigned (+)ssRNA |
| **Weeds** | | | | |
| 14 | Parthenium weed | *Parthenium hysterophorus* | Asteraceae | Asterales |

## 5.3. Potential Hazard Organisms: Risk Analyses

The risk analysis of quarantine pests include the use of a developing or evolving process (PPQ, 2000; Orr et al., 1993), the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990), and the evaluation of risk by comparisons to lists of factors within the guidelines (Kaplan, 1992; Orr et al., 1993). The risk assessment was done in accordance with International Plant Protection Convention (IPPC) and the International Standards for Phytosanitary Measures (ISPM 2 and ISPM 11). The risk analysis of quarantine pests of cut flowers and foliages idenfied for Bangladesh has been analyzed details as follows:

## INSECT PESTS

### 5.3.1. Malaysian fruit fly: *Bactrocera latifrons* (Hendel)

#### 5.3.1.1. Hazard Identification

**Scientific name:** *Bactrocera latifrons* (Hendel)

**Synonyms**:

*Chaetodacus antennalis (*Shiraki, 1933)
*Chaetodacus latifrons (*Hendel)
*Dacus latifrons* (Hendel)
*Dacus parvulus (*Hendel, 1912)

**Common names**: Malaysian fruit fly

### Taxonomic tree

Domain: Eukaryota
Kingdom: Metazoa
Phylum: Arthropoda
Subphylum: Uniramia
Class: Insecta
Order: Diptera
Family: Tephritidae
Genus: *Bactrocera*
Species: *Bactrocera latifrons*

### EPPO Code: DACULA.

**Bangladesh status:** Not present in Bangladesh [CABI/EPPO, 2015]

#### 5.3.1.2. Biology

Eggs (9-587 eggs) are laid below the skin of the host fruit. These hatch within a few days (mean 2.3) and the larvae feed for about a week (mean 8.5 days). Pupariation is in the soil under the host plant for little over a week (mean 10.2 days). Adults occur throughout the year and females begin oviposition after 6-17 days, and continue laying eggs for 6-117 days (Vargas and Nishida, 1985). Adult flight and the transport of infected fruit are the major means of movement and dispersal of *Bactrocera spp*. to previously uninfected areas. Many Bactrocera spp. can fly 50-100 km (Fletcher, 1989).

#### 5. 3.1.3. Hosts

*B. latifrons* is a pest of fruit and vegetable species, mainly belonging to Solanaceae and to a lesser extent to Cucurbitaceae, such as: *Capsicum annuum, C. chinense, C. frutescens,*

*Physalis peruviana, Solanum aethiopicum, S. lycopersicum, S. melongena, S. torvum - Cucumis sativus, C. melo, Cucurbita maxima, Citrullus lanatus, Lagenaria siceraria, Momordica charantia*. A recent review has also identified more than 50 plant species (in 14 plant families) on which field infestations by *B. latifrons* have been recorded (e.g. *Citrus aurantifolia* (Rutaceae), *Dimocarpus longan* (Sapindaceae), *Passiflora foetida* (Passifloraceae), *Psidium guajava* (Myrtaceae), *Punica granatum* (Lytraceae)).

### 5. 3.1.4. Distribution

*B. latifrons* has a predominantly south and south-east Asian distribution. Waterhouse (1993) records this species from Indonesia, although no area is specified. Given that this species has been found in Sabah and **West Malaysia** it may at least be expected in Kalimantan and Sumatra. In Africa, *B. latifrons* has only been recorded from Tanzania and Kenya. Its occurance in other parts of Africa is currently unknown (Meyer et al., 2007). This species was recently introduced to Hawaii and was first discovered there in 1983 (Liquido et al., 1994). *B. latifrons* originates from Asia but its range has expanded through introductions into Africa (Kenya and Tanzania, first found in 2007 and 2006 respectively) and the islands of Hawaii (US, first found in Honolulu in 1983) and Yonaguni (Okinawa prefecture, Ryukyu Archipelago, **Japan,** first found in 1984).

EPPO region: Absent.

Africa: Kenya, Tanzania.

Asia: Brunei Darussalam, China (Fujian, Guangdong, Guangxi, Hainan, Xianggang (Hong Kong), Yunnan), India (Karnataka, Kerala, Himachal Pradesh, Tamil Nadu, West Bengal), Indonesia (Kalimantan, Sulawesi), Japan (Ryukyu), Laos, Malaysia (Sabah, West), Myanmar, Pakistan, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam.

North America: USA (Hawaii only). Isolated outbreaks have been reported occasionally from California, but have been eradicated.

### 5. 3.1.5. Hazard identification conclusion

Considering the facts that *B. latifrons* -

- is not known to be present in Bangladesh [CABI/EPPO, 2015];
- is potentially economic important to Bangladesh because it is an important pest of Solanaceae and Cucurbitaceae in Asia including China, India, Thailand, **Japan** [CABI/EPPO, 2015] from where brinjal seeds are imported to Bangladesh.
- can become established in Bangladesh through imports of the brinjal seeds. Some of the major host plants of B. latifrons, such as tomato, aubergine, sweet pepper, cucumber, melons and other cucurbits are widely grown in the Asia region, in both field and protected conditions. Economic damage has been reported from countries where *B. latifrons* occurs. According to the EPPO study on pest risks associated with the import of brinjal seeds, the climatic similarity between the area where *B. latifrons* occurs and Bangladesh region is same. As experience has shown that control and eradication of fruit flies is complex and costly, the introduction of *B. latifrons* in Bangladesh should be avoided.
- *B. latifrons* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

**5. 3.1.6. Determine likelihood of pest establishing in Bangladesh via this pathway**

Table 1.1 – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **a. Has this pest been established in several new countries in recent years,-Yes,**<br>• This pest has been established in many Asian countries. The introduction of this pest in India was first reported in 2014; Japan in 2014, China in 2014; Thailand in 2014, Sri-lanka in 2014).<br>b. **Posibility of survival during transport, storage and transfer of this pest? Yes**<br>• The brinjal seeds and fruits are transported from India, China, Japan, Thailand, Taiwan and Vietnam to Bangladesh mainly by Airfreight, and or Landport. Therefore, the period of time taken for shipment through these transportation pathways from the exporting countries to Bangladesh is very short. Within this period the eggs and larva of fruitfly can easily survive within the fruit of eggplant. Becauase eggs (9-587 eggs) are laid below the skin of the host fruit. These hatch within at few days (mean 2.3) and the larvae feed for about a week (mean 8.5 days). Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with High risk potential.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• The major risk is from the import of fruit containing larvae, either as part of cargo, or through the smuggling of fruit in airline passenger baggage or mail. For example, in New Zealand (Baker and Cowley,1991) recorded 7-33 interceptions of fruit flies per year in cargo and 10-28 per year in passenger baggage. Private individuals who successfully smuggle fruit are likely to discard it when they discover that it is rotten. Larvae have been found in peppers sent by mail from Hawaii to California (Foote et al., 1993).<br>**D. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• *B. latifrons* is a remarkably polyphagous species with 50 plant species from 14 families being recorded as hosts. The host range of *B. latifrons* is the fruits *Capsicum annuum, C. chinense, C. frutescens, Physalis peruviana, Solanum aethiopicum, S. lycopersicum, S. melongena, S. torvum - Cucumis sativus, C. melo, Cucurbita maxima, Citrullus lanatus, Lagenaria siceraria, Momordica charantia* (EPPO, 2016), which are mostly common in Bangladesh.<br>• Adult flight is the main means of natural spread. No data is specifically given for flying distances of *B. latifrons*, but several Bactrocera spp. have been reported to fly 50-100 km. Over long distances, movement and trade of fruit and vegetables can transport the pest. In the EPPO region, B. latifrons has been intercepted several times in imported fruits and vegetables from | **YES and HIGH** |

| | |
|---|---|
| Asia, thus showing that the pest has pathways to enter the region. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

**5. 3.1.7. Determine the Consequence establishment of this pest in Bangladesh**

**Table 1.2** – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| a. **Is this a serious pest of Bangladesh? - Yes.**<br><br>*B. latifrons* is a remarkably polyphagous species with 50 plant species from 14 families being recorded as hosts. The host range of *B. latifrons* is the fruits *Capsicum annuum, C. chinense, C. frutescens, Physalis peruviana, Solanum aethiopicum, S. lycopersicum, S. melongena, S. torvum - Cucumis sativus, C. melo, Cucurbita maxima, Citrullus lanatus, Lagenaria siceraria, Momordica charantia* (EPPO, 2016), which are mostly common in Bangladesh.<br><br>• *B. latifrons* is of quarantine significance for Bangladesh. Its introduction and rapid spread to many countries, and the problems presented by its presence in field crops, illustrate clearly the serious nature of this pest and the potential threat to the field crops as well as other horticultural crops in Bangladesh still free from the pest.<br><br>• This is a fairly serious pest of several important field crops for Bangladesh.<br><br>**b. Economic impact and yield loss**<br><br>• *B. latifrons* is Asian in origin. It was only very recently detected in Africa. The first specimens were trapped early in 2006 in Morogoro, Tanzania (Mwatawala et al., 2010). Surveys have shown that this species is widely distributed in Tanzania although not present in large numbers because of its limited host range (Mwatawala *et al.,* 2010). In 2007, it was also found in Kenya near the border with Tanzania (Ekesi, unpublished records). So far, the species has not been reported from any other African countries. *B. latrifons* was found in the Hawaiian Islands around 1983 (Vargas and Nishida, 1985) and causes a great economic lost of fruits and planting materials.<br>• Adult fruit fly (*Bactrocera spp*.) can be controlled with methyl eugenol traps (Lakshmanan *et al.* 1973), bait sprays, pheromone mating disruption, and pesticide applications to fruit (Abbas *et al*. 2000). Larvae inside brinjal can be killed by hot water treatment of mature fruit (Wadhi and Sharma, 1972), cold treatments (Burikam et al. 1992), vapor heat treatment (Heard et al. 1992, Heather et al. 1992), and gamma irradiation (Heather et al. 1991). The expense required to control fruit flies and the loss of export potential due to the presence of fruit flies would have a High Economic Impact.<br><br>**c. Environmental impact**<br><br>•The appearance of the Malaysian fruitefly within new areas is in most | **Yes and High** |

| | |
|---|---|
| cases, the result of movement of infested plant material. The movement and establishment of fruitefly populations through this route bring along the possibility of insecticide resistance genes. This invariably leads to an increase in the use of insecticides as fruitfly control becomes increasingly more difficult. This in turn can produce an ever increasing spiral in the levels of insecticide resistance and insecticide use, having a direct impact on the environment.<br>Adult fruit fly (*Bactrocera spp*.) can be controlled with methyl eugenol traps (Lakshmanan *et al.* 1973), bait sprays, pheromone mating disruption, and pesticide applications to fruit (Abbas *et al.* 2000). Larvae inside mango fruit can be killed by gamma irradiation (Heather et al. 1991). The residual toxicity of the applied chemical insecticides on fruits and irradiated mango would have a High Environmental Impact. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5. 3.1.8. Calculating the Risk of this Pest via this pathway for Bangladesh

**Establishment Potential X Consequence Potential = Risk**

Table 1.3 – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5. 3.1.9. Risk Management Measures

- Avoid importation of fruits and vegetables from countries, where this pest is available.
- Many countries, such as the mainland USA, forbid the import of susceptible fruit without strict post-harvest treatment having been applied by the exporter. This may involve fumigation, heat treatment (hot vapour or hot water), cold treatments, insecticidal dipping, or irradiation (Armstrong and Couey, 1989). However, recent research has indicated that B. latifrons is more heat tolerant than other species (Jang *et al*., 1999). Irradiation is not accepted in most countries and many have now banned methyl bromide fumigation. Heat treatment tends to reduce the shelf life of most fruits and so

the most effective method of regulatory control is to preferentially restrict imports of a given fruit to areas free of fruit fly attack.

- One of the most effective control techniques against fruit flies in general is to wrap fruit, either in newspaper, a paper bag, or in the case of long/thin fruits, a polythene sleeve. This is a simple physical barrier to oviposition but it has to be applied well before the fruit is attacked. Little information is available on the attack time for most fruits but few Bactrocera spp. attack prior to ripening.
- Although cover sprays of entire crops are sometimes used, the use of bait sprays is both more economical and more environmentally acceptable. A bait spray consists of a suitable insecticide (e.g. malathion) mixed with a protein bait. Both males and females of fruit flies are attracted to protein sources emanating ammonia, and so insecticides can be applied to just a few spots in an orchard and the flies will be attracted to these spots. The protein most widely used is hydrolysed protein, but some supplies of this are acid hydrolysed and so highly phytotoxic. (Smith and Nannan, 1988) have developed a system using autolysed protein. In Malaysia this has been developed into a very effective commercial product derived from brewery waste.
- This species is not attracted to either cue lure or methyl eugenol. Field monitoring is by sampling susceptible fruits for larvae. In Hawaii a new lure chemical is being developed (White and Liquido, 1995).

### 5. 3.1.10. References


Armstrong J.W. and Couey H.M., 1989. Control; fruit disinfestation; fumigation, heat and cold. In: Robinson AS, Hooper G, eds. Fruit Flies; their Biology, Natural Enemies and Control. World Crop Pests. Amsterdam, Netherlands: Elsevier, 3(B):411-424.

Baker R.T. and Cowley J.M., 1991. A New Zealand view of quarantine security with special reference to fruit flies, In: Vijaysegaran S, Ibrahim AG, eds. First International Symposium on Fruit Flies in the Tropics, Kuala Lumpur, 1988. Kuala Lumpur, Malaysia: Malaysian Agricultural Research and Development Institute, 396-408.

CABI Invasive Species Compendium. Bactrocera latifrons (Solanum fruit fly) http://www.cabi.org/isc/datasheet/8719

EPPO (2015). EPPO Study on Pest Risks Associated with the Import of Tomato Fruit. EPPO Technical Document No. 1068. Available at http://www.eppo.int

Fletcher B.S., 1989. Ecology; life history strategies of tephritid fruit flies, In: Robinson AS, Hooper G, eds. Fruit Flies; their Biology, Natural Enemies and Control. World Crop Pests. Amsterdam, Holland: Elsevier, 3(B):195-208.

Foote R.H., Blanc F.L. and Norrbom A.L., 1993. Handbook of the Fruit Flies (Diptera: Tephritidae) of America North of Mexico. Ithaca, USA: Comstock.

Jang E.B., Nagata J.T., Chan H.T.Jr. and Laidlaw W.G., 1999. Thermal death kinetics in eggs and larvae of Bactrocera latifrons (Diptera: Tephritidae) and comparative thermotolerance to three other tephritid fruit fly species in Hawaii. Journal of Economic Entomology, 92(3):684-690; 37 ref.

Liquido N.J., Harris E.J. and Dekker L.A., 1994. Ecology of Bactrocera latifrons (Diptera: Tephritidae) populations: host plants, natural enemies, distribution, and abundance. Annals of the Entomological Society of America, 87(1):71-84.

Meyer M. De., Mohamed S. and White I.M., 2007. Invasive fruit fly pests in Africa. Tervuren, Belgium: Royal Museum for Central Africa. http://www.africamuseum.be/fruitfly/AfroAsia.htm

Mwatawala M, Meyer Mde, White IM, Maerere A, Makundi RH, 2007. Detection of the solanum fruit fly, Bactrocera latifrons (Hendel) in Tanzania (Dipt., Tephritidae). Journal of Applied Entomology, 131(7):501-503. http://www.blackwell-synergy.com/loi/jen

Smith D. and Nannan L., 1988. Yeast autolysate bait sprays for control of Queensland fruit fly on passionfruit in Queensland. *Queensland Journal of Agricultural and Animal Sciences*, 45(2):169-177.

Vargas R.I. and Nishida T., 1985. Life history and demographic parameters of Dacus latifrons (Diptera: Tephritidae). *Journal of Economic Entomology*, 78(6):1242-1244.

Vargas RI, Nishida T, 1985. Life history and demographic parameters of Dacus latifrons (Diptera: Tephritidae). Journal of Economic Entomology, 78(6):1242-1244

Waterhouse D.F., 1993. The Major Arthropod Pests and Weeds of Agriculture in Southeast Asia. ACIAR Monograph No. 21. Canberra, Australia: Australian Centre for International Agricultural Research, 141 pp.

White I.M. and Liquido N.J., 1995. Case 2967; Chaetodacus latifrons Hendel, 1915 (currently Bactrocera latifrons; Insecta, Diptera): proposed precedence of the specific name over that of Dacus parvulus Hendel, 1912. Bulletin of Zoological Nomenclature, 52:250-252.

## 5.3.2. Serpentine leaf miner: *Liriomyza trifolii* (Burgess)

### 5.3.2.1. Hazard identification

**Scientific Name:** *Liriomyza trifolii* Burgess in Comstock, 1880

**Synonyms**: *Agromyza phaseolunata* Frost, 1943
*Liriomyza alliivora* Frick, 1955
*Liriomyza alliovora* Frick, 1955
*Liriomyza phaseolunata* (Frost, 1943)
*Oscinis trifolii* Burgess in Comstock, 1880

**Common names**: Serpentine leaf miner
Chrysanthemum leaf miner

**Taxonomic tree**

Phylum: Arthropoda
Subphylum: Mandibulata
Class: Insecta
Order: Diptera
Family: Agromyzidae
Genus: *Liriomyza*
Species: *Liriomyza trifolii*

EPPO Code: LIRITR. This pest has been included in EPPO A2 list: No. 131

**Bangladesh status:** Not present in Bangladesh [EPPO, 2014; CABI/EPPO, 1997]

### 5. 3.2.2. Biology

Peak emergence of adults occurs before midday (McGregor, 1914). Males usually emerge before females. Mating takes place from 24 h after emergence and a single mating is sufficient to fertilize all eggs laid. Female flies puncture the leaves of the host plants causing wounds which serve as sites for feeding or oviposition. Feeding punctures cause the destruction of a larger number of cells and are more clearly visible to the naked eye. About

15% of punctures made by *L. trifolii* contain viable eggs (Parrella et *al*., 1981). Eggs are inserted just below the leaf surface. The number of eggs laid varies according to temperature and host plant. *L. trifolii* females each laid 25 eggs in celery at 15°C and 400 eggs at temperatures around 30°C. One female of *L. trifolii* laid 493 eggs in peas (Poe, 1981) and another laid 639 eggs in chrysanthemums (cv. Fandango).

The life-cycle is probably continuous throughout the year. There is a noticeable first generation which reaches a peak in April (Spencer, 1973). On celery *L. trifolii* completes its life-cycle (oviposition to adult emergence) in 12 days at 35°C, 26 days at 20°C, and 54 days at 15°C (Leibee, 1982). On chrysanthemums the life-cycle is completed in 24 days at 20°C but on *Vigna sinensis* and *Phaseolus lunatus* it takes only 20 days at this temperature (Poe, 1981). Adults of *L. trifolii* live between 15 and 30 days. On average, females live longer than males.

### 5. 3.2.3. Hosts

**a. Major hosts:** The main host of *L. trifolii* includes aubergine, Chinese cabbage, spinach, ornamental gourd, cucurbits, beans, soyabean, common bean, cow pea, okra, cotton, tomato Ageratum, Aster, marigold, Callistephus, safflower, *Chrysanthemum morifolium*, Dahlia, Gerbera (barbeton daisy), sunflower, carnation, gypsophila (baby's breath), Zinnia, salvia (sage), garlic, Begunia, groundnut, lettuce etc.

**b. Minor hosts:** The minor or other hosts of this pest include pumpkin, bottle gourd, loofah, castor bean, *Chrysanthemum indicum,* faba bean, onion, Goosefoot, citrullus, etc.

### 5. 3.2.4. Distribution

*L. trifolii* has not yet been reported from many countries where it is actually present. It is generally recognized that all the countries bordering the Mediterranean have *L. trifolii* in varying degrees and that it occurs in all mainland states of the USA. *L. trifolii* has been recorded from the Juan Fernandez Islands (an offshore territory of Chile; Martinez and Etienne, 2002; EPPO, 2009). The record for Argentina has been changed to 'Absent, unreliable record' as Martinez and Etienne (2002) and EPPO (2006) are based on Burgess (in Comstock, 1880 (1879)) and there have been no other reports of the pest in Argentina. *L. trifolii* is a quarantine pest for Argentina (SENASA, personal communication, 2008).

*L. trifolii* originates in North America and spread to other parts of the world in the 1960-1980s and in India, it was first reported in 1991 (EPPO, 2014). A detailed review of its spread is given in Minkenberg (1988).

- **EPPO region**: First detected in 1976. Now present in Austria, Belgium, Bulgaria, Cyprus, Egypt, France, Greece, Ireland, Israel, Italy, Lebanon, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain (including Canary Islands), Switzerland, Turkey, Yugoslavia. Eradicated in the Czech Republic, Denmark, Finland, Germany, Hungary, Norway, Sweden, UK.
- **Asia**: Cyprus, India (Andhra Pradesh), Israel, Japan (Honshu), Korea Republic, Lebanon, Philippines, Taiwan, Turkey (EPPO, 2014), China (CABI, 1997).
- **Africa**: Egypt, Ethiopia, Kenya, Mauritius, Nigeria, Réunion, Senegal, South Africa, Tanzania, Tunisia.
- **North America**: Canada (Alberta, Nova Scotia, Ontario, Quebec), Mexico (unconfirmed), USA (outside in New Mexico, California, most eastern states from Florida northward to New Jersey, Wisconsin and Iowa; under glass in other southern states).
- **Central America and Caribbean**: Bahamas, Barbados, Costa Rica, Cuba, Dominican Republic, Guadeloupe, Guatemala, Martinique, Trinidad and Tobago.
- **South America**: Brazil, Colombia, French Guiana, Guyana, Peru, Venezuela.
- **Oceania**: American Samoa, Guam, Micronesia, Northern Mariana Islands, Samoa, Tonga.

### 5. 3.2.5. Hazard Identification Conclusion

Considering the facts that *Liriomyza trifolii* (Burgess) -

- is not known to be present in Bangladesh [EPPO, 2014; CABI/EPPO, 1997];
- is potentially economic important to Bangladesh because it is an important pest of flowers and foliages in Asia including India, China, Thailand (absent, unreliable record), **Japan**, Sri Lanka, Lebanon, Philippines, Cyprus, Israel, Turkey, Taiwan, [EPPO, 2014; CABI/EPPO, 1997] from where flowers are imported to Bangladesh.
- can become established in Bangladesh through imports of the vegetable seeds, nursery stock, flowers and foliages. It has capability to cause direct economic and ecological damage to many valuable cultivated crops, because one female of *L. trifolii* can lay 493 eggs in peas (Poe, 1981) and another laid 639 eggs in chrysanthemums and larvae develop within the leaf surface. Dispersal over long distances is on planting material of host species. Cut flowers can also present a danger as a means of dispersal; it should be noted, for example, that the vase life of chrysanthemums is sufficient to allow completion of the life-cycle of the pest. [EPPO, 2016].
- *L. trifolii* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 5. 3.2.6. Determine likelihood of pest establishing in tour country via this pathway

Table 2.1 – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **a. Has this pest been established in several new countries in recent years,-Yes,**<br>• This pest has been established in many Asian countries. The introduction of this pest in India was first reported in 1991; Turkey in 1985, Tunisia in 1992, introduced in Kenya in 1976, now present in many Asian countries including Japan, Korea, the Republic, Thailand (absent, unreliable record) and China.<br>• *L. trifolii* originates in North America and spread to other parts of the world in the 1960-1980s.<br>• In EPPO region, this pest has been first detected in 1976. Now present in Austria, Belgium, Bulgaria, Cyprus, Egypt, France, Greece, Ireland, Israel, Italy, Lebanon, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain (including Canary Islands), Switzerland, Turkey, Yugoslavia. Eradicated in the Czech Republic, Denmark, Finland, Germany, Hungary, Norway, Sweden, UK.<br>**b. Posibility of survival during transport, storage and transfer of this pest? Yes**<br>• The brinjal seeds and fruits are transported from India, China, Japan, Thailand, Taiwan and Vietnam to Bangladesh mainly by Airfreight, and or Landport. Therefore, the period of time taken for shipment through these transportation pathways from the exporting countries to Bangladesh is very short. Within this period the eggs and larva of serpentine leaf miner can easily survive within the fruit and planting | **YES and HIGH** |

| | |
|---|---|
| materials of eggplant. On celery *L. trifolii* completes its life-cycle (oviposition to adult emergence) in 12 days at 35°C, 26 days at 20°C, and 54 days at 15°C (Leibee, 1982). On the life-cycle is completed in 24 days at 20°C but on Vigna sinensis and Phaseolus lunatus it takes only 20 days at this temperature (Poe, 1981). Adults of *L. trifolii* live between 15 and 30 days. Secondly, fruit/planting material is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with High risk potential.<br><br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br><br>• Internationally, *L. trifolii* is liable to be carried on any plants for planting or on cut flowers and foliages, and nursery stocks, which are the main means of dispersal of this pest [EPPO, 2016].<br><br>D. **Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br><br>• *L. trifolii* has been recorded from 25 families with preference shown for the Asteraceae, including the following important crops: *Brassica chinensis*, *Capsicum annuum*, celery, Chinese cabbages, cotton, cucumbers, garlic, leeks, lettuces, lucerne, marrows, melons, onions, peas, *Phaseolus coccineus*, *P. lunatus*, *P. vulgaris*, potatoes, spinach, tomatoes, *Tropaeolum* spp., *Vigna* spp., watermelons, *Aster* spp., chrysanthemums, *Dahlia* spp., *Dianthus* spp., *Gerbera* spp., *Gypsophila* spp., *Lathyrus* spp., *Zinnia* spp., beetroots, *Bidens* spp., (Stegmaier (1968). which are mostly common in Bangladesh.<br><br>• On celery *L. trifolii* completes its life-cycle (oviposition to adult emergence) in 12 days at 35°C, 26 days at 20°C, and 54 days at 15°C (Leibee, 1982). On chrysanthemums the life-cycle is completed in 24 days at 20°C but on *Vigna sinensis* and *Phaseolus lunatus* it takes only 20 days at this temperature (Poe, 1981). *L. trifolii* females each laid 25 eggs in celery at 15°C and 400 eggs at temperatures around 30°C. One female of *L. trifolii* laid 493 eggs in peas (Poe, 1981) and another laid 639 eggs in chrysanthemums (cv. Fandango).<br><br>• The duration of larval development also varies with temperature and host plant but is generally 4-7 days at mean temperatures above 24°C (Harris & Tate, 1933). Adult emergence of *Liriomyza* species occurs 7-14 days after pupariation, at temperatures between 20 and 30°C (Leibee, 1982). At low temperatures emergence is delayed. In the laboratory *L. trifolii* survived cold storage at 4.5°C for 8 weeks (Miller, 1978).<br><br>• In the southern USA, the life-cycle is probably continuous throughout the year. There is a noticeable first generation which reaches a peak in April (Spencer, 1973). In southern Florida, *L. trifolii* has two or three complete generations followed by a number of incomplete, overlapping generations (Spencer, 1973).<br><br>• These climatic requirements for growth and development of *L. trifolii* are more or less similar with the climatic condition of **Bangladesh**. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and | Low |

| | |
|---|---|
| • The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | |

**5. 3.2.7. Determine the Consequence establishment of this pest in Bangladesh**

**Table 2.2:** Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| a. Is this a serious pest of **Bangladesh? - Yes**.<br>• *L. trifolii* is a remarkably polyphagous species and has been recorded from 25 families with preference shown for the Solanaceous,cucurbitaceous and Asteraceae, including the following important crops: Brinjal, *Capsicum annuum*, celery, Chinese cabbages, cotton, cucumbers, garlic, leeks, lettuces, lucerne, marrows, melons, onions, peas, *Phaseolus coccineus*, *P. lunatus*, *P. vulgaris*, potatoes, spinach, tomatoes, *Tropaeolum* spp., *Vigna* spp., watermelons, *Aster* spp., chrysanthemums, *Dahlia* spp., *Dianthus* spp., *Gerbera* spp., *Gypsophila* spp., *Lathyrus* spp., *Zinnia* spp., beetroots, *Bidens* spp., *Brassica chinensis* (Stegmaier, 1968).<br>• This species is now the major pest of chrysanthemums in North America (D'Aguilar & Martinez, 1979). Vegetable losses in the USA are also considerable, for example losses for celery were estimated at US$ 9 million in 1980 (Spencer, 1982). *L. trifolii* is also known to be a vector of plant viruses (Zitter *et al*., 1980).<br>• *L. trifolii* is already a serious pest of chrysanthemums in those countries in the EPPO region where it is established. It is apparently not capable of overwintering outdoors in northern Europe.<br>• Damage is caused by larvae mining into leaves and petioles. The photosynthetic ability of the plants is often greatly reduced as the chlorophyll-containing cells are destroyed. Severely infested leaves may fall, exposing plant stems to wind action, and flower buds and developing fruit to scald (Musgrave *et al*., 1975). The presence of unsightly larval mines and adult punctures in the leaf palisade of ornamental plants can further reduce crop value (Smith *et al*., 1962; Musgrave *et al*., 1975).<br>• *L. trifolii* is of quarantine significance for Bangladesh. Its introduction and rapid spread to many countries, and the problems presented by its presence in flowers and other crops, illustrate clearly the serious nature of this pest and the potential threat to the flower and foliages as well as other crops in Bangladesh still free from the pest.<br>• This is a fairly serious pest of several important vegetables and other crops for Bangladesh.<br>**B. Economic impact and yield loss**<br>• The main damage is caused by larvae who mining the leaves of the brinjal plant and should not be confused by other mining insects as *Ceuthorrhynchus suturalis* or *Phytobia cepae*. Young seeding are most susceptible for insects pests and feeding by larvae. Older plants more | **Yes and High** |

| | |
|---|---|
| readily tolerate attacks by this pest. However, if the infestation is severe and many larvae are feeding on the same leaf, photosynthetic capacity is reduced, thus causing a slowing in development of the plant and in later stadium also bulb formation.<br>• The first larval stage of the vegetable leafminer burrows into the mesophyl tissue. The second stage also feeds in the mesophyl tissue, which reduce photosynthetic capacity. The third stage larva concentrates its feeding towards the upper leaf surface. When it is mature, it cuts a longitudinal slit in the leaf and leaves to pupate on the leaf surface or on the ground.<br>• Moreover, there are effective control methods and therefore the economic impacts is not high. Only when young seedlings are attacked, plants can be die and led to harvest losses. Because these young plants died in the early growing season, risk on contamination on matured bulbs is low.<br>**c. Environmental Impact**<br>• Damage is caused by *L. trifolii* larvae mining into leaves and petiole. The photosynthetic ability of the plants is often greatly reduced as the chlorophyll-containing cells are destroyed. Severely infested leaves may fall, exposing plant stems to wind action, and flower buds and developing fruit to scald (Musgrave *et al.,* 1975). The presence of unsightly larval mines and adult punctures caused by *L. trifolii* in the leaf palisade of ornamental plants, such as chrysanthemums, can further reduce plant value (Smith *et al.,* 1962; Musgrave *et al.,* 1975). In young plants and seedlings, *L. trifolii* mining may cause considerable delay in plant development, even leading to plant loss. The level of damage depends on many factors, including climate suitability, host resistance, crop distribution, growing conditions, control methods in place and the degree of infestation (EFSA, 2012).<br>• This invariably leads to an increase in the use of insecticides as leaf miner control becomes increasingly more difficult. This in turn can produce an ever increasing spiral in the levels of insecticide resistance and insecticide use, having a direct impact on the environment | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.2.8. Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 2.3 – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.2.9. Risk Management Measures

- Avoid importation of vegetables seeds, nursery stock, flowers and foliages from countries, where this pest is available.
- In chrysanthemum cuttings, *L. trifolii* survives cold storage at 1.7°C for at least 10 days. Newly laid eggs of *L. trifolii* in chrysanthemums survived for up to 3 weeks in cold storage at 0°C (Webb & Smith, 1970). Eggs incubated for 36-48 h were killed after 1 week under the same conditions (Webb & Smith, 1970). All stages of larvae were killed after 1-2 weeks at 0°C (Webb & Smith, 1970). These authors, therefore, proposed that chrysanthemum cuttings should be maintained under normal glasshouse conditions for 3-4 days after lifting to allow eggs to hatch. Subsequent storage of the plants at 0°C for 1-2 weeks should then kill off the larvae.
- Gamma irradiation of eggs and first larval stages at doses of 40-50 Gy provided effective control (Yathom *et al*., 1991), but lower doses were ineffective.
- EPPO (OEPP/EPPO, 1990) recommends that planting material (except seeds) of celery, *Cucumis*, lettuces and tomatoes, brinjal and material (except seeds and pot plants) of *Capsicum*, carnations, chrysanthemums, *Gerbera*, *Gypsophila* and *Senecio hybridus* from countries where the pest occurs must either have been inspected at least every month during the previous 3 months and found free from the pests, or have been treated by a recommended method. It is left optional as to whether countries make the same requirements for pot plants of the second group of plants mentioned above.
- A phytosanitary certificate may be required for vegetables especially brinjal seeds, cut flowers and for with leaves.

### 5.2.10. References

CABI/EPPO, 1997. Distribution maps of quarantine pests for Europe (edited by Smith, I. M. and Charles, L. M. F.). Wallingford, UK: CAB International, xviii + 768 pp.

D'Aguilar, J.; Martinez, M. (1979) Sur la présence en France de *Liriomyza trifolii* Burgess. *Bulletin de la Société Entomologique de France* **84**, 143-146.

EFSA, 2012. Scientific Opinion on the risks to plant health posed by Liriomyza huidobrensis (Blanchard) and Liriomyza trifolii (Burgess) to the EU territory with the identification and evaluation of risk reduction options. EFSA Journal, 10(12):190 pp. www.efsa.europa.eu/efsajournal

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2016. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

Leibee, G.L. (1982) Development of *Liriomyza trifolii* on celery. In: *Proceedings of IFAS-Industry Conference on Biology and Control of* Liriomyza *leafminers, Lake Buéna Vista, Florida* (Ed. by Schuster, D.J.), pp. 35-41.

Miller, G.W. (1978) *Liriomyza* spp. and other American leafminer pests associated with chrysanthemums. Diptera: Agromyzidae. *EPPO Publications, Series C* No. 57, pp. 28-33.

Minkenberg, O.P.J.M. (1988) Dispersal of *Liriomyza trifolii*. *Bulletin OEPP/EPPO Bulletin* **18**, 173-182.

Musgrave CA, Poe SL, Weems HV Jr, 1975. The vegetable leafminer, Liriomyza sativae Blanchard (Diptera: Agromyzidae), in Florida. Entomology Circular, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, No. 162:4 pp.

Musgrave, C.A.; Poe, S.L.; Weems, H.V. (1975) The vegetable leafminer *Liriomyza sativae* Blanchard. *Entomology Circular, Florida Department of Agriculture and Consumer Services, Division of Plant Industry* No. 162, pp. 1-4.

OEPP/EPPO (1984) Data sheets on quarantine organisms No. 131, *Liriomyza trifolii*. *Bulletin OEPP/EPPO Bulletin* **14**, 29-37.

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

OEPP/EPPO (1992) Quarantine procedures No. 42. Identification of *Liriomyza* spp. *Bulletin OEPP/EPPO Bulletin* **22**, 235-238.

OEPP/EPPO, 1990. Specific quarantine requirements. EPPO Technical Documents, No. 1008. Paris, France: EPPO.

Poe, S.L. (1981) Miner notes. *Society of American Florists* **2**, 1-10.

Smith, F.F.; Boswell, A.L.; Wave, H.E. (1962) New chrysanthemum leaf miner species. *Florists' Review* **130**, 29-30.

Spencer, K.A. (1973) *Agromyzidae (Diptera) of economic importance* (*Series Entomologica* No. 9), 418 pp. Junk, The Hague, Netherlands.

Spencer, K.A. (1982) US celery under threat. *Grower* **97**, 15-18.

Stegmaier, C.E. (1968) A review of recent literature of the host plant range of the genus *Liriomyza* (Diptera: Agromyzidae) in the continental United States and Hawaii, excluding Alaska. *Florida Entomologist* **51**, 167-182.

Webb, R.E.; S (1970) Survival of eggs of *Liriomyza munda* in chrysanthemums during cold storage. *Journal of Economic Entomology* **63**, 1359-1361.

Webster, F.M.; Parks, T.H. (1913) The serpentine leafminer. *Journal of Agricultural Research, Washington D.C.* **1**, 59-87.

Yathom, S.; Padova, R.; Chen, M.; Ross, I. (1991) Effect of gamma irradiation on sterility of *Liriomyza trifolii* flies. *Phytoparasitica* **19**, 149-152.

Zitter, T.A.; Tsai, J.H.; Harris, K.F. (1980) Flies. In: *Vectors of plant pathogens* (Ed. by Harris, K.F.; Maramorosch, K.), pp. 165-176. Academic Press, New York, USA.

## 5.3.3. Pea leaf miner: *Liriomyza huidobrensis* (Blanchard)

### 5.3.3.1 Hazard Identification

**Scientific Name:** *Liriomyza huidobrensis* (Blanchard)

**Synonyms**: *Agromyza huidobrensis* Blanchard

*Liriomyza cucumifoliae* Blanchard

*Liriomyza langei* Frick

*Liriomyza dianthi* Frick

**Common names**: Pea leaf miner,

South American leaf miner

**Taxonomic tree**

Phylum: Arthropoda
Subphylum: Mandibulata
Class: Insecta
Order: Diptera
Family: Agromyzidae
Genus: *Liriomyza*
Species: *Liriomyza huidobrensis*

**EPPO Code:** LIRIHU. This pest has been included in EPPO A2 list: No. 152

**Bangladesh status:** Not present in Bangladesh [CABI/EPPO, 2002; EPPO, 2014].

### 5.3.3.2. Biology

Males usually emerge before females. Mating takes place from 24 h after emergence and a single mating is sufficient to fertilize all eggs laid. Female flies puncture the leaves of the host plants causing wounds which serve as sites for feeding or oviposition. Feeding punctures cause the destruction of a larger number of cells and are more clearly visible to the naked eye. About 15% of punctures made by *L. trifolii* and *L. sativae* contain viable eggs (Parrella *et al*., 1981). The life-cycle is probably continuous throughout the year. There is a noticeable first generation which reaches a peak in April (Spencer, 1973). In California, *L. huidobrensis* completes its life-cycle in 17-30 days during the summer and in 50-65 days during the winter (Lange et al., 1957). Adults of Liriomyza spp. live, on average, between 15 and 30 days, and females generally live longer than males.

### 5.3.3.3. Hosts

**a. Major hosts:** The main host of *L. huidobrensis* includes, tomato, aubergine, potato, Celery, lettuce, marigold, gypsophila (baby's breath), ornamental gourd, common bean, pea, onion, garlic etc.

**b. Minor hosts:** The minor or other hosts of this pest include Amaranthus, Aster, gerbera, marigold, zinnia, spinach, melon, cucumber, faba bean, bell pepper, petuniaetc.

### 5.3.3.4. Distribution

*L. huidobrensis* originates in Central and South America and was absent from other continents until the 1980s. It was first detected in the EPPO region in 1987 in the Netherlands where it was found on glasshouse lettuces; it is presumed to have been imported directly from South America. It has since spread considerably in the EPPO region, but remains absent from a significant number of countries, in particular in central and eastern Europe.

- **EPPO region**: Austria, Belgium, Cyprus, Czech Republic, France (Trouvé *et al*., 1991), Israel, Italy (Suss, 1991; including Sicily), Malta, Netherlands, Portugal, Spain (including Canary Islands), UK (England, Northern Ireland, Scotland). *L. huidobrensis* has been intercepted, or has occurred and been eradicated, in Denmark, Finland, Germany (Leuprecht, 1991), Ireland and Sweden.
- **Asia**: Cyprus, India (Uttar Pradesh), Israel, Thailand.
- **Africa**: Mauritius, Réunion.
- **North America**: Mexico (unconfirmed), USA (California, Hawaii and in glasshouses in Florida and Virginia).
- **Central America and Caribbean**: Belize, Costa Rica, Dominican Republic, El Salvador, Guadeloupe, Guatemala, Honduras, Nicaragua, Panama.
- **South America**: Argentina, Brazil (Matto Grosso, São Paulo), Chile, Colombia, Peru, Venezuela.
- **Oceania**: Australia.

**5.3.3.5. Hazard Identification Conclusion**

Considering the facts that *Liriomyza huidobrensis* -

- is not known to be present in Bangladesh [CABI/EPPO, 2002; EPPO, 2014];
- is potentially economic important to Bangladesh because it is an important pest of flowers and foliages Asia including China (restricted distribution), India (restricted distribution), Thailand, **Japan (**restricted distribution), Sri Lanka, Cyprus, Israel, Lebanon, Philippines, Taiwan, [CABI/EPPO, 2002; EPPO, 2014] from where vegetables seeds especially brinjal seeds and nursery stocks imported to Bangladesh.
- can become established in Bangladesh through imports of the brinjal seeds and nursery stocks. It has capability to cause direct economic and ecological damage to many valuable cultivated crops, Female flies of *L. huidobrensis* puncture the leaves of the host plants causing wounds which serve as sites for feeding or oviposition and eggs are inserted into the epidermis and mesophyll layer of the leaf (Poe, 1981). Adult flies are capable of limited flight. Dispersal over long distances is on planting material of host species. Vegetables can also present a danger as a means of dispersal; it should be noted, for example, that the vase life of chrysanthemums is sufficient to allow completion of the life-cycle of the pest [EPPO, 2016].
- *L. huidobrensis* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

**5.3.3.6. Determine likelihood of pest establishing in tour country via this pathway.**

Table 3.1 – Which of these descriptions best fit of this pest?

| Description | Establishment Potential is: |
|---|---|
| **a. Has this pest been established in several new countries in recent years,-Yes,**<br>This pest has been established in many Asian countries. The introduction of this pest in India was first reported in 1994; Indonesia in 1994 (Mujica & Cisneros, 1997), Thailand in 1994; Taiwan in 1991; Cyprus in 1994; Finland in 1997; Ireland in 1997; Italy in 1991; Turkey in 1985, Netherlands in 1989; Slovenia in 1999 (CABI/EPPO, 2002; EPPO, 2014). | **YES and HIGH** |

Now present in many Asian countries including Japan, China etc.

**b. Posibility of survival during transport, storage and transfer of this pest? Yes**

- The cucurbit seeds and fruits are transported from India, Japan, Thailand, Taiwan, Vietnam, U.S.A, Australia, France, Germany, Italy, Netherlands, Belgium, Brazil, and Chile to Bangladesh mainly by Airfreight, and or Landport. Therefore, the period of time taken for shipment through these transportation pathways from the exporting countries to Bangladesh is very short. Within this period the eggs and catterpiller of leaf miner can easily survive with seeds and other planting materials. Because, In California, *L. huidobrensis* completes its life-cycle in 17-30 days during the summer and in 50-65 days during the winter (Lange *et al.,* 1957). Adults of Liriomyza spp. live, on average, between 15 and 30 days, and females generally live longer than males. Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with High risk potential.

c. **Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**

- Internationally, *L. huidobrensis* is liable to be carried on any plants for planting or on vegetable seeds especially brinjal seeds and nursery stocks, which are the main means of dispersal of this pest [EPPO, 2016].

**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**

- Fourteen families of plants have been recorded as hosts of *L. huidobrensis*, without a clear preference for any particular family. *L. huidobrensis* has been reported from aubergines (*Solanum melongena*), beets (*Beta vulgaris*), *Capsicum annuum*, celery (*Apium graveolens*), cucumbers (*Cucumis sativus*), faba beans (*Vicia faba*), garlic (*Allium sativum*), *Lathyrus* spp., lettuces (*Lactuca sativa*), lucerne (*Medicago sativa*), melons (*Cucumis melo*), onions (*Allium cepa*), peas (*Pisum sativum*), *Phaseolus vulgaris*, potatoes (*Solanum tuberosum*), *Amaranthus* spp., *Aster* spp., chrysanthemums (*Dendranthema morifolium*), *Dahlia* spp., *Dianthus* spp., *Gypsophila* spp., *Zinnia* spp., hemp (*Cannabis sativa*), *Primula* spp., radishes (*Raphanus sativus*), spinach (*Spinacia oleracea*), tomatoes (*Lycopersicon esculentum*), *Tropaeolum* spp., and *Verbena* spp., which are mostly common in **Bangladesh**.

- In the southern USA, the life-cycle is probably continuous throughout the year. There is a noticeable first generation which reaches a peak in April (Spencer, 1973). In California, *L. huidobrensis* completes its life-cycle in 17-30 days during the summer and in 50-65 days during the winter (Lange *et al*., 1957). The duration of larval development also varies with temperature and host plant but is generally 4-7 days at mean temperatures above 24°C (Harris & Tate, 1933). Reductions in population levels of *L. huidobrensis* occurred in California (USA) when the daily maximum temperature rose to 40°C (Lange *et al*., 1957).

- These climatic requirements for growth and development of *L. huidobrensis* are more or less similar with the climatic condition of **Bangladesh**.

| | |
|---|---|
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

**5.3.3.7. Determine the <u>Consequence</u> establishment of this pest in Bangladesh**

**Table3. 2.** – Which of these descriptions best fit of this pest?

| Description | Consequence potential is: |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *L. huidobrensis* is a remarkably polyphagous species and has been recorded from 14 families without a clear preference for any particular family including the following important crops: Fourteen families of plants have been recorded as hosts of *L. huidobrensis*, without a clear preference for any particular family. aubergines (*Solanum melongena*), beets (*Beta vulgaris*), *Capsicum annuum*, celery (*Apium graveolens*), cucumbers (*Cucumis sativus*), faba beans (*Vicia faba*), garlic (*Allium sativum*), *Lathyrus* spp., lettuces (*Lactuca sativa*), lucerne (*Medicago sativa*), melons (*Cucumis melo*), onions (*Allium cepa*), peas (*Pisum sativum*), *Phaseolus vulgaris*, potatoes (*Solanum tuberosum*), *Primula* spp., radishes (*Raphanus sativus*), spinach (*Spinacia oleracea*), tomatoes (*Lycopersicon esculentum*),*L. huidobrensis* has been reported from *Amaranthus* spp., *Aster* spp., chrysanthemums (*Dendranthema morifolium*), *Dahlia* spp., *Dianthus* spp., *Gypsophila* spp., *Zinnia* spp., hemp (*Cannabis sativa*), *Tropaeolum* spp., and *Verbena* spp. (Spencer, 1990).<br>• *L. huidobrensis* has the potential to become a major pest of a wide variety of field crops and horticultural crops grown under glass and as protected crops in the EPPO region. This species could also cause damage to these crops grown in the open in the warmer parts of the region.<br>• *L. huidobrensis* is of quarantine significance for Bangladesh. Its introduction and rapid spread to many countries, and the problems presented by its presence in vegetables especially brinjal and other crops, illustrate clearly the serious nature of this pest and the potential threat to the flower and foliages as well as other crops in Bangladesh still free from the pest.<br>• This is a fairly serious pest of several important vegetables especially brinjal seeds and other crops for Bangladesh.<br>**b. Economic impact and yield loss**<br>• This species damages a range of glasshouse ornamentals and also attacks vegetable crops (Lange *et al.,* 1957). In South America, it is a key pest of potato. In the EPPO region, *L. huidobrensis* is already a major pest of chrysanthemums, Primula, Verbena, lettuces (OEPP/EPPO, 1994), Phaseolus, cucumbers, celery and Cucurbita pepo (ADAS, 1991). Treatments for chrysanthemums are recommended if 50 larvae are found in a random sample of the upper two-thirds of ten stems (Spencer, 1982). Since it has spread to Mediterranean countries, it has appeared on | **Yes and High** |

| | |
|---|---|
| outdoor crops (e.g. lettuce and beet; Echevarria *et al.,* 1994). It has proved a much more serious pest than *L. trifolii* (Weintraub & Horowitz, 1995). Damage is caused by larvae mining into leaves and petioles. The photosynthetic ability of the plants is often greatly reduced as the chlorophyll-containing cells are destroyed. Severely infested leaves may fall, exposing plant stems to wind action, and flower buds and developing fruit to scald (Musgrave *et al.,* 1975). The presence of unsightly larval mines and adult punctures in the leaf palisade of ornamental plants can further reduce crop value (Smith *et al.,* 1962; Musgrave *et al.,* 1975). In young plants and seedlings, mining may cause considerable delay in plant development leading to plant loss. All of these can affect the yield and quality of a crop and thus its market value.<br>**c. Environmental Impact**<br>• The appearance of the leaf miner within new areas is in most cases, the result of movement of infested plant material. The movement and establishment of leaf miner populations through this route bring along the possibility of insecticide resistance genes. Some insecticides, particularly pyrethroids (abamectin) and also cyromazine (Van der Staay, 1992; Leuprecht, 1993), are effective, but leaf miner resistance can sometimes make control difficult (Parrella *et al.,* 1984; Macdonald, 1991). This invariably leads to an increase in the use of insecticides as leaf miner control becomes increasingly more difficult. This in turn can produce an ever increasing spiral in the levels of insecticide resistance and insecticide use, having a direct impact on the environment. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.3.8. Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 3.3. – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.3.9. Risk Management Measures

- Avoid importation of flowers and foliages from countries, where this pest is available.
- All stages are killed within a few weeks by cold storage at 0°C. Newly laid eggs are, however, the most resistant stage and it is recommended that cuttings of infested ornamental plants be maintained under normal glasshouse conditions for 3-4 days after lifting, to allow eggs to hatch. Subsequent storage of the plants at 0°C for 1-2 weeks should then kill off the larvae of leaf miner species (Webb & Smith, 1970).
- To avoid the introduction of *L. huidobrensis* (and the other leaf miner species, including *L. sativae* and *Amauromyza maculosa*; EPPO/CABI, 1996), EPPO (OEPP/EPPO, 1990) recommends that propagating material (except seeds) of *Capsicum*, carnations, celery, chrysanthemums, *Cucumis*, *Gerbera*, *Gypsophila*, lettuces, *Senecio hybridus* and tomatoes from countries where the pests occur must have been inspected at least every month during the previous 3 months and found free from the pests.
- A phytosanitary certificate may be required for brinjal seeds, nursery stock and vegetables with leaves.

### 5.3.3.10. References


ADAS (1991) Protected crops technical notes No. 144. Agricultural Development and Advisory Service, Ministry of Agriculture, Fisheries and Food, UK.

CABI/EPPO, 1997. Distribution maps of quarantine pests for Europe (edited by Smith, I. M. and Charles, L. M. F.). Wallingford, UK: CAB International, xviii + 768 pp.

CABI/EPPO, 2002. Liriomyza huidobrensis. Distribution Maps of Plant Pests, No. 568. Wallingford, UK: CAB International.

Echevarria, A.; Gimeno, C.; Jiménez, R. (1994) Liriomyza huidobrensis, a new pest of crops in Valencia. Boletin de Sanidad Vegetal, Plagas 20, 103-109.

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2016. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO/CABI (1996) *Amauromyza maculosa*, *Liriomyza sativae*, *Liriomyza trifolii*. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Holderness, M.). CAB INTERNATIONAL, Wallingford, UK.

Harris, H.M.; Tate, H.D. (1933) A leafminer attacking the cultivated onion. *Journal of Economic Entomology* **26**, 515-516.

IIE, 1996. Distribution Maps of Plant Pests, No. 586. Wallingford, UK: CAB INTERNATIONAL.

Knodel-Montz, J.J.; Poe, S.L. (1982) Ovipositor morphology of three economically important *Liriomyza* species (Diptera: Agromyzidae). *Proceedings of the Third Annual Industry Conference on Leaf Miners, San Diego, USA*, pp. 186-195.

Lange, W.H.; Gricarick, A.A.; Carlson, E.C. (1957) Serpentine leafminer damage. *California Agriculture* **11**, 3-5.

Leuprecht, B. (1992) [*Liriomyza huidobrensis*, a new, dangerous leaf- miner]. *Gesunde Pflanzen* **44**, 51-58.

Leuprecht, B. (1993) [Studies on the chemical and biological control of a dangerous leafminer in greenhouse vegetables]. Gesunde Pflanzen 45, 89-93.

Leuprecht, B. (1993) [Studies on the chemical and biological control of a dangerous leafminer in greenhouse vegetables]. *Gesunde Pflanzen* **45**, 89-93.

Macdonald, O. (1991) Responses of the alien leafminers Liriomyza huidobrensis and L. trifolii to some pesticides scheduled for their control in UK. Crop Protection 10, 509-513.

Menken, S.B.J.; Ulenberg, S.A. (1986) Allozymatic diagnosis of four economically important *Liriomyza* species (Diptera, Agromyzidae). *Annals of Applied Biology* **109**, 41-47.

Mujica N, Cisneros F, 1997. Developing IPM components for leafminer fly in the Ca±ete Valley of Peru. Program Report 1995-96. Lima, Peru: International Potato Center (CIP), 177-184.

Musgrave, C.A.; Poe, S.L.; Weems, H.V. (1975) The vegetable leafminer Liriomyza sativae Blanchard. Entomology Circular, Florida Department of Agriculture and Consumer Services, Division of Plant Industry No. 162, pp. 1-4.

Musgrave, C.A.; Poe, S.L.; Weems, H.V. (1975) The vegetable leafminer *Liriomyza sativae* Blanchard. *Entomology Circular, Florida Department of Agriculture and Consumer Services, Division of Plant Industry* No. 162, pp. 1-4.

OEPP/EPPO (1984) Data sheets on quarantine organisms No. 131, *Liriomyza trifolii*. *Bulletin OEPP/EPPO Bulletin* **14**, 29-37.

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

OEPP/EPPO (1992) Quarantine procedures No. 42. Identification of *Liriomyza* spp. *Bulletin OEPP/EPPO Bulletin* **22**, 235-238.

OEPP/EPPO (1994) Guidelines on good plant protection practice. No. 3. Glasshouse lettuce. *Bulletin OEPP/EPPO Bulletin* **24**, 847-856.

OEPP/EPPO, 1990. Specific quarantine requirements. EPPO Technical Documents, No. 1008. Paris, France: EPPO.

Parrella, M.P.; Keil, C.B.; Morse, J.G. (1984) Insecticide resistance in Liriomyza trifolii. California Agriculture 38, 22-33.

Poe, S.L. (1981) Miner notes. *Society of American Florists* **2**, 1-10.

Smith, F.F.; Boswell, A.L.; Wave, H.E. (1962) New chrysanthemum leaf miner species. Florists' Review 130, 29-30.

Smith, F.F.; Boswell, A.L.; Wave, H.E. (1962) New chrysanthemum leaf miner species. *Florists' Review* **130**, 29-30.

Spencer, K.A. (1973) *Agromyzidae (Diptera) of economic importance* (*Series Entomologica* No. 9), 418 pp. Junk, The Hague, Netherlands.

Spencer, K.A. (1982) US celery under threat. Grower 97, 15-18.

Spencer, K.A. (1982) US celery under threat. *Grower* **97**, 15-18.

Suss, L. (1991) [First record in Italy of *Liriomyza huidobrensis*]. *Bollettino di Zoologia Agraria e di Bachicoltura* **23**, 197-202.

Trouvé, C.; Martinez, M.; Phalip, M.; Martin, C. (1991) [A new pest in Europe, the South American miner fly]. *Phytoma* No. 429, 42-46. 6 *Liriomyza huidobrensis*

Van der Staay, M. (1992) Chemical control of the larvae of the leafminer Liriomyza huidobrensis in lettuce. Mededelingen van de Faculteit Landbouwwetenschappen, Rijksuniversiteit Gent 57, 473- 478.

Webb, R.E.; Smith, F.F. (1970) Survival of eggs of *Liriomyza munda* in chrysanthemums during cold storage. *Journal of Economic Entomology* **63**, 1359-1361.

Weintraub, P.G.; Horowitz, A.R. (1995) The newest leafminer pest in Israel, Liriomyza huidobrensis. Phytoparasitica 23, 177-184.

### 5.3.4. Silver whitefly: *Bemisia tabaci (B biotype)*

#### 5.3.4.1. Hazard identification

**Scientific Name:** *Bemisia tabaci (B biotype) (*Gennadius, 1889)

**Synonyms**:

*Bemisia argentifolii Bellows,*

*Perring, Gill & Hendrick, 1994*

*Bemisia tabaci B*

**Common names**: Silver whitefly,
Poinsettia whitefly;
Tobacco whitefly, B biotype

## Taxonomic tree

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

Order: Hemiptera

Suborder: Sternorrhyncha

Superfamily: Aleyrodoidea

Family: Aleyrodidae

Genus: *Bemisia*

Species: *Bemisia tabaci* (*B biotype*)

EPPO Code: BEMIAR. This pest has been included in EPPO A2 list: No. 178

**Bangladesh status:** Not present in Bangladesh [EPPO, 2014; CABI/EPPO, 1999]

#### 5.3.4.2. Biology

Eggs are laid usually in circular groups, on the underside of leaves, with the broad end touching the surface and the long axis perpendicular to the leaf. They are anchored by a pedicel which is inserted into a fine slit made by the female in the tissues, and not into stomata, as in the case of many other aleyrodids. Eggs are whitish when first laid but gradually turn brown. Hatching occurs after 5-9 days at 30°C but, like many other developmental rates, this depends very much on host species, temperature and humidity. On hatching, the first instar, or "crawler", is flat, oval and scale-like. This first instar is the only larval stage of this insect which is mobile. It moves from the egg site to a suitable feeding location on the lower surface of the leaf where its legs are lost in the ensueing moult

and the larva becomes sessile. It does not therefore move again throughout the remaining nymphal stages. The first three nymphal stages last 2-4 days each (this could however vary with temperature). The fourth nymphal stage is called the 'puparium', and is about 0.7 mm long and lasts about 6 days; it is within the latter period of this stage that the metamorphosis to adult occurs. The adult emerges through a "T"-shaped rupture in the skin of the puparium and spreads its wings for several minutes before beginning to powder itself with a waxy secretion from glands on the abdomen. Copulation begins 12-20 h after emergence and takes place several times throughout the life of the adult. The life span of the female could extend to 60 days. The life of the male is generally much shorter, being between 9 and 17 days. Each female lays up to 160 eggs during her lifetime, although the B biotype has been shown to lay twice as many, and each group of eggs is laid in an arc around the female. Eleven to fifteen generations can occur within one year.

#### 5.3.4.3. Hosts

*B. tabaci* was mainly known as a pest of field crops in tropical and subtropical countries: cassava *(Manihot esculenta)*, cotton *(Gossypium)*, sweet potatoes *(Ipomoea batatas)*, tobacco *(Nicotiana)* and tomatoes *(Lycopersicon esculentum)*. Its host plant range within any particular region was small, yet *B. tabaci* had a composite range of around 300 plant species within 63 families (Mound & Halsey, 1978). With the evolution of the highly polyphagous B biotype, *B. tabaci* has now become a pest of glasshouse crops in many parts of the world, especially Capsicum, **courgettes *(Cucurbita pepo)***, **cucumbers *(Cucumis sativus)***, Hibiscus, Gerbera, Gloxinia, lettuces (*Lactuca sativa*), poinsettia (*Euphorbia pulcherrima*) and tomatoes (*Lycopersicon esculentum*). *B. tabaci* moves readily from one host species to another and is estimated as having a host range of around 600 species (Asteraceae, Brassicaceae, Convolvulaceae, **Cucurbitaceae**, Euphorbiaceae, Fabaceae, Malvaceae, Solanaceae, etc.).

#### 5.3.4.4. Distribution

- ***EPPO region****:* Present and widespread in the field in Algeria, Cyprus, France (South), Greece, Israel, Italy, Libya, Portugal, Spain, Turkey and Ukraine (CABI & EPPO, 1999; EPPO, 2014).
- ***Asia****:* Afghanistan, Bhutan, China *(*He et al., 2008), Cyprus, Hong Kong, Israel, India (Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Jammu and Kashmir, Kerala, Karnataka, Maharashtra, Meghalaya, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal) *(*CABI & EPPO, 1999; EPPO, 2014), Indonesia, Iran, Iraq, Japan, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Saudi Arabia, Sri Lanka, Thailand, Yemen. The B biotype has been recorded in Cyprus, India, Israel, Japan and Yemen.
- **Africa:** Algeria, Angola, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Morocco, Mozambique, Nigeria *(*Brown et al., 1995a; EPPO, 2014; CABI/Bedford et al., 1994a).
- **North America:** Bermuda, Canada, Mexico, USA. The *B biotype* is confirmed in Mexico and USA (southern states, Hawaii, New York).
- **Central America and Caribbean:** Antigua and Barbuda, Barbados, Belize, Costa Rica, Cuba, Dominica, Dominican Republic, Trinidad and Tobago. The B biotype has been recorded in Central America and the Caribbean Basin.
- **South America:** Argentina, Brazill.
- **Oceania:** Australia, Fiji, New Zealand, Papua New Guinea, Samoa, Solomon Islands, Tuvalu. The B biotype is present in Australia.
- EU: Present.

#### 5.3.4.5. Hazard Identification Conclusion

Considering the facts that *Bemisia tabaci B biotype*-

- is not known to be present in Bangladesh [EPPO, 2014; CABI/EPPO, 1999];

- is potentially economic important to Bangladesh because it is an important pest of field crops and flowers in Asia including China, India, Thailand, **Japan**, Sri Lanka, Cyprus, Israel, Turkey, Lebanon, Philippines, Taiwan, [EPPO, 2014; CABI/EPPO, 1999] from where many vegetables, seeds, vegetable parts and flowers are imported to Bangladesh.
- EPPO (OEPP/EPPO, 1989) has listed *B. tabaci* as an A2 quarantine pest, and it is also a quarantine pest for CPPC. The risk to the EPPO region is primarily to the glasshouse industry in northern countries, and mainly concerns the B biotype (though it is difficult in practice to confirm this in specific cases). Since its recent introduction to several of these countries, the pest has proved particularly difficult to combat because of its polyphagy, its resistance to many insecticides and its disruption of biological control programmes (Della Giustina et al., 1989). Very few countries remain free from B. tabaci, illustrating the difficulty of preventing its movement in international trade.

- *Bemisia tabaci (B biotype)* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

**5.3.4.6. Determine likelihood of pest establishing in Bangladesh via this pathway**

Table 1.1 – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| a. **Has this pest been established in several new countries in recent years-Yes**,<br>• First reports of a newly evolved biotype of *B. tabaci*, the B biotype, appeared in the mid-1980s (Brown et al., 1995b). Commonly referred to as the silverleaf whitefly or poinsettia strain, the B biotype has been shown to be highly polyphagous and almost twice as fecund as previously recorded strains and has been documented as being a separate species, *B. argentifolii* (Bellows et al., 1994).<br>• The B biotype has been recorded in Cyprus, **India,** Israel, **Japan** and Yemen (EPPO, 2014).<br>• The presence of the B biotype has been confirmed in Cyprus, **France** (South) (Villevieille & Lecoq, 1992), Israel, **Italy**, Spain and in the glasshouse infestations of northern Europe (e.g. **Netherlands**).<br>**b. Posibility of survival during transport, storage and transfer of this pest? Yes**<br>• The cucurbit seeds and fruits are transported from India, China, Japan, Thailand, Taiwan, Vietnam, Philippines, Indonesia, U.S.A, Australia, France, Germany, Italy, Netherlands, Belgium, Brazil, and Chile to Bangladesh mainly by Airfreight, and or Landport. Therefore, the period of time taken for shipment through these transportation pathways from the exporting countries to Bangladesh is very short. Within this period the eggs and crawlers of whitefly can easily survive on fruit surfaces of cucurbits. Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with **High (3)** risk potential.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• The cucurbits are imported into Bangladesh manily from India, China, | **YES and HIGH** |

| | |
|---|---|
| Japan, Thailand. *B. tabaci* B biotype is a common problem in such countries. So, the pathway appear good for this pest to entire in Bangladesh. Adults of *B. tabaci* do not fly very efficiently but, once airborne, they can be transported quite large distances by the wind. All stages of the pest are liable to be carried on planting material and cucurbits of host species. The international trade in poinsettia is considered to have been a major means of dissemination within the EPPO region of the B biotype of *B. tabaci*.<br>**c. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• This pest can become establish in Bangladesh through imports of the vegetables, seeds, vegetable parts and flowers. *B. tabaci* was mainly known as a pest of field crops in tropical and subtropical countries. *B. tabaci* had a composite range of around 300 plant species within 63 families. *B. tabaci* moves readily from one host species to another and is estimated as having a host range of around 600 species (Asteraceae, Brassicaceae, Convolvulaceae, **Cucurbitaceae**, Euphorbiaceae, Fabaceae, Malvaceae, Solanaceae, etc.) which are mostly common in Bangladesh.<br>• The development time of this insect from egg to adult may range from 15-70 days dependent upon temperature and plant host. Development occurs in temperatures ranging from 50 to 89.6°F (10 to 32°C). 80.6°F (27°C) appears to be the optimal temperature for development. Under control conditions on cotton, the pest completes its development in 17 days at 86°F (30°C) On the contentinal U.S. development from egg to adult under field conditions varies with the season; development variesfrom 25 to 50 days. Very little seasonal difference occurs in Hawaii. Overlapping whitefly generations occur throughout the year.<br>• These climatic requirements for growth and development of *Bemisia tabaci* are more or less similar with the climatic condition of **Bangladesh**. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

**5.3.4.7. Determine the Consequence establishment of this pest in Bangladesh**

**Table 1.2:** Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• Until recently, *B. tabaci* was mainly known as a pest of field crops in tropical and subtropical countries: cassava *(Manihot esculenta),* cotton *(Gossypium),* sweet potatoes *(Ipomoea batatas),* tobacco *(Nicotiana)* and tomatoes *(Lycopersicon esculentum).* Its host plant range within any particular region was small, yet *B. tabaci* had a composite range of around 300 plant species within 63 families (Mound & Halsey, 1978). With the evolution of the highly polyphagous **B biotype**, *B. tabaci* has now become a pest of glasshouse crops in many parts of the world, especially *Capsicum,* **courgettes** | **Yes and High** |

***(Cucurbita pepo),*** **cucumbers** ***(Cucumis sativus)****,* Hibiscus*,* Gerbera, Gloxinia, lettuces *(Lactuca sativa),* poinsettia *(Euphorbia pulcherrima)* and tomatoes *(Lycopersicon esculentum).*

- *B. tabaci* has been known as a minor pest of cotton and other tropical or semi-tropical crops in the warmer parts of the world and, until recently, has been easily controlled by insecticides. In the southern states of the USA in 1991, however, it was estimated to have caused combined losses of 500 million USD to the winter vegetable crops (Perring et al., 1993) through feeding damage and plant virus transmission. *B. tabaci* is also a serious pest in glasshouses in North America and Europe.
- The larvae of the B biotype of *B. tabaci* are unique in their ability to cause phytotoxic responses to many plant and crop species. These include a severe silvering of courgette leaves, white stems in pumpkin, white streaking in leafy brassica crops, uneven ripening of tomato fruits, reduced growth, yellowing and stem blanching in lettuce and kai choy (*Brassica campestris*) and yellow veining in carrots and Lonicera (Bedford et al., 1994a, 1994b).
- *B. tabaci* B biotype is of quarantine significance for Bangladesh. Its introduction and rapid spread to many countries and the problems presented by its presence in vegetables, flowers and other crops, illustrate clearly the serious nature of this pest and the potential threat to thevegetables cucurbits as well as other crops in Bangladesh still free from the pest.
- This is a fairly serious pest of several important vegetables, flower and other crops for Bangladesh.

**b. Economic impact and yield loss**

- The B biotype of *B. tabaci* can have a serious impact on the production of certain field crops as well as a wide range of protected horticultural crops. In the majority of cases, this is due to viruses that the whitefly transmits between susceptible crops or acquires from indigenous host reservoirs.
- The B biotype is also able to induce a phytotoxic response from a number of plant species that could cause yield loss or reduced quality produce. This includes squash silver leaf (Bedford et al., 1994), pumpkin white stem (Costa and Brown, 1991), white streaking of cole crops (Brown et al., 1992), reduced growth and stem blanching of kai choy (Costa et al., 1993) and uneven ripening of tomato (Maynard and Cantliffe, 1989). All of these can affect the yield and quality of a crop and thus its market value.
- In 1991, the B biotype alone caused an estimated $500 million loss to the 1991 winter harvest in California, USA, mainly through virus damage. However, in other areas of the world where the B biotype has appeared, it is found alongside an indigenous non-B biotype, so it is extremely difficult to determine specific economic damage. For example, the B biotype is found alongside the K biotype in Pakistan where both biotypes transmit a disease of cotton, Cotton leaf curl virus. Around 2 million tonnes of cotton are grown in Pakistan and between 30 and 40% crop losses can be expected through whitefly-transmitted viruses based on figures in the mid 1990s. An estimate of 2.4 billion dollars damage was caused by the virus between 1993 and 1994 (Bhatti and Soomro 1996). In 1994, the cotton virus spread to India as did a whitefly-transmitted virus of tomato, Tomato leaf curl virus (Colvin et al. 2002), which caused a number of complete crop failures. This tomato virus was then reported to have spread to potato (Gard et al., 2001). Again the B biotype was present within the epidemics although indigenous biotypes G, H

| | |
|---|---|
| and I were also recorded from India, so specific damage attributed to B biotypes alone, could not be calculated.<br>• Within Israel around the Mediterranean Basin, North Africa and on the Canary Islands the B biotype is present alongside the indigenous Q biotype. As seen in Pakistan, it is impossible to calculate the economic impact of the B biotype alone in these areas. The economic impact of more recent appearances of the B biotype within Africa, South and Central America and Australasia currently remains unknown. A European network for the exchange of research ideas into whitefly-related problems exists and can be accessed at www.whitefly.org (EWSN, 1999).<br>**c. Environmental Impact**<br>• The appearance of the B biotype within new areas is in most cases, the result of movement of infested plant material. The movement and establishment of B biotype populations through this route bring along the possibility of insecticide resistance genes. This invariably leads to an increase in the use of insecticides as whitefly control becomes increasingly more difficult. This in turn can produce an ever increasing spiral in the levels of insecticide resistance and insecticide use, having a direct impact on the environment. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.4.8. Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table1.3 – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.4.9. Risk Management Measures

- Avoid importation of vegetables, cucurbits from countries, where this pest is available.
- In countries where *B. tabaci* biotype B is not already present, the enforcement of strict phytosanitary regulations as required for *B. tabaci*, may help to reduce the risk of this whitefly becoming established.

- Because of the difficulty of detecting low levels of infestation in consignments, it is best to ensure that the place of production is free from the pest (OEPP/EPPO, 1990). Particular attention is needed for consignments from countries where certain *B. tabaci*-listed viruses, now on the EPPO A1 or A2 quarantine lists, are present. These viruses are also transmitted by the B biotype.

### 5.3.4.10. References


Bedford I.D., Briddon R.W., Jones P., Alkaff N. and Markham P.G., 1994. Differentiation of three whitefly-transmitted geminiviruses from the Republic of Yemen. European Journal of Plant Pathology, 100(3-4):243-257.

Bedford, I.D.; Briddon, R.W.; Brown, J.K.; Rosell, R.C.and Markham, P.G. (1994a) Geminivirus transmission and biological characterisation of Bemisia tabaci (Gennadius) biotypes from different geographic regions. Annals of Applied Biology 125, 311-325.

Bellows, T.S.; Perring, T.M.; Gill, R.J. and Headrick, D.H. (1994) Description of a species of Bemisia (Homoptera: Aleyrodidae). Annals of the Entomological Society of America 87, 195-206.

Brown J.K., Coats S.A., Bedford I.D., Markham P.G., Bird J. and Frohlich D.R., 1995. Characterization and distribution of esterase electromorphs in the whitefly, Bemisia tabaci (Genn.) (Homoptera: Aleyrodidae). Biochemical Genetics, 33(7/8):205-14; 22 ref.

Brown, J.K.; Frohlich, D.R.and Rosell, R.C. (1995b) The sweetpotato or silverleaf whiteflies. Biotypes of Bemisia tabaci or a species complex. Annual Review of Entomology 40, 511-534.

CABI , EPPO , 1999. Bemisia tabaci biotype B. [Distribution map]. Distribution Maps of Plant Pests, June. Wallingford, UK: CAB International, Map 591.

Della Giustina, W.; Martinez, M.; Bertaux, F. (1989) Bemisia tabaci: le nouvel ennemi des cultures sous serres en Europe. Phytoma No. 406, 48-52.

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

He Y.X., Huang J., Weng Q.Y. and Liang Z.S., 2008. Biochemical mechanisms of resistance to chlorpyrifos and dichlorvos in field populations of Bemisia tabaci (Gennadius) B-biotype. Acta Entomologica Sinica, 51(4):384-389. http://www.insect.org.cn

Mound, L.A. and Halsey, S.H. (1978) Whiteflies of the world, a systematic catalogue of the Aleyrodidae (Homoptera) with host plant and natural enemy data. British Museum (Natural History), London, UK

Perring, T.M.; Cooper, A.D.; Rodriguez, R.J.; Farrar, C.A.and Bellows, T.S. (1993) Identification of a whitefly species by genomic and behavioural studies. Science 259, 74-77.

Villevieille, M.and Lecoq, H. (1992) L'argenture de la courgette - Une maladie nouvelle en France, liée à un aleurode. Phytoma - La Défense des Végétaux, No. 440, 35-36.

## 5.3.5. Vegetable weevil: *Listroderes costirostris* Schönherr

### 5.3.5.1. Hazard Identification

**Scientific name:** *Listroderes costirostris* Schönherr

**Synonyms**: *Desiantha nociva* French
*Listroderes difficilis* Germain
*Listroderes hypocritus* Hustache
*Listroderes lugubris* Germain
*Listroderes obliquus* Klug
*Listroderes paranensis* Hustache
*Listroderes vicinus* Hustache

**Common names**: Vegetable weevil;
Australian tomato weevil;
Brown vegetable weevil;
Buff-colored tomato weevil;
Carrot weevil;
Dirt-colored weevil;
Turnip weevil

**Taxonomic tree**

Domain: Eukaryota
Kingdom: Metazoa
Phylum: Arthropoda
Subphylum: Uniramia
Class: Insecta
Order: Coleoptera
Family: Curculionidae
Genus: Listroderes
Species: *Listroderes costirostris*

**EPPO Code:** LISTCO.

**Bangladesh status:** Not present in Bangladesh [CABI & EPPO, 2000; EPPO, 2014]

### 5.3.5.2. Biology

Most of these notes are taken from High (1939) who described the life history of the pest in southern USA. L. costirostris deposits its eggs on plants or in nearby soil. The crowns of host plants are the preferred locations when ample moisture is present. After depositing the eggs on the leaves and stems, the weevil attaches them to the leaves by a glutinous secretion exuded at the time of oviposition. In the soil, the weevil constructs a small pocket with its ovipositor before depositing the eggs. The eggs are usually deposited singly, although masses of two to eight or more eggs are sometimes found. Weevils depositing only unfertilized eggs often oviposit in masses. Immediately after hatching, the larvae begin feeding on the buds of the host plants, or on the undersides of leaves close to the buds. Later in their development they feed on all the foliage parts, and on root crops, such as turnips and carrots, they often feed on the roots, causing severe damage. The larval period under laboratory conditions varies greatly according to temperature and moisture, averaging approximately 35 days. Larvae are found in the field from the last week of October until mid-May of the following year, occurring in greatest abundance during December, January and February.

### 5.3.5.3. Hosts

**a. Major hosts:** The main host of *Listroderes costirostris* includes *Solanum melongena* (aubergine), Solanum lycopersicum (tomato), potato, grapevine orchid, safflower, *Chrysanthemum morifolium,* roses,Gerbera, gypsophila, Zinnia, Begunia, Poinsettia,

balsam. amaranth, carrot, lettuce, cabbage, wild radish, wild mustard, melon, sugarbeet, cucumber, pea, peach, apple, apricot, *Allium cepa* (onion) etc.

**b. Minor hosts:** The minor or other hosts of this pest include pumpkin, *Chrysanthemum indicum,* pistachio etc.

**5.3.5.4. Distribution**

- **EPPO region:** Present and widespread in the field in France, Greece, Israel, Italy, Libya, Portugal, Spain,Turkey and Ukraine (CABI & EPPO, 2000; EPPO, 2014).
- **Asia:** *Listroderes costirostris* is distributed in many Asian countries including Israel (Friedman, 2009; EPPO, 2014), Japan (Morrone, 1993; CABI & EPPO, 2000; EPPO, 2014), Taiwan (Hsu & Chiang, 1983;), Korea (Morimoto, 1992; CABI & EPPO, 2000; EPPO, 2014).
- **Africa:** Central African Republic, Morocco, Nigeria (Balachowsky, 1963; CABI & EPPO, 2000; EPPO, 2014).
- **North America:** USA (southern states, Hawaii, New York,Oregon, South Carolina, Texas, Viriginia)( High, 1939; O'Brien & Wibmer, 1982; CABI & EPPO, 2000; EPPO, 2014).
- **Central America and Caribbean:** Antigua and Barbuda, Barbados, Belize, Costa Rica, Cuba, Dominica, Dominican Republic, Trinidad and Tobago. The B biotype has been recorded in Central America and the Caribbean Basin.
- **South America:** Argentina, Brazill,Bolivia,Venezuela (CIE, 1964; CABI & EPPO, 2000; EPPO, 2014).
- **Oceania:** Australia, Fiji, New Zealand, Papua New Guinea, Samoa, Solomon Islands, Tuvalu. The B biotype is present in Australia.
- **EU:** Present.

**5.3.5.5. Hazard identification conclusion**

Considering the facts that *Listroderes costirostris* -

- is not known to be present in Bangladesh [CABI & EPPO, 2000; EPPO, 2014];
- is potentially economic important to Bangladesh because it is an important pest of vegetables in Asia including Iarael, **Japan** [CABI & EPPO, 2000; EPPO, 2014,] Taiwan from where vegetables are imported to Bangladesh.
- can become established in Bangladesh through imports of the brinjal seeds. It has capability to cause direct economic and ecological damage to many valuable cultivated crops, because the eggs are laid in leaves, flower structures or fruit (High 1939). The major method of long distance dispersal for this pest is via transportation of infested seed and nursery stock [EPPO, 2016]
- *Listroderes costirostris* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

**5.3.5.3.6. Determine likelihood of pest establishing in Bangladesh via this pathway**

Table 5.1 – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| a. **Has this pest been established in several new countries in recent years,-Yes,**<br>• *Listroderes costirostris* is distributed in many Asian countries including Israel (Friedman, 2009; EPPO, 2014), Japan (Morrone, 1993; CABI & EPPO, 2000; EPPO, 2014), Taiwan (Hsu & Chiang, 1983;), Korea (Morimoto, 1992; CABI & EPPO, 2000; EPPO, 2014).<br>• High (1939) reported serious economic damage to vegetable crops in the ten USA States where the pest was established in 1930. Growers in Mississippi, USA, reported losses as high as 90%, with common losses ranging from 40 to 70%. During 1933, the estimated crop losses for tomatoes alone ranged from 5 to 70% of the total crop value. Entire plantings of turnips, carrots, cabbages, mustard and spinach can be destroyed or seriously injured during the early stages of growth by this weevil. Practically all vegetable growers in the region adjacent to the Gulf of Mexico, USA, have suffered crop losses due to L. costirostris damage (High, 1939).<br>**b. Posibility of survival during transport, storage and transfer of this pest? Yes**<br>• The brinjal seeds and fruits are transported from Japan, Thailand, Taiwan, Indonesia, U.S.A, Australia, France, Germany, Italy, Netherlands, Belgium, Brazil, and Chile to Bangladesh mainly by Airfreight, and or Landport. Therefore, the period of time taken for shipment through these transportation pathways from the exporting countries to Bangladesh is very short. Within this period the eggs and larvae of vegetable wevill can easily survive on fruit surfaces of brinjal. Because, Egg incubation period ranged from 15 to 33 days when the average daily temperature was 12.8-24.4°C. During the spring and autumn most of the eggs under observation hatched within 15-20 days after deposition. Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with **High** risk potential. As *L. costirostris* reproduces parthenogenetically, a single individual is capable of establishing the species in any new area where climatic conditions are favourable (Lovell, 1932). During the height of the breeding season, the weevil can be transported easily from place to place through the shipment of green vegetables and root crops, either on the plants or secluded in shipping containers. Repeated observations have demonstrated that the pest may be accidentally transported by persons or vehicles (High, 1939), although *L. costirostris* is not included on any quarantine lists for any country.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Internationally, *Listroderes costirostris* is liable to be carried on any plants for planting or on brinjal seeds, and nursery stocks, | **YES and HIGH** |

| | |
|---|---|
| which are the main means of dispersal of this pest [EPPO, 2016].<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• *Listroderes costirostris* is a remarkably polyphagous species with 87plant species from 20 families being recorded as hosts. The host range of *Listroderes costirostris* is *Solanum melongena* (aubergine), *Solanum lycopersicum* (tomato), potato, grapevine orchid, safflower, Chrysanthemum morifolium, roses,Gerbera, gypsophila, Zinnia, Begunia, Poinsettia, balsam. amaranth, carrot, lettuce, cabbage, wild radish, wild mustard, melon, sugarbeet, cucumber, pea, peach, apple, apricot, *Allium cepa* (onion) etc.As long as environmental conditions are favourable, | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

**5.3.5.3.7. Determine the Consequence establishment of this pest in Bangladesh**

**Table 5.2** – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *Listroderes costirostris* is a remarkably polyphagous species with 87 plant species from 20 families being recorded as hosts The host range of Listroderes costirostris is Solanum melongena (aubergine), Solanum lycopersicum (tomato), potato, grapevine orchid, safflower, Chrysanthemum morifolium, roses,Gerbera, gypsophila, Zinnia, Begunia, Poinsettia, balsam. amaranth, carrot, lettuce, cabbage, wild radish, wild mustard, melon, sugarbeet, cucumber, pea, peach, apple, apricot, Allium cepa (onion) etc.As long as environmental conditions are favourable.<br>• *Listroderes costirostris* is of quarantine significance for Bangladesh. Its introduction and rapid spread to many countries, and the problems presented by its presence in vegetables, flowers and other crops, illustrate clearly the serious nature of this pest and the potential threat to the field crops as well as horticultural crops in Bangladesh still free from the pest.<br>• This is a fairly serious pest of several important vegetables, flower and other crops for Bangladesh.<br>**b. Economic impact and yield loss**<br>• The primary injury by larvae is caused when they devour the buds of the host plants, stunting them, followed by foliage attack, with the exception of the main stems and larger veins. The loss of the leaves not only interferes with the normal functioning of the plants, but affects the market value of the crops, for example, in southern USA, | **Yes and High** |

| | |
|---|---|
| the leaves of turnips have a greater market value than the roots. Even when the infestation is not severe enough to cause noticeable injury, the mere presence of the larvae lowers the market value of the crops (High, 1939).<br>• High (1939) reported serious economic damage to vegetable crops in the ten USA States where the pest was established in 1930. Growers in Mississippi, USA, reported losses as high as 90%, with common losses ranging from 40 to 70%. During 1933, the estimated crop losses for tomatoes alone ranged from 5 to 70% of the total crop value. Entire plantings of turnips, carrots, cabbages, mustard and spinach can be destroyed or seriously injured during the early stages of growth by this weevil. Practically all vegetable growers in the region adjacent to the Gulf of Mexico, USA, have suffered crop losses due to L. costirostris damage (High, 1939).<br>**c. Environmental Impact**<br>• The appearance of the vegetable weevil within new areas is in most cases, the result of movement of infested plant material. As *L. costirostris* reproduces parthenogenetically, a single individual is capable of establishing the species in any new area where climatic conditions are favourable (Lovell, 1932). During the height of the breeding season, the weevil can be transported easily from place to place through the shipment of green vegetables and root crops, either on the plants or secluded in shipping containers. Repeated observations have demonstrated that the pest may be accidentally transported by persons or vehicles (High, 1939), This invariably leads to an increase in the use of insecticides as *L. costirostris* control becomes increasingly more difficult. This in turn can produce an ever increasing spiral in the levels of insecticide resistance and insecticide use, having a direct impact on the environment. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

**5.3.5.3.8. Calculating the Risk of this Pest via this pathway for Bangladesh**

**Establishment Potential X Consequence Potential = Risk**

Table5.3 – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.5.3.9. Risk Management Measures

- Avoid importation of vegetables especially brinjal, tomato etc and planting materials like seeds, nursery stock from countries, where this pest is available.
- Treatment should begin when 5% or more of small, newly set plants (within 3 weeks after transplanting) are killed or injured. Vegetable weevil larvae in tobacco plant beds can be controlled using acephate insecticides.
- In addition, resistance of this pest has developed to certain pesticides. Accordingly, the only safe measure is to ensure that the place of production is free from the pest by appropriate inspection (OEPP/EPPO, 1990).

### 5.3.5.3.10. References


Balachowsky AS, 1963. Entomology applied to agriculture. Tome 1. Coleoptera. Second Volume. Paris, France: Masson et Cie, 982-984.

CABI , EPPO , 2000. Listroderes costirostris. [Distribution map]. Distribution Maps of Plant Pests, December (1st revision). Wallingford, UK: CAB International, Map 178.

CIE, 1964. Listroderes costirostris Schönh. (obliquus Klug)(Col., Curculionidae) (vegetable weevil). Distribution Maps of Pests Series A (agricultural), Map No. 178. Wallingford, UK: CAB International.

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

Friedman ALL, 2009. The vegetable weevil, Listroderes costirostris Schoenherr (Curculionidae: Cyclominae): a new invasive pest in Israel. Phytoparasitica, 37(4):331-332. http://www.springerlink.com/content/887447h18l808264/?p=1e540bbcee7b4924aec42a6046a19011&pi=5

High MM, 1939. The Vegetable Weevil. Circular. Washington, USA: United States Department of Agriculture.

Lovell OH, 1932. The vegetable weevil, Listroderes obliquus. Bulletin California Agricultural Experiment Station, 546.

Morimoto K, 1992. Curculionidae from Cheju Island, Korea, with descriptions of three new species (Insecta, Coleoptera). Esakia 32:1-18.

Morrone JJ, 1993. Systematic revision of the costirostris species group of the weevil genus Listroderes Schoenherr (Coleoptera: Curculionidae). Transactions of the American Entomological Society, 119(4):271-315.

O'Brien CW, Wibmer GJ, 1982. Annotated checklist of the weevils (Curculionidae sensu lato) of North America, Central America and the West Indies (Coleoptera: Curculionoidea). Memoirs, American Entomological Institute, 34:1-382.

### 5.3.6. Alfalfa thrips: *Frankliniella occidentalis* (Pergande)

#### 5.3.6.1. Hazard Identification

**Scientific name:** *Frankliniella occidentalis* (Pergande)

**Synonyms**: *Frankliniella californica* (Moulton)
*Frankliniella helianthi* (Moulton)
*Frankliniella moultoni* Hood
*Frankliniella trehernei* Morgan

**Common names**: Alfalfa thrips (English)

Western flower thrips,

**Taxonomic tree**

Phylum: Arthropoda
Subphylum: Mandibulata
Class: Insecta
Order: Thysanoptera
Family: Thripidae
Genus: *Frankliniella*
Species: *Frankliniella occidentalis*

EPPO Code: FRANOC. This pest has been included in EPPO A2 list: No. 177

**Bangladesh status:** Not present in Bangladesh [EPPO, 2014; CABI/EPPO, 1999]

#### 5.3.6.2. Biology

*F. occidentalis* reproduces throughout the year producing as many as 12-15 generations per year. The total life-cycle from egg to egg at 15, 20, 25 and 30°C is 44.1, 22.4, 18.2 and 15 days, respectively. Each female lays between 20 and 40 eggs. Pre-oviposition time is 10.4 days at 15°C and 2-4 days at both 20 and 30°C; highest reproductive rate (95.5 hatched eggs/female) is at 20°C. The eggs are inserted in the parenchyma cells of leaves, flower parts and fruits, and hatch in about 4 days at 27°C. This period is lengthened to 13 days at 15°C. The eggs are susceptible to desiccation, and high mortality at this stage is not uncommon. Adult thrips have been observed entering closed chrysanthemum buds, presumably to lay eggs, a behavior pattern which makes control very difficult (Bryan & Smith, 1956; Lublinkhof & Foster, 1977).

#### 5.3.6.3. Hosts

**c. Major hosts:** The main host of *F. occidentalis* includes tomato, aubergine, potato, grapevine orchid, safflower, *Chrysanthemum morifolium,* roses, Gerbera, gypsophila, Zinnia, Begunia, Poinsettia, balsam. amaranth, carrot, lettuce, cabbage, wild radish, wild mustard, melon, sugarbeet, cucumber, pea, peach, apple, apricot, etc.

**d. Minor hosts:** The minor or other hosts of this pest include pumpkin, *Chrysanthemum indicum,* pistachio etc.

#### 5.3.6.4. Distribution

*F. occidentalis* is distributed in many Asian countries including India (CABI/EPPO, 1999; EPPO, 2014; Kaomud & Tyagi Vikas Kumar, 2015), Thailand, Sri Lanka (CABI/EPPO, 1999; EPPO, 2014), Japan (Nakahara, 1997; CABI/EPPO, 1999; EPPO, 2014), China (EPPO, 2014; Reitz et al., 2011; Zhang et al., 2003), Iran (EPPO, 2014).

*F. occidentalis* is naturally abundant in many field crops throughout western North America from southern California (and presumably Mexico) into Canada. In the late 1970s and 1980s, it spread across the USA and Canada. It reached the Netherlands in 1983 and then spread outwards across Europe (Kirk and Terry, 2003). This sudden explosion remains unexplained but is possibly the result of some undetected genetic change in a population on a crop under intensive cultivation and insecticide treatment (Immaraju et al., 1992). Having become well established in Europe and Israel, it spread to the highlands of eastern Africa and subsequently entered New Zealand in 1992 and Australia in 1993. In Australia it has spread around Sydney, Adelaide and Brisbane, but in Western Australia summer temperatures that routinely exceed 40°C may be limiting its spread to the vicinity of Perth. It is present in southern Brazil (Monteiro et al., 1995), and also in the Cameron Highlands of Peninsular Malaysia (Fauziah and Saharan, 1991), and it is becoming more common in tropical lowland countries. In Costa Rica and Colombia, although abundant in screen houses where chrysanthemums are grown, it remains rare outside on native plants or crops, whereas in Guatemala it has been reported as a pest of field-grown crops. In Florida, USA, it can be abundant in crop fields but becomes progressively less abundant away from crop areas, presumably because of competition from native thrips and predation (Reitz et al., 2006; Paini et al., 2007, 2008; Northfield et al., 2008).

#### 5.3.6.5. Hazard identification conclusion

Considering the facts that *Frankliniella occidentalis* -

- is not known to be present in Bangladesh [EPPO, 2014; CABI/EPPO, 1999];
- is potentially economic important to Bangladesh because it is an important pest of flowers and foliages in Asia including China, India, Thailand, **Japan** [EPPO, 2014; CABI/EPPO, 1999] from where flowers are imported to Bangladesh.
- can become established in Bangladesh through imports of the brinjal seeds. It has capability to cause direct economic and ecological damage to many valuable cultivated crops, because the eggs are laid in leaves, flower structures or fruit (Childers and Achor, 1995). The major method of long distance dispersal for this pest is via transportation of infested seed and nursery stock [EPPO, 2016].
- *Frankliniella occidentalis* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

#### 5.3.6.6. Determine likelihood of pest establishing in Bangladesh via this pathway

Table 6.1 – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **a. Has this pest been established in several new countries in recent years,-Yes,**<br>• This pest has been established in many Asian countries. The introduction of this pest in India was first reported in 2015; Japan in 1990, the Republic of Korea in 1993; Sri Lanka in 1996, Israel in 2003).<br>• *Frankliniella occidentalis* is highly polyphagous, breeding on many field and horticultural crops that are transported around the world. The international movement of plant material has fostered the rapid | **YES and** |

| | |
|---|---|
| spread of the species throughout the world and many populations are now highly resistant to various insecticides. It is considered likely that the development of resistance in the late 1970s is the factor that triggered the worldwide spread and establishment of this species (Kirk and Terry, 2003).<br><br>**b. Posibility of survival of this pest during transport, storage and transfer? - Yes**<br><br>• The total life-cycle of Alfalfa thrips, *F. occidentalis* from egg to adult at 15, 20, 25 and 30°C is 44.1, 22.4, 18.2 and 15 days, respectively. The eggs are inserted in the parenchyma cells of leaves, flower parts and fruits, and hatch in about 4 days at 27°C. This period is lengthened to 13 days at 15°C (Bryan & Smith, 1956; Lublinkhof & Foster, 1977). Therefore, the period of time taken for shipment through transportation pathways from the exporting countries to Bangladesh is sufficient enough for survival. Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with high risk potential.<br><br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br><br>• Internationally, *F. occidentalis* is liable to be carried on any plants for planting or on brinjal seeds, and nursery stocks, which are the main means of dispersal of this pest [EPPO, 2016].<br><br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br><br>• *F. occidentalis* is a remarkably polyphagous species with 244 plant species from 62 families being recorded as hosts. The host range of *F. occidentalis* is tomatoes, *Capsicum*, Cucurbitaceae and strawberries, *Beta*, carrots, cotton, grapefruits, grapes, onions, flowers of roses, carnations, *Gladiolus*, chrysanthemums, *Gerbera*, sweet peas, plums, peas, *Phaseolus*, safflower (EPPO, 2016), which are mostly common in Bangladesh.<br><br>• As long as environmental conditions are favourable, *F. occidentalis* will reproduce continuously, with up to 15 generations in a year being recorded under glass (Bryan and Smith, 1956; Lublinkhof and Foster, 1977). Development and reproductive rates are temperature dependent. The total life cycle from egg to egg has been recorded as 44.1, 22.4, 18.2 and 15 days at 15, 20, 25 and 30°C. Each female lays typically between 20 and 40 eggs during its life. At 15°C, pre-oviposition time is longer (10.4 days) than at higher temperatures of 20 or 30°C (2-4 days). However, because of faster development times, greater population growth rates are seen at temperatures of 30$^{o}$C (Gaum et al., 1994). | **HIGH** |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

### 5.3.6.7. Determine the Consequence establishment of this pest in Bangladesh

**Table 6.2** – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| a. Is this a serious pest of **Bangladesh? - Yes**.<br>• *F. occidentalis* is a remarkably polyphagous species with 244 plant species from 62 families being recorded as hosts. In the USA, the host range of *F. occidentalis* is brinjal, tomatoes, *Capsicum*, Cucurbitaceae and strawberries. *Beta*, carrots, cotton, grapefruits, grapes, onions, flowers of roses, carnations, *Gladiolus*, sweet peas, apricots, peaches and nectarines, plums, peas, *Phaseolus*, *Purshia tridentata*, safflower. In Europe, this pest is most commonly on brinjal, tomatoes, chrysanthemums, *Gerbera*, roses and *Saintpaulia* [EPPO, 2016].<br>• *F. occidentalis* is of quarantine significance for Bangladesh. Its introduction and rapid spread to many countries, and the problems presented by its presence in vegetables, flowers and other crops, illustrate clearly the serious nature of this pest and the potential threat to the field crops as well as horticultural crops in Bangladesh still free from the pest.<br>• This is a fairly serious pest of several important vegetables, flower and other crops for Bangladesh.<br>**b. Economic Impact and Yield Loss**<br>• *F. occidentalis* attacks the flowers and foliage of a great number of crops. As well as feeding on plant fluids with their sucking mouthparts, *F. occidentalis* also eats the pollen and nectar of many plants, and the spreading of pollen during this feeding result in pollination and premature senescence - which can be a serious problem with certain ornamental crops such as *Saintpaulia*.<br>• *F. occidentalis* is a very important pest of ornamental flower crops as it takes only a few individuals to scarthe marketable portion of the crop, the flower and reduces the aesthetic quality of the crop.<br>• *F. occidentalis* also attacks vegetables under glass and the decline in cucumber production in British Columbia (Canada) is attributed mainly to the spread of this pest. For example, in 1985, *F. occidentalis* was estimated to have caused a 20% yield loss in the glasshouse cucumber crop.<br>• In California (USA), *F. occidentalis* also causes damage outdoors, on lucerne (by larval feeding on flowers and young pods) and on fruit trees (by scarring and silvering the surface of the fruit, especially in *Prunus*). Nursery stock of fruit trees and roses is also damaged, the terminal buds being killed or weakened. A range of other crops in North America is damaged by this pest to a greater or lesser extent.<br>• *F. occidentalis* may affect most fruiting vegetables with the exception of tomatoes. Problems are most severe on cucumbers where the blossoms can be reduced or so extensively damaged that no fruit is produced. The cucumber fruits often show severe distortion.<br>• *F. occidentalis* has been associated with outbreaks of tomato spotted | **Yes and High** |

| | |
|---|---|
| wilt virus (TSWV) on tomatoes in Ontario (Canada). The symptoms of this disease include stunting, distortion and mosaic mottling of leaves, and clearing of leaf veins and fruit. TSWV causes severe loss (50-90%) of lettuces in Hawaii (USA), particularly in the major vegetable-growing area of Kula. Twenty-five weed species found in Kula serve as reservoirs for *F. occidentalis*, 17 of which may harbour TSWV. In lettuce fields there is a high correlation between thrips populations and TSWV incidence. In Louisiana (USA) the incidence of TSWV in tomato, pepper and tobacco crops has increased dramatically since about 1978. The infection can reach 60% in commercial fields and 100% in gardens. It is thought that the expanded geographical range of *F. occidentalis* into Louisiana is responsible for the increase of TSWV. However, it has also been suggested that the role of *F. occidentalis* as the vector of the virus in California has been over-emphasized, and that *Thrips tabaci* is probably more important.<br>**c. Environmental Impact**<br>• *F. occidentalis* represents a potential threat to many crops. The establishment of it could trigger chemical control programs by using different insecticides that are toxic and harmful to the environment.<br>• Chemical control is important and widely practised, but is often constrained by the secretive habits of *F. occidentalis*, and because populations have been found to develop resistance quickly. For example, MacDonald (1995) demonstrated 30-fold differences in susceptibility to Malathion among populations of *F. occidentalis* in the remarkably small area of the southern half of England. A disturbing practice is mixing insecticides into 'cocktails' to obtain short-term control enhancement when one insecticide loses efficacy, because of the added risk of longer term resistance that this brings. The nature of quick resistance development of this pest against insecticides also triggers further changing of new chemical insecticides that also enhance harmful impact on the environment. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.6.8. Calculating the Risk of this Pest via this pathway for Bangladesh

**Establishment Potential X Consequence Potential = Risk**

Table 6.3 – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |

| | | |
|---|---|---|
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.6.9. Risk Management Measures

- Avoid importation of flowers and foliages from countries, where this pest is available.
- Treatments against *F. occidentalis* on plants in transit are unlikely to be entirely successful because of the ability of the pest to secrete itself in small crevices and tightly closed plant parts, because the eggs are protected by the epidermis of the host, and because of the subterranean habit of certain stages (Zhang *et al.,* 2004).
- In addition, resistance of this pest has developed to certain pesticides. Accordingly, the only safe measure is to ensure that the place of production is free from the pest by appropriate inspection (OEPP/EPPO, 1990).

### 5.3.6.10. References


Agrawal AA, Karban R, Colfer RG, 2000. How leaf domatia and induced plant resistance affect herbivores, natural enemies and plant performance. Oikos, 89(1):70-80.

Bryan DE, Smith RF, 1956. The *Frankliniella occidentalis* complex in California. University of California, Publications in Entomology, 10:359-410.

CABI/EPPO , 1999. *Frankliniella occidentalis*. [Distribution map]. Distribution Maps of Plant Pests, December (1st revision). Wallingford, UK: CAB International, Map 538.

CABI/EPPO, 1998. Distribution maps of quarantine pests for Europe (edited by Smith, I. M. and Charles, L. M. F.). Wallingford, UK: CAB International, xviii + 768 pp.

Childers CC, Achor DS, 1995. Thrips feeding and oviposition injuries to economic plants, subsequent damage and host responses to infestation. In: Thrips biology and management: proceedings of the 1993 International Conference on Thysanoptera [ed. by Parker, B. L.\Skinner, M.\Lewis, T.]. London, USA: Plenum Publishing Co. Ltd, 31-51.

EPPO, 2016. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

Gaum WG, Giliomee JH, Pringle KL, 1994. Life history and life tables of western flower thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae), on English cucumbers. Bulletin of Entomological Research, 84(2):219-224.

Hansen EA, Funderburk JE, Reitz SR, Ramachandran S, Eger JE, McAuslane H, 2003. Within-plant distribution of Frankliniella species (Thysanoptera: Thripidae) and Orius insidiosus (Heteroptera: Anthocoridae) in field pepper. Environmental Entomology, 32(5):1035-1044.

Immaraju JA, Paine TD, Bethke JA, Robb KL, Newman JP, 1992. Western flower thrips (Thysanoptera: Thripidae) resistance to insecticides in coastal California greenhouses. Journal of Economic Entomology, 85(1):9-14.

Kaomud Tyagi , Vikas Kumar, 2015. First report of western flower thrips, *Frankliniella occidentalis* (Pergande)(Thripidae: Thysanoptera) from India - a potential havoc to Indian Agriculture. HALTERES, 6:1-3.

Kirk WDJ, Terry LI, 2003. The spread of the western flower thrips *Frankliniella occidentalis* (Pergande). Agricultural and Forest Entomology, 5:301-310.

Lewis T, 1997. Thrips as Crop Pests. Wallingford, UK: CAB International, 740 pp.

Lublinkhof J, Foster DE, 1977. Development and reproductive capacity of *Frankliniella occidentalis* (Thysanoptera: Thripidae) reared at three temperatures. Journal of the Kansas Entomological Society, 50(3):313-316

Monteiro RC, Zucchi RA, Mound LA, 1995. *Frankliniella occidentalis* (Pergande, 1895) (Thysanoptera, Thripidae) em Chrysanthemum sp. In: Anais do 15 Congresso de Entomologia. Sociedade Entomologica do Brasil, Caxambuco, MG. Caxambuco, Brazil: Sociedade Entomologica do Brasil.

Nakahara S, 1997. Annotated list of the Frankliniella species of the world (Thysanoptera: Thripidae). Contributions on Entomology, International, 2:353-389.

Northfield TD, Paini DR, Funderburk JE, Reitz SR, 2008. Annual cycles of Frankliniella spp. (Thysanoptera: Thripidae) thrips abundance on North Florida uncultivated reproductive hosts: predicting possible sources of pest outbreaks. Annals of the Entomological Society of America, 101(4):769-778. http://esa.publisher.ingentaconnect.com/content/esa/aesa/2008/00000101/00000004/art00008

OEPP/EPPO, 1990. Specific quarantine requirements. EPPO Technical Documents, No. 1008. Paris, France: EPPO.

Paini DR, Funderburk JE, Jackson CT, Reitz SR, 2007. Reproduction of four thrips species (Thysanoptera: Thripidae) on uncultivated hosts. Journal of Entomological Science, 42(4):610-615.

Reitz SR, 2008. Comparative bionomics of *Frankliniella occidentalis* and *Frankliniella tritici*. Florida Entomologist, 91(3):474-476. http://www.fcla.edu/FlaEnt/

Reitz SR, 2009. Biology and ecology of the western flower thrips (Thysanoptera: Thripidae): the making of a pest. Florida Entomologist [Western Flower Thrips Symposium Papers, Florida, USA, 15 July 2008.], 92(1):7-13. http://www.fcla.edu/FlaEnt/

Reitz SR, Funderburk JE, Waring SM, 2006. Differential predation by the generalist predator Orius insidiosus on congeneric species of thrips that vary in size and behavior. Entomologia Experimentalis et Applicata, 119(3):179-188. http://www.blackwell-synergy.com/doi/full/10.1111/j.1570-7458.2006.00408.x

Reitz SR, Gao YL, Lei ZR, 2011. Thrips: Pests of concern to China and the United States. Agricultural Sciences in China, 10:867-892.

Zhang Rong, Ma JianHua, Yang Fang, Xian ChengZhong, Zhang SheHui, 2004. Field trials of some insecticides for controlling *Frankliniella occidentalis*. Pratacultural Science, 21(1):20-21.

Zhang YJ, Wu QJ, Xu BY, Zhu GR, 2003. The occurrence and damage of *Frankliniella occidentalis* (Thysanoptera: Thripidae): a dangerous alien invasive pest in Beijing. Plant Protection, 4:58-59.

## 5.3.7. Tobacco caterpillar: *Spodoptera littoralis* (Boisduval)

### 5.3.7.1 Hazard Identification

**Scientific Name:** *Spodoptera littoralis* (Boisduval)

**Synonyms**: *Hadena littoralis* Boisduval
*Noctua gossypii*
*Prodenia littoralis* (Boisduval)
*Prodenia litura Fabricius sensu auctorum*
*Prodenia retina* (Freyer)
*Prodenia testaceoides* Guenee

**Common names**: Tobacco caterpillar;
Tomato caterpillar
Egyptian cotton leafworm;
Egyptian cotton worm;
Mediterranean brocade moth;
Mediterranean climbing cutworm;
Mediterranean climbing cutworm;

### Taxonomic tree

Domain: Eukaryota
Kingdom: Metazoa
Phylum: Arthropoda
Subphylum: Uniramia
Class: Insecta
Order: Lepidoptera
Family: Noctuidae
Genus: *Spodoptera*
Species: *Spodoptera littoralis*

**EPPO Code:** PRODLI. This pest has been included in EPPO A2 list: No. 42

**Bangladesh status:** Not present in Bangladesh [CIE, 1967; EPPO, 2014].

### 5.3.7.2. Biology

Between 2 and 5 days after emergence, females lay 1000-2000 eggs in egg masses of 100-300 on the lower leaf surface of the host plant (Miyahara *et al*., 1971). The masses are covered by hair-like scales from the end of the insect's abdomen. Fecundity is adversely affected by high temperature and low humidity (about 960 eggs laid at 30°C and 90% RH and 145 eggs at 35°C and 30% RH). Newly laid eggs of one strain of *S. littoralis* were reported to survive exposure to 1°C for 8 days.

The eggs hatch in about 4 days in warm conditions, or up to 11-12 days in winter. The larvae pass through six instars in 15-23 days at 25-26°C.. The young larvae (first to third instar) feed in groups, leaving the opposite epidermis of the leaf intact. Later, the (4th to 6th instar) larvae disperse and spend the day in the ground under the host plant, feeding at night and early in the morning.

The pupal period is spent in earthen cells in the soil and lasts about 11-13 days at 25°C. Longevity of adults is about 4-10 days, being reduced by high temperature and low humidity.

Thus, the life cycle can be completed in about 5 weeks. The development thresholds and thermal requirements of S. litura have been specified by Rao et al. (1989). For more information, see Bishara (1934), Schmutterer (1969), Salama *et al.* (1970), Cayrol (1972), Nasr (1973), Baker & Miller (1974), Shutova & Cheknonadskikh (1974), Cunningham & Broadley (1975).

**5.3.6.3. Hosts**

**a. Major hosts:** The main crop species attacked by *S. lituralis* in the tropics are vegetables (aubergines, *Brassica oleracea*, *B. oleracea* var. *capitata*, Capsicum, pea, radish, carot, cucurbit vegetables, Phaseolus, potatoes, sweet potatoes, Vigna etc.) *Colocasia esculenta*, cotton, flax, groundnuts, jute, lucerne, maize, rice, soyabeans, tea, tobacco,.

**b. Minor hosts:** The minor or other hosts include ornamentals such as china aster (*Callisterphus chinensis*), chrysanthemum (*Chrysanthemum indicum*), Gerbera, sunflower, carnation etc, wild plants, weeds and shade trees (e.g. *Leucaena leucocephala*, the shade tree of cocoa plantations in Indonesia).

**5.3.7.4. Distribution**

**EPPO region**: Widespread in Algeria, Cyprus, Egypt, Israel, Libya, Malta, Morocco, Spain; locally established in Greece, Italy, Portugal, Tunisia; found but not established in Denmark, Finland, France, Germany, Netherlands, UK (England). It was also reported from Lebanon, Syria and Turkey.

**Asia**: Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Lebanon, Oman, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen, Pakistan, Japan, Indonesia.

**Africa**: Algeria, Angola, Benin, Burkina Faso, Burundi, Botswana, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Egypt, Equatorial Guinea, Eritrea, Gambia, Ghana, Guinea, Kenya, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, St. Helena, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zaire, Zambia, Zimbabwe.

**EU**: Present.

**5.3.7.5. Hazard Identification Conclusion**

Considering the facts that *S. littoralis* -

- is not known to be present in Bangladesh [CIE, 1967; EPPO, 2014];
- is potentially economic important to Bangladesh because it is an important pest of flowers and foliages Asia including Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Lebanon, Oman, Pakistan, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen [CIE, 1967a; EPPO, 2014] and Japan (Nakasuji, 1976) from where flowers are imported to Bangladesh.
- can become established in Bangladesh through imports of the flowers and foliages. It has capability to cause direct economic and ecological damage to many valuable cultivated crops, because this pest has high reproductive potential, high dispersal ability for long distance and high survivability at adverse environment, the risk rating for establishment potential is high**.**
- *Spodoptera littoralis* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

**5.3.7.6. Determine likelihood of pest establishing in tour country via this pathway.**

Table 7.1. – Which of these descriptions best fit of this pest?

| Description | Establishment Potential is: |
|---|---|
| **a. Has this pest been established in several new countries in recent years,-Yes,**<br>• This pest has been established in many Asian countries including Bahrain, Iran, Iraq, Jordan, Lebanon, Oman, Saudi Arabia, Turkey, United Arab Emirates, Yemen (EPPO, 2016), Pakistan, Japan, Indonesia. The introduction of another species *S. litura* into the UK was on aquatic plants imported from Singapore (Aitkenhead *et al*., 1974). *S. littoralis* has been trapped outside its normal range in Europe (Hachler, 1986), presumably as a result of entry on imported commodities.<br>• EPPO has listed *S. littoralis* as an A2 quarantine pest (OEPP/EPPO, 1981). CPPC, NAPPO and OIRSA also consider this species of quarantine significance. *S. littoralis* is already fairly widespread in Mediterranean countries.<br>**c. Posibility of survival during transport, storage and transfer of this pest? Yes**<br>• The brinjal fruits, seeds and other planting materials are transported from China, Japan, Thailand, Taiwan, Vietnam, Indonesia, U.S.A, Australia, etc to Bangladesh mainly by Airfreight, and or Landport. Therefore, the period of time taken for shipment through these transportation pathways from the exporting countries to Bangladesh is very short. Within this period the eggs and catterpillers of tomato catterpillers can easily survive on fruit surfaces of brinjal. The eggs hatch in about 4 days in warm conditions, or up to 11-12 days in winter. The larvae pass through six instars in 15-23 days at 25-26°C. At lower temperatures, for example *S. littoralis* on glasshouse chrysanthemums in Europe, larvae often go through an extra instar, and maturation may take up to 3 months. Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with **High** risk potential.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Commerce appears to be the most likely pathway for introduction. Eggs or larvae are carried on imported plants, cut flowers and edible crops. Adult moths have also occasionally been recorded as immigrants presumed to have originated from Mediterranean Europe or northern Africa (Eight records to 2010).<br>• Internationally, *S. littoralis* is liable to be carried on any plants for planting materials such as brinjal seeds,nursery stocks, which are the main means of dispersal of this pest [EPPO, 2016].<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• *S. littoralis* species is totally polyphagous (Brown & Dewhurst, 1975; Holloway, 1989). The host range of this pest species covers at least 87 | **YES and HIGH** |

| | |
|---|---|
| species of economic importance (Salama et al., 1970). Among the main crop species attacked by *S. lituralis* in the tropics are vegetables (aubergines, *Brassica oleracea*, *B. oleracea* var. *capitata*, Capsicum, pea, radish, carot, cucurbit vegetables, Phaseolus, potatoes, sweet potatoes, Vigna etc.), *Colocasia esculenta*, cotton, flax, groundnuts, jute, lucerne, maize, rice, soyabeans, tea, tobacco. Other hosts include ornamentals such as china aster (*Callisterphus chinensis*), chrysanthemum (*Chrysanthemum indicum*), Gerbera, sunflower, carnation etc, wild plants, weeds and shade trees (e.g. *Leucaena leucocephala*, the shade tree of cocoa plantations in Indonesia), among these hosts many of them mostly common in **Bangladesh**.<br>• Adult females lay 1000-2000 eggs in egg masses of 100-300 on the lower leaf surface of the host plant (Miyahara *et al*., 1971). Newly laid eggs of one strain of *S. littoralis* were reported to survive exposure to 1°C for 8 days. Partially developed eggs survived longer than newly laid ones under equivalent conditions.<br>• The larvae pass through six instars in 15-23 days at 25-26°C. At lower temperatures, for example *S. littoralis* on glasshouse chrysanthemums in Europe, larvae often go through an extra instar, and maturation may take up to 3 months. The pupal period is spent in earthen cells in the soil and lasts about 11-13 days at 25°C. Longevity of adults is about 4-10 days, being reduced by high temperature and low humidity. Thus, the life cycle can be completed in about 5 weeks. In Japan (Nakasuji, 1976), four generations develop between May and October, while in the humid tropics there may be eight annual generations. In the seasonal tropics, several generations develop during the rainy season, while the dry season is survived in the pupal stage.<br>• These climatic requirements for growth and development of *S. littoralis* are more or less similar with the climatic condition of **Bangladesh**. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

**5.3.7.7. Determine the Consequence establishment of this pest in Bangladesh**

**Table 7.2.** – Which of these descriptions best fit of this pest?

| Description | Consequence potential is: |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *S. littoralis* is an extremely serious pest, the larvae of which can defoliate many economically important crops within its subtropical and tropical range all the year round. On cotton, the pest may cause considerable damage by feeding on the leaves, fruiting points, flower buds and, occasionally, also on bolls. When groundnuts are infested, larvae select primarily the young folded leaves for feeding but, in severe attacks, leaves of any age are stripped off. Sometimes, even the ripening kernels in the pods in the soil may be attacked. Pods of cowpeas and the seeds | **Yes and High** |

they contain are also often badly damaged. In tomatoes, larvae bore into the fruit which is thus rendered unsuitable for consumption. Numerous other crops are attacked, mainly on their leaves.

- In Europe, damage due to *S. littoralis* was minimal until about 1937. In 1949, there was a catastrophic larval population explosion in southern Spain. The main crops affected were lucerne, potatoes and other vegetable crops. At present, this noctuid is of great economic importance in Cyprus, Israel, Malta, Morocco and Spain. In Italy, it is especially important on protected crops of ornamentals and vegetables (Inserra & Calabretta, 1985; Nucifora, 1985). In Greece, *S. littoralis* causes slight damage in Crete on lucerne and *Trifolium* only.
- Larval penetration into maturing cotton bolls causes considerable damage as well as introducing bacterial and fungal rot agents that cause secondary damage.
- *S. littoralis* is of quarantine significance for Bangladesh. Its introduction and rapid spread to many countries, and the problems presented by its presence in flowers and other crops, illustrate clearly the serious nature of this pest and the potential threat to the flower and foliages as well as other crops in Bangladesh still free from the pest.
- This is a fairly serious pest of several important flower and other crops for Bangladesh.

**b. Economic impact and yield loss**

- *S. littoralis* is one of the most destructive agricultural lepidopterous pests within its subtropical and tropical range. It can attack numerous economically important crops all the year round. On cotton, the pest may cause considerable damage by feeding on the leaves, fruiting points, flower buds and, occasionally, also on bolls. When groundnuts are infested, larvae select primarily the young folded leaves for feeding but, in severe attacks, leaves of any age are stripped off. Sometimes, even the ripening kernels in the pods in the soil may be attacked. Pods of cowpeas and the seeds they contain are also often badly damaged. In tomatoes, larvae bore into the fruit which is thus rendered unsuitable for consumption. Numerous other crops are attacked, mainly on their leaves. In Europe, damage due to *S. littoralis* was minimal until about 1937. In 1949, there was a catastrophic larval population explosion in southern Spain. The main crops affected were lucerne, potatoes and other vegetable crops. At present, this noctuid is of great economic importance in Cyprus, Israel, Malta, Morocco and Spain (but not in the north, e.g. Cataluña). In Italy, it is especially important on protected crops of ornamentals and vegetables (Inserra & Calabretta, 1985; Nucifora, 1985). In Greece, S. littoralis causes slight damage in Crete on lucerne and Trifolium only.

**c. Environmental Impact**

- The appearance of the *S. littoralis* within new areas is in most cases, the result of movement of infested plant material. The movement and establishment of *S. littoralis* populations through this route bring along the possibility of insecticide resistance genes. This invariably leads to an increase in the use of insecticides as *S. littoralis* control becomes increasingly more difficult. This in turn can produce an ever increasing spiral in the levels of insecticide resistance and insecticide use, having a direct impact on the environment.

| | |
|---|---|
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.7.8. Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table7.3. – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.7.9. Risk Management Measures

- Avoid importation of plantilng materials such as brinjal seeds and nursery stocks from countries, where this pest is available.
- For planting material, EPPO recommends (OEPP/EPPO, 1990) absence of the pests from the place of production during the last 3 months, or treatment of the consignment. For brinjal, pre-export inspection is considered sufficient.
- Cold storage of brinjal seeds nursery stocks for at least 10 days at a temperature not exceeding 1.7°C will kill all stages of *S. littoralis*, and presumably also *S. litura*, but may damage the plants. Storage at slightly higher temperatures or shorter durations does not eradicate *S. littoralis*, but differences in response to cold have been observed both between strains and within developmental stages of the pest (Powell & Gostick, 1971; Miller, 1976). The standard treatment now used in the UK is cold storage for 2-4 days at less than 1.7°C, followed by methyl bromide fumigation at 15-20°C with a CTP of 54 g h $m^3$ (Mortimer & Powell, 1988). This has been adopted as an EPPO quarantine procedure (OEPP/EPPO, 1984). Irradiation has been investigated as a treatment for brinjal seeds (Navon *et al.*, 1988).
- For cut chrysanthemum flowers, Wang & Lin (1984) suggest enclosing buds in perforated polythene bags to exclude the pest and dipping the cut stems in insecticide solutions.
- A phytosanitary certificate may be required for vegetables seeds especially brinjal, nursery stocks and for vegetables with leaves.

### 5.3.7.10. References


Nucifora, A. (1985) [Successive cultivation and systems of integrated control in protected crops of the Mediterranean area]. Tecnica Agricola 37, 223-241.

Inserra, S.; Calabretta, C. (1985) [Attack by noctuids: a recurring problem in greenhouse crops of the Ragusa coast]. Tecnica Agricola 37, 283-297.

Aitkenhead, P.; Baker, C.R.B; Chickera, G.W.D. de (1974) An outbreak of *Spodoptera litura*, a new pest under glass in Britain. *Plant Pathology* **23**, 117-118.

Brown, E.S.; Dewhurst, C.F. (1975) The genus *Spodoptera* in Africa and the Near East. *Bulletin of Entomological Research* **65**, 221-262.

CABI/EPPO, 1997. Distribution maps of quarantine pests for Europe (edited by Smith, I. M. and Charles, L. M. F.). Wallingford, UK: CAB International, xviii + 768 pp.

CABI/EPPO, 2014. Data Sheets on Quarantine Pests: ***Spodoptera littoralis*** **and** ***Spodoptera litur,*** European and Mediterranean Plant Protection Organization.

CIE (1967a) *Distribution Maps of Pests, Series A* No. 232. CAB International, Wallingford, UK.

CIE, 1967b. Distribution Maps of Pests, Series A No. 61 (revised). Wallingford, UK: CAB International.

EPPO, 2014. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO, 2016. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

EPPO/CABI (1996) *Amauromyza maculosa*, *Liriomyza sativae*, *Liriomyza trifolii*. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Holderness, M.). CAB INTERNATIONAL, Wallingford, UK.

Hachler, M. (1986) [Notes on three pests of subtropical ornamental plants captured in western Switzerland]. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* **59**, 263-266.

Inserra, S.; Calabretta, C. (1985) [Attack by noctuids: a recurring problem in greenhouse crops of the Ragusa coast]. *Tecnica Agricola* **37**, 283-297.

Miller, G.W. (1976) Cold storage as a quarantine treatment to prevent the introduction of *Spodoptera littoralis* into glasshouses in the UK. *Plant Pathology* **25**, 193-196.

Miyahara, Y.; Wakikado, T.; Tanaka, A. (1971) [Seasonal changes in the number and size of the egg-masses of *Prodenia litura*]. *Japanese Journal of Applied Entomology and Zoology* **15**, 139-143.

Nakasuji, F. (1976) Factors responsible for change in the pest status of the tobacco cutworm *Spodoptera litura*. *Physiology and Ecology Japan* **17**, 527-533.

Nakasuji, F.; Matsuzaki, T. (1977) The control threshold density of the tobacco cutworm *Spodoptera litura* on eggplants and sweet peppers in vinylhouse. *Applied Entomology and Zoology* **12**, 184-189.

Navon, A.; Wysoki, M.; Keren, S. (1983) Potency and effect of *Bacillus thuringiensis* preparations against larvae of *Spodoptera littoralis* and *Boarmia* (*Ascotis*) *selenaria*. *Phytoparasitica* **11**, 3-11.

Navon, A.; Yatom, S.; Padova, R.; Ross, I. (1988) [Gamma irradiation of *Spodoptera littoralis* eggs and neonate larvae to eliminate the pest on flowers for export]. *Hassadeh* **68**, 722-724.

Nucifora, A. (1985) [Successive cultivation and systems of integrated control in protected crops of the Mediterranean area]. *Tecnica Agricola* **37**, 223-241.

OEPP/EPPO (1979) Data sheets on quarantine organisms No. 42, *Spodoptera litura*. *Bulletin OEPP/EPPO Bulletin* **9** (2).

OEPP/EPPO (1981) Data sheets on quarantine organisms No. 120, *Spodoptera littoralis*. *Bulletin OEPP/EPPO Bulletin* **11** (1).

OEPP/EPPO (1984) Quarantine procedures No. 16. Combined methyl bromide fumigation and cold storage treatment for chrysanthemum cuttings. *Bulletin OEPP/EPPO Bulletin* **14**, 596, 606.

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

Patel, H.K.; Patel, N.G.; Patel, V.C. (1971) Quantitative estimation of damage to tobacco caused by the leaf-eating caterpillar, *Prodenia litura*. *PANS* **17**, 202-205.

Powell, D.F.; Gostick, K.G. (1971) Control of *Spodoptera littoralis*, *Myzus persicae* and *Tetranychus urticae* by cold storage and fumigation. *Bulletin of Entomological Research* **61**, 235-240.

Salama, H.S.; Dimetry, N.Z.; Salem, S.A. (1970) On the host preference and biology of the cotton leaf worm *Spodoptera littoralis*. *Zeitung für Angewandte Entomologie* **67**, 261-266.

Salama, H.S.; Foda, M.S.; Sharaby, A. (1989) A proposed new biological standard for bioassay of bacterial insecticides versus *Spodoptera* spp. *Tropical Pest Management* **35**, 326-330.

Salama, H.S.; Shoukry, A. (1972) Flight range of the moth of the cotton leaf worm *Spodoptera littoralis*. *Zeitung für Angewandte Entomologie* **71**, 181-184.

Wang, C.L.; Lin, R.T. (1984) [Study on the quarantine treatments of insect pests on chrysanthemum cut flowers application of protection bags and improved dipping methods]. *Journal of Agricultural Research of China* **33**, 325-330.

## 5.3.8. Red spider mite: *Tetranychus evansi*

### 5.3.8.1 Hazard Identification

**Scientific name:** *Tetranychus evansi* Baker & Pritchard, 1960

**Synonyms**: No synonyms recorded, but *Tetranychus takafujii* Ehara & Ohashi, 2002, is suspected to be the same species.

**Common names**: Red tomato spider-mite (English)

Red spider mite

Cassava stem mussel scale;

White mussel scale

**Taxonomic tree**

Domain: Eukaryota
Kingdom: Metazoa
Phylum: Arthropoda
Class: Arachnida
Order: Acarina

Family: Tetranychidae

Genus: *Tetranychus*

Species: *Tetranychus evansi*

**EPPO Code:** TETREV. This pest has been included in EPPO A2 list: No. 349

**Bangladesh status:** Not present in Bangladesh [EPPO, 2016].

### 5.3.8.2 Biology

Arrhenotokous parthenogenesis is the rule for Tetranychid mites. Unfertilised eggs develop into haploid males while diploid females are produced biparentally from fertilized eggs. The sex-ratio is about 70% females.

*Tetranychus evansi* reproduction is continuous throughout the year. No diapause has been observed even in the coldest parts of its distribution area nor for *T. takafujii* in Tokyo Bay (Ohashi *et al.*, 2003). This could limit the distribution to areas with moderately cold winters.

Qureshi *et al.* (1969), Moraes & McMurtry (1987) and Bonato (1999) have studied the life-history of the mite. The theoretical minimal growing temperature varies from 10.3°C to 13.7°C depending on authors and stages. The optimal temperature is 34°C and the maximal 38°C. The duration of development from egg to adult ranges from 46 days at 15°C to 8-13 days at 25°C and 6 days at 35°C. The number of eggs laid by females varies from 80 with extreme low and high temperatures to a range of 120-250, depending on the authors, for optimal temperatures. This mite has one of the highest rates of population increase among *Tetranychus* species (~0.4) which leads to heavily infested plants at the end of a favourable growing season. This phenomenon causes spectacular outbreaks and high mite populations can kill host plants. Dispersal behaviour is associated with outbreaks, in which mites form large aggregates at the top of the infested plants and are blown with the wind.

### 5.3.8.3 Hosts

*T. evansi* is polyphagous. It has been reported on 31 plant families (Spider Mites Web Database, Migeon & Dorkeld, 2007). Major hosts are within the *Solanaceae.*

**Cultivated hosts**

The primary cultivated solanaceous hosts are tomato (*Lycopersicon esculentum*) (Silva, 1954; Migeon, 2007), aubergine (*Solanum melongena*) (Moraes *et al.*, 1987a; Leite *et al.*, 2003), potato (*S. tuberosum*) (Escudero & Ferragut, 2005), tobacco (*Nicotiana tabacum*) (Blair, 1989) and to a lesser degree peppers and chillies (*Capsicum annuum*) (Silva, 1954). Bean (*Phaseolus vulgaris*) is a cultivated non-solanaceous host (Gutierrez & Etienne, 1986).

The EWG regarded the following crops as secondary, or minor, hosts since there are very few records in the literature of *T. evansi* occurring on them, *Abelmoschus esculentus* (Tuttle *et al.* 1977), beetroot (*Beta vulgaris*) (Aucejo *et al.*, 2003), *Phacelia* sp. (Qureshi *et al.* 1969), cotton (*Gossypium hirsutum*) (Wene, 1956), castor bean (*Ricinus communis*) (Ho *et al.* 2004), peanuts (*Arachis hypogea* and *A. prostrata*) (Moutia 1958, Chiavegato & Reis 1969, Feres & Hirose 1986), sweet potato (*Ipomea batatas*) (Moutia, 1958), watermelon (*Citrullus lanatus* (Ferragut, pers. comm. 2007), and *Rosa* spp. (Qureshi *et al.* 1969).

**Weeds**

The preferred host for *T. evansi* is the widespread weed *Solanum nigrum* (Migeon, 2007). Other weed hosts include *Amaranthus blitoides*, *Chenopodium* spp. (El Jaouani, 1988), *Convolvulus arvensis*, *Conyza* spp., *Diplotaxis erucoides*, *Hordeum murinum, Lavatera trimestris*, *Sonchus* spp. (Ferragut & Escudero, 1999; Aucejo, Foo, Gimeno, *et al.*, 2003).

INRA Spider Mites Web database (Migeon & Dorkeld, 2007) provides a more extensive lists of hosts / plants on which *T. evansi* has been recorded.

#### 5.3.8.4 Geographical distribution

*T. evansi* is suspected to originate from South America. It has been unintentionally introduced to other parts of the world.
Because the pest can easily be confused with other *Tetranychus* species, there is uncertainty on the pest distribution, e.g. it could be present on crops but considered to be another *Tetranychus* species, or present but disregarded on non-crop plants. The geographic distribution of *T. evansi* is given below:

**EPPO region**: France (Pyrénées-Orientales, Alpes Maritimes, Var), Greece (EPPO, 2007), Israel (EPPO, 2006a), Italy (Liguria, EPPO 2006b), Jordan (Palevsky, pers. comm. 2007), Portugal (from Algarve to Lisbon including Madeira), Spain (Canary Islands, Baleares Islands, along the Mediterranean coast, Atlantic coast of Andalusia).

**Asia**: Israel (EPPO, 2006), Jordan (Palevsky, pers. comm. 2007), Taiwan (including Kinmen and Lienchang Islands). If *T. takafujii* is shown to be a synonym of *T. evansi*, then the pest would also be known to occur in Japan (EPPO, 2006).

**Africa:** Democratic Republic of Congo, Congo, Gambia, Kenya, Malawi, Mauritius (including Rodrigues island), Morocco, Mozambique, Namibia, Niger (pers. comm. Migeon, 2007), Reunion Island, Senegal, Seychelles, Somalia, South Africa, Tunisia, Zambia, Zimbabwe. Detections of *T. evansi* on consignments of plant products from Gambia, suggest that *T. evansi* may also be present in Gambia (MacLeod, pers. comm. 2007).

**North America:** USA (Arizona, California, Florida, Texas, Hawaii).

**Central America and Caribbean**: Puerto Rico, Virgin Islands

**South America**: Brazil, Argentina

**Oceania:** Hawaii (USA).

#### 5.3.8.5 Hazard Identification Conclusion

Considering the facts that *T. evansi*

- is not known to be present in Bangladesh [EPPO, 2006].
- is potentially economic important to Bangladesh because it is an important pest of Solanaceous crops in Asia including Japan, Taiwan (EPPO, 2006) from where vegetable seeds especially brinjal seeds and nursery stocks are imported to Bangladesh.
- Local movement is mainly linked to wind currents. In international trade, *T. evansi* may be carried on Solanaceous plants for planting (except tubers and seeds) and this is the hypothesis used to explain the introduction of the pest e.g. in Africa. The mites are less likely to infest fruits, these only present a risk where peduncles are present (aubergines, vine tomatoes, fresh beans, and to a lesser degree, chillies and peppers).
- *T. evansi* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

**5.3.8.6 Determine likelihood of pest establishing in tour country via this pathway**

**Table 8.1** – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **a. Has this pest been established in several new countries in recent years,-Yes,**<br>• *T. evansi* is suspected to originate from South America. It has been unintentionally introduced to other parts of the world. However, this pest is widely distributed in many Asian countries including Japan, Taiwan (CABI, 2015).<br>• *T. evansi* is a tropical species of New World origin. There is no mention in the literature of the history of its spread, but it has undoubtedly reached countries outside the New World as a result of human transport of infested planting materials.<br>**b. Posibility of survival during transport, storage and transfer?—Yes**<br>• The mites are less likely to infest fruits, these only present a risk where peduncles are present (cucurbits, aubergines, vine, tomatoes, fresh beans, and to a lesser degree, chillies and peppers).<br>• The duration of development from egg to adult ranges from 46 days at 15°C to 8-13 days at 25°C and 6 days at 35°C. Within this period the eggs and mites can easily survive on fruit surfaces of cucurbits. Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with High risk potential.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Internationally, *T. evansi* is liable to be carried on any plants for planting materials such as seeds, nursery stocks of brinjal, which are the main means of dispersal of this pest [EPPO, 2006].<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• The preferred host (*S. nigrum*) and at least three major cultivated hosts (aubergines, tomatoes and potatoes) and rose are widely distributed in many Asian countries including Japan, China, Thailand, India (CABI, 2015), among of these are common in **Bangladesh**.<br>• *T. evansi* is a warmth-loving pest. A study by Bonato (1999) showed that the optimal temperature for population growth is 34°C. The shortest developmental time (6.3 days) occurs at 36°C. At 25°C, the life cycle is completed in 13.5 days.<br>• These climatic requirements for growth and development of *T. evansi* are more or less similar with the climatic condition during summer season of **Bangladesh**. | **YES and HIGH** |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and | Low |

| | |
|---|---|
| • Its host(s) are not common in your country and your climate is not similar to places it is established | |

### 5.3.8.7 Determine the <u>Consequence</u> establishment of this pest in Bangladesh

**Table 8.2** – Which of these descriptions best fit of this pest?

| Description | Consequence potential is: |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• If infested plants for planting are introduced in protected cultivation where no plant protection products are used, *T. evansi* has the potential to cause economic damage although we do not know about the susceptibility of cultivars used.<br>• In African countries where *T. evansi* is established, it has been reported as a serious pest in particular of tomato. Of the thirteen known spider mite species on Reunion, *T. evansi* is one of the most destructive pests on crops (Gutierrez & Etienne, 1986). In Southern Africa *T. evansi* is considered as the most important dry season acarine pest of tomatoes (Fiaboe, 2007). Severe damage is also recorded on aubergine (Migeon, pers. comm. 2007). Infested tomato plants turn yellow, green then brown. Plants generally show a bleached yellow-orange or russeted appearance. Infested plants may be killed very rapidly (Jeppson *et al.*, 1975). In Zimbabwe, up to 90% yield losses have been recorded from field trials. However, it should be noted that with improved use of plant protection products, the damage on crops could be significantly reduced (Knapp *et al* 2003).<br>• This is a fairly serious pest of several important field crops for Bangladesh.<br>**b. Economic Impact and Yield Loss**<br>• *Tetranychus evansi* is regarded as an important pest of tomato and other solanaceous crops. In East and South Africa it has been considered the most important dry season pest of tomatoes (Knapp, 2002) since it was first recorded in 1979 and yield losses are noted. In Western Africa, it damages tomatoes and aubergines (Duverney & Ngueye-Ndiaye, 2005).<br>• *Tetranychus evansi* is one of four species of red spider mites causing damage in vegetable crops in eastern Spain (Escudero and Ferragut, 2005), although there is no specific data on economic impact caused by *T. evansi* alone (Ferragut, pers. com. 2007). In Spain, damage has only been recorded in outdoor crops such as aubergine, potato and tomato (Ferragut, pers com. 2007) the same situation occurs in Israel on aubergine and potato.<br>• The most severe damage in Israel occurs on aubergine (Palevsky pers. com. 2007). Few outbreaks are recorded under protected conditions, even in areas where the pest is present outdoors on weeds.<br>• An outbreak in organic farming production unit was detected in southern France on tomato in protected cultivation in October 2007 (Migeon, pers. com. 2007). This illustrates the potential of the pest to cause damage in protected organic farming cultivation.<br>**c. Environmental Impact**<br>• Acaricides are commonly used against *T. evansi* and other spider mites on Solanaceous crops. Mite populations have developed resistance, in | **Yes and High** |

| | |
|---|---|
| particular in Zimbabwe during the 1980s but current use of non organo-phosphorous acaricides is effective at controlling populations although it does not allow integrated crop protection or organic production.<br>• The pesticide resistance invariably leads to an increase in the use of insecticides as whitefly control becomes increasingly more difficult. This in turn can produce an ever increasing spiral in the levels of insecticide resistance and insecticide use, having a direct impact on the environment. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.8.8 Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

**Table 8.3** – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.8.9 Risk Management Measures

**a. Measures related to consignments:**

- **Visual inspection:** Visual detection of mites is possible but confusion with other mites (such as *T. urticae (syn. cinnabarinus), T. turkestani, T. ludeni, T. neocaledonicus, T. lombardini)* is possible. Mites and eggs in low numbers would be difficult to detect.
- **Treatment of the consignment:** Chemical treatments (combining treatments targeting adults and eggs) may be recommended, but their efficacy has to be verified by inspection.

**b. Measures related to the crop or to places of production**

- Pest Free Area for *T. evansi*
- Pest Free Place of Production:
  (i) Mites are expected to spread more than five kilometres.
  (ii) Having a five km buffer zone free from host plants is not a realistic option but a place of production freedom should consist in:
    - Isolation: no other host plants in the immediate vicinity of the place of production (minimum 5 m recommended by Clark, 2001)
    - Hygienic measures to prevent the pest to enter the greenhouse.

- Treatment of the crop during the production (the active ingredients which have resulted in more than 90% of mortality in adult females are: hexythiazox, propargite, dicofol, acrinatrin, fenbutatin oxide, dicofol+hexythiazox, fenpyroximate and dicofol.)
- Two inspections of the consignment prior to export

**c. Other possible measures**

- Surveillance in the importing country was not considered as a possible measure.

### 5.3.8.10 References


Aucejo S, Foo M, Gimeno E, Gomez-Cadenas A, Monfort R, Obiol F, Prades E, Ramis M, Ripolles JL, Tirado V, Zaragoza L, Jacas J A & Martinez-Ferrer MT (2003). Management of Tetranychus urticae in citrus in Spain: acarofauna associated to weeds. *Bulletin OILB/SROP*, **26 (6)**: 213-220.

Blair B W (1989). Laboratory screening of acaricides against Tetranychus evansi Baker & Pritchard. *Crop Protection*, **8 (3):** 212-216.

Bonato O (1999). The effect of temperature on life history parameters of Tetranychus evansi (Acari: Tetranychidae). *Experimental & Applied Acarology*, **23 (1):** 11-19.

Bonato, O. (1999). The effect of temperature on life history parameters of *Tetranychus evansi* (Acari: Tetranychidae). *Experimental & Applied Acarology* **23**(1): 11-19.

Chiavegato LG & Reis PR (1969). Presence Tetranychus evansi Baker and Pritchard, 1960 (Acarina, Tetranychidae) in peanuts (Arachis hypogea L.) in Saõ Paulo state. *Ciencia e Cultura,* **21** (2): 372.

Clark J (2001). Illustrating the value of weed clearance around polyhouses. In, Medhurst, A. (ed.), Western Flower Thrips Newsletter No. 24, December 2001 (National Strategy [in Australia] for the management of Western Flower Thrips and Tomato Spotted Wilt Virus), pp. 20-21.

El-Jaouani N (1988). *Contribution à la connaissance des acariens phytophages au Maroc et étude bio-écologique de Tetranychus evansi Baker et Pritchard (Acarina: Tetranychidae)*. Rabat, Maroc, Institut Agronomique et Vétérinaire Hassan II: 60.

EPPO (2004). Introduction of *Tetranychus evansi* in some Mediterranean countries: Addition to the EPPO Alert List. *EPPO Reporting Service 2004* (5), 80.

EPPO (2006a). *Tetranychus evansi* is present in Israel. *EPPO Reporting Service 2006* (1), 005.

EPPO (2006b). First report of *T. evansi* in Italy. *EPPO Reporting Service 2006* (9), 185.

EPPO (2007). First report of *Tetranychus evansi* in Crete, Greece. *EPPO Reporting Service 2007* (3), 049.

EPPO (2016). Report of a Pest Risk Analysis for *Tetranychus evansi.* European and Mediterranean Plant Protection Organization. *https://www.eppo.int/QUARANTINE/Alert.../Tetranychus_evansi.doc*

Escudero LA & Ferragut F (2005). Life-history of predatory mites *Neoseiulus californicus* and *Phytoseiulus persimilis* (Acari: Phytoseiidae) on four spider mite species as prey, with special reference to *Tetranychus evansi* (Acari: Tetranychidae). *Biological Control*, **32 (3):** 378-384.

Feres RJF & Hirose M (1986). Presence of *Tetranychus evansi* Baker & Pritchard (Acari, Tetranychidae) sobre Arachis prostrata Benth (Fabaceae) no campus da UNESP de São José do Rio Preto, Estado de São Paulo. Resumos do 13° Coloquio de Incentivo à Pesquisa, IBILCE, UNESP, Pesquisa: 42.

Ferragut F & Escudero LA (1999). *Tetranychus* evansi Baker & Pritchard (Acari, Tetranychidae), a new red spider mite in Spanish horticultural production. *Boletin de Sanidad Vegetal, Plagas,* 25 (2): 157-164 (In Spanish).

Fiaboe KKM, Gondim MGC Jr., Moraes GJ, de Ogol CKPO & Knapp M (2007). Surveys for natural enemies of the tomato red spider mite *Tetranychus evansi* (Acari: Tetranychidae) in northeastern and southeastern Brazil. Zootaxa, **1395:** 33-58.

Gillet JL, HansPetersen HN, Leppla NC & Thomas DD (2006) Grower's IPM guide for Florida Tomato and Pepper Production http://ipm.ifas.ufl.edu/resources/success_stories/T&PGuide/index.shtml [last accessed 2008-01-28]

Gutierrez J & Etienne J (1986). Les Tetranychidae de l'île de la Réunion et quelques-uns de leurs prédateurs. *Agronomie Tropicale,* **41 (1)**: 84-91.

Ho CC, Wang SC & Chien YL (2004). *Field* observation on 2 newly recorded spider mites in Taiwan. *Plant Protection Bulletin*, **47:** 391-402.

Jeppson LR, Keifer HH, Baker EW (1975) In: Mites injurious to economic plants, pp. 223-224. Bishen Singh Mahendra Pal Singh India (in arrangement with University of California Press, Berkeley, Etats-Unis).

Knapp M, Wagener B & Navajas M (2003). Molecular discrimination between the spider mite Tetranychus evansi Baker & Pritchard, an important pest of tomatoes in southern Africa, and the closely related species T. urticae Koch (Acarina: Tetranychidae). *African Entomology*, **11 (2):** 300-304.

Krainacker DA & Carey JR (1990). Ambulatory dispersal and life history response to food deprivation in twospotted spider mites. *Entomologia Experimentalis et Applicata* **56(2):** 139-144.

Leite GLD, Picanco M, Zanuncio J C & Marquini F (2003). Factors affecting mite herbivory on eggplants in Brazil. *Experimental and Applied Acarology*, **31 (3/4)**: 243-252.

Migeon A (2005). Un nouvel acarien ravageur en France: *Tetranychus evansi* Baker et Pritchard. *Phytoma - La Défense des Végétaux*, **579**: 38-43

Migeon A (2007). Acarien rouge de la tomate: nouvelles observations et perspectives. *PHM Revue Horticole*, **488**: 20-24.

Migeon, A. & F. Dorkeld (2007) Spider mites web. http://www.montpellier.inra.fr/CBGP/spmweb.

Moraes GJ de, McMurtry JA 1987a. Effect of temperature and sperm supply on the reproductive potential of *Tetranychus evansi* Acari Tetranychidae. *Experimental and Applied Acarology* **3** (2), 95-108.

Moraes, G J de & Lima HC (1983) Biology of *Euseius concordis* (Chant) (Acarina: Phytoseiidae) a predator of the tomato russet mite. *Acarologia*, 24 (3): 251-255

Moraes, G. J. d. and J. A. McMurtry (1987). Effect of temperature and sperm supply on the reproductive potential of *Tetranychus evansi* (Acari: Tetranychidae). *Experimental & Applied Acarology* **3**(2): 95-107.

Moutia LA (1958). *Contribution to* the study of some phytophagous Acarina and their predators in Mauritius. *Bulletin of Entomological Research,* **49**: 59-75.

Oatman, E. R., C. A. Fleschner and J. A. McMurtry (1967). New, highly destructive spider mite present in Southern California. *Journal of Economic Entomology* **60**(2): 477-480.

Ohashi, K, Y. Kotsubo and A. Takafuji (2003). Distribution and overwintering ecology of *Tetranychus takafujii* (Acari: Tetranychidae), a species found from Kinki district, Japan. *Journal of the Acarological Society of Japan* **12**(2): 107-113.

Qureshi SA, Oatman ER & Fleschner CA (1969). Biology of the spider mite, *Tetranychus evansi*. Annals *of the Entomological Society of America*, **62 (4):** 898-903.

Qureshi, S. A., E. R. Oatman and C. A. Fleschner (1969). Biology of the spider mite, *Tetranychus evansi*. *Annals of the Entomological Society of America* **62**(4): 898-903.

Silva P (1954). A new acari harmful to tomato in Bahia. *Boletim do Instituto Biologica da Bahia*, **1 (1):** 1-20.

Tuttle D M, Baker EW & Sales F M (1977) Spider mites (Tetranychidae: Acarina) of the state of Ceara, Brazil*. International Journal of Acarology*, **3 (1):** 1-8.

Wene GP (1956). *Tetranychus marianae* McG., a new pest of tomatoes. *Journal of Economic Entomology*, **49 (5):** 712.\

Yaninek JS (1988) Continental dispersal of the cassava green mite, an exotic pest in Africa, and implications for biological control. *Experimental and Applied Acarology* **4:** 211-224.

## 5.3.9. Phytophthora root rot: *Phytophthora megasperma*

### 5.3.9.1 Hazard Identification

**Scientific Name:** *Phytophthora megasperma* Drechsler

**Synonyms**: *Phytophthora fragariae* var. *fragariae*
*Phytophthora fragariae* var. *rubi*

**Common names**: Phytophthora root rot
Red core disease
Red stele disease

**Taxonomic tree**

Domain: Eukaryota

Phylum: Heterokontophyta

Class: Oomycetes

Order: Pythiales

Family: Pythiaceae

Genus: *Phytophthora*

Species: *Phytophthora megasperma*

EPPO Code: PHYTDR

**Bangladesh status:** Not present in Bangladesh [CABI, 2006]

### 5.3.9.2 Biology

The fungus survives in crop debris in the soil, principally as oospores. Oospores germinate and form sporangia especially in spring. The temperature optima for oospore germination and production, determined in laboratory experiments, are 27°C and 18-23°C, respectively (Schechter & Gray, 1987). After flooding or heavy rainfall, sporangia release zoospores. Zoospores, moving in soil water on crop residues, are attracted by host roots, encyst, germinate and penetrate the roots without forming an appressorium (Odermatt et al., 1988).

Lateral roots are destroyed and the whole plant may be killed at the seedling stage. Older plants are attacked more slowly, the fungus spreading gradually from the taproot up the

stem to the lower branches. Leaves may be infected directly from soil splashed onto their surface. Pods and seeds are not normally infected, although the fungus has been reported from seeds.

The disease is favoured by high soil moisture and rainfall, and is most severe on heavy soils. Tightly compacted soil also increases the incidence of *P. megasperma* f.sp. *glycines* (Moots et al., 1988). Most root damage occurs under cool conditions (15°C). Under warm, dry conditions, plants recover by replacing the lateral roots destroyed by the fungus.

#### 5.3.9.3 Hosts

*Phytophthora megasperma* has been recorded to attack multiple species in multiple families including: **Solanaceae** (tomato, potato, eggplant), **Brassicaceae** (cabbage, cauliflower), **Liliaceae** (asparagus), **Apiaceae** (carrot), **Rutaceae** (lemon, grape fruit), **Asteraceae** (sunflower), **Poaceae** (rice, sugar cane), **Sterculiaceae** (cacao), **Cucurbitaceae** (cucumber), **Caryophyllaceae** (carnation, *Dianthus caryophyllus*), **Lauraceae** (avocado) Malvaceae (hollyhock, *Alcea rosea*), **Rosaceae** (apple, apricot, cherry, plum, peach, strawberry and rose) (CABI, 2006).

#### 5.3.9.4 Distribution

*Phytophthora megasperma* is found in Australia, New Zealand, United States, France, Greece, Ireland, Italy, Spain, United Kingdom, Scotland.

**Asia:** *P. megasperma* widespread in Japan, Philippines. (http://zipcodezoo.com/Chromista/P/Phytophthora_medicaginis.asp, (CABI, 2006).

#### 5.3.9.5 Hazard Identification Conclusion

Considering the facts that *Phytophthora megasperma* -

- is not known to be present in Bangladesh.
- is potentially economic important to Bangladesh because it is an important pest of vegetables like tomato, potato, eggplant etc in Asia including Japan from where planting materials iike seeds, nursery stocks and others are imported to Bangladesh.
- There is no evidence that *Phytophthora megasperma* is seed borne (Richardson, 1979). It can be introduced in diseased nursery stock, so nursery hygiene is essential. Zoospores can be passively spread long distances in irrigation water, or in drainage ditches (Ribeiro and Linderman, 1991).
- *Phytophthora megasperma* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

#### 5.3.9.6 Determine likelihood of pest establishing in tour country via this pathway.

Table 13.1. – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **a. This pest has established in several new countries in recent years?— Yes**<br>• This disease is widely established in Japan and Philippines. *P. megasperma* f.sp. glycines was formerly considered to be an A1 quarantine pest for EPPO (OEPP/EPPO, 1989), but was transferred to the EPPO A2 list in 1992 due to its recent appearance within the EPPO region. | YES and HIGH |

There is every reason to suppose that it could establish itself widely and cause losses in the Euro-Mediterranean region.

**b. Posibility of survival during transport, storage and transfer of this pest? Yes**

- The fungus survives in crop debris in the soil, principally as oospores (Schechter & Gray, 1987). After flooding or heavy rainfall, sporangia release zoospores. Zoospores, moving in soil water on crop residues, are attracted by host roots, encyst, germinate and penetrate the roots without forming an appressorium (Odermatt et al., 1988).
- Lateral roots are destroyed and the whole plant may be killed at the seedling stage. Older plants are attacked more slowly, the fungus spreading gradually from the taproot up the stem to the lower branches. Leaves may be infected directly from soil splashed onto their surface. Fruits and seeds are not normally infected, although the fungus has been reported from seeds (Moots et al., 1988). Most root damage occurs under cool conditions (15°C). Therefore, the oospores can also survive during transportation of plants or seeds.

**c. Does the pathway appear good for this pest to enter Bangladesh and establish? Yes**

- The natural spread of the pathogen is very slow and over extremely short distances. The main path of distribution is by means of infected cuttings which may be obtained from infected but symptomless mother plants.
- By itself, the fungus has low dispersal potential. It is liable to be moved as oospores in debris accompanying seeds, or possibly in seeds. Bangladesh imports vegetable seeds from many exporting countries including Japan. Therefore, seed transmission appears to be of high significance in Bangladesh; it may be supposed that the risk is virtually high with low-quality seed.

d. **Are the host(s) of this pest fairly common in Bangladesh and the climate is similar to places it established? – Yes**

- *Phytophthora megasperma* has been recorded to attack multiple species in multiple families including: Solanaceae (tomato, potato, eggplant), Brassicaceae (cabbage, cauliflower), Liliaceae (asparagus), Apiaceae (carrot), Rutaceae (lemon, grape fruit), Asteraceae (sunflower), Poaceae (rice, sugar cane), Sterculiaceae (cacao), Cucurbitaceae (cucumber), Caryophyllaceae (carnation, *Dianthus caryophyllus*), Lauraceae (avocado) Malvaceae (hollyhock, *Alcea rosea*), Rosaceae (apple, apricot, cherry, plum, peach, strawberry and rose) (CABI, 2006). Many of these hosts are fairly common in Bangladesh.
- The fungus survives in crop debris in the soil, principally as oospores. Oospores germinate and form sporangia especially in spring. The temperature optima for oospore germination and production, determined in laboratory experiments, are 27°C and 18-23°C, respectively (Schechter & Gray, 1987). After flooding or heavy rainfall, sporangia release zoospores. Zoospores, moving in soil water on crop residues, are attracted by host roots, encyst, germinate and penetrate the roots without forming an appressorium (Odermatt et al., 1988).
- These climatic requirements for proper growth and development of this fungus also more or less similar with the climatic conditions of Bangladesh.

| | |
|---|---|
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

### 5.3.9.7 Determine the Consequence establishment of this pest in Bangladesh

**Table 9.2** – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• This is a serious pest of **Bangladesh**. In the USA, *P. megasperma* f.sp. *glycines* causes severe losses of soyabean plants (Schmitthenner, 1989). Yield losses may reach 50% in susceptible cultivars. The disease can be avoided by planting in well drained fertile soils under warm conditions. Oospores survive for long periods in the soil, so sites where the disease has occurred should preferably be avoided.<br>• This is a fairly serious pest of several important flower and other crops for Bangladesh.<br>**b. Economic impact and yield loss**<br>• Generally, *Phytophthora megasperma* is one of the less aggressive species of Phytophthora, and causes debilitation rather than substantial plant death (CABI, 2006).<br>**c. Environment Impact**<br>• Soil water management techniques, particularly those that minimize prolonged periods of flooding (Wilcox and Mircetich, 1985b), are regarded as one of the most effective ways of managing all diseases caused by *P. megasperma*.<br>• The Oomycete-active fungicides have the capacity to slow disease development, but they will not eradicate *P. megasperma* from the soil. | **Yes and High** |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.9.8 Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

**Table 9.3 – Calculating risk rating**

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |

| | | |
|---|---|---|
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

Calculated Risk Rating **– High**

#### 5.3.9.9 Phytosanitary Measures

- Only good-quality clean seed should be imported (OEPP/EPPO, 1990).
- Normal precautions taken against truly seed borne pathogens of soyabeans should be more than adequate to protect against the low risk of introduction with soil.

#### 5.3.9.10 References


CABI (2006). Crop Protection Compendium, 2006 Edition. CAB International, Wallingford, UK.

EPPO/CABI (1992) *Phytophthora megasperma* f.sp. *glycinea*. In: Quarantine pests for Europe (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Harris, K.M.). CAB International, Wallingford, UK.



EPPO/CABI (1992) *Phytophthora megasperma* f.sp. *glycinea*. In: Quarantine pests for Europe (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Harris, K.M.). CAB International, Wallingford, UK.



Moots, C.K.; Nickell, C.D.; Gray, L.E. (1988) Effects of soil compaction on the incidence of *Phytophthora megasperma* f.sp. *glycinea* in soybean. Plant Disease 72, 896-900.

Odermatt, M.; Rothlisberger, A.; Werner, C.; Hohl, H.R. (1988) Interactions between agarose-embedded plant protoplasts and germ tubes of Phytophthora. Physiological and Molecular Plant Pathology 33, 209-220.

OEPP/EPPO (1989) Data sheets on quarantine organisms No. 169, *Phialophora gregata*. Bulletin OEPP/EPPO Bulletin 19, 699-702.

OEPP/EPPO (1990) Specific quarantine requirements. EPPO Technical Document No. 1008.

Schechter, S.E.; Gray, L.E. (1987) Oospore germination in *Phytophthora megasperma* f.sp. *glycinea*. Canadian Journal of Botany 65, 1465-1467.


## 5.3.10. Golden cyst nematode: *Globodera rostochiensis*

#### 5.3.10.1. Hazard Identification

**Scientific name:** ***Globodera rostochiensis***

**Synonyms**: *Heterodera rostochiensis* Wollenweber

**Common names**: Yellow potato cyst nematode,
Golden potato cyst nematode,
Golden nematode

**Taxonomic tree**

Kingdom: Animalia
Phylum: Nematoda
Class: Secernentea

Order: Tytenchida

Family: Heteroderiidae

Genus: *Globodera*

Species: *Globodera rostochiensis*

**EPPO Code:** HETDRO. This pest has been included in EPPO A2 list: No. 125

**Bangladesh status:** Not present in Bangladesh EPPO, 1997; CABI, 2007 []

### 5.3.10.2 Biology

Second-stage juveniles hatch, under stimulus from host root exudates, from eggs within cysts in the soil, and invade the roots. Each individual nematode feeds on a group of cells in the pericycle, cortex or endodermis, transforming them into a syncytium or transfer cell. The nematode remains here for the rest of its development, as it passes through two more juvenile stages to become either male or female. Females swell and break through the root surface but remain attached. They are fertilized by the vermiform, actively moving males. After copulation the males die and the females remain on the roots while eggs develop within them. Females are white when they protrude from the root surface but those of *G. rostochiensis* later pass through a golden yellow phase lasting 4-6 weeks. When the females are fully mature they die and their skin hardens and turns brown to become a protective cover (the cyst) around the eggs within. There are, on average, 500 eggs per cyst. At this point they generally drop from the surface of the root into the soil, where the eggs can either hatch immediately to attack the crop or remain dormant to act as a source of inoculum for future crops. Cysts can remain infective for many years in the absence of solanaceous hosts (Stelter, 1971; Stone, 1973b; Jones & Jones, 1974).

### 5.3.10.3 Hosts

Potatoes are by far the most important host crop. Tomatoes and aubergines are also attacked. Other *Solanum* spp. and their hybrids can also act as hosts.

The species of *Globodera* have several different pathotypes (Kort, 1974). The pathotypes are characterized by their ability to multiply on certain tuberous *Solanum* clones and hybrids used in breeding. Five pathotypes are recognized within *G. rostochiensis* (Ro1-Ro5 international notation).

### 5.3.10.4 Geographical distribution

The centre of origin of the two species is in the Andes Mountains in South America from where they were introduced to Europe with potatoes, probably in the mid-19th century. From there, they were spread with seed potatoes to other areas. The present distribution covers temperate zones down to sea level and in the tropics at higher altitudes. In these areas, distribution is linked with that of the potato crop.

- ***Globodera rostochiensis***

**EPPO region**: Albania, Algeria, Austria, Belarus, Belgium, Bulgaria, Czech Republic, Cyprus, Denmark, Egypt, Estonia, Faroe Islands, Finland, France, Germany, Greece (including Crete), Hungary (one locality only), Iceland, Ireland, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Malta, Morocco, Netherlands, Norway, Poland, Portugal (including Madeira; unconfirmed in Azores), Spain (including Canary Islands), Russia (Central Russia, Eastern Siberia, Far East, Northern Russia, Southern Russia, Western Siberia), Slovakia, Sweden, Switzerland, Tunisia, UK (England, Channel Islands), Ukraine, Yugoslavia (unconfirmed). Found in Israel on only two occasions in 1954 and 1965 in a small area in the Sharon region, and was successfully eradicated.

**Asia**: Cyprus, India (Kerala, Tamil Nadu), Japan (Hokkaido), Lebanon, Pakistan, Philippines, Sri Lanka, Tajikistan, Russia (Eastern Siberia, Far East, Western Siberia).

**Africa**: Algeria, Egypt, Libya, Morocco (intercepted only), Sierra Leone, South Africa, Tunisia.

**North America**: Canada (Newfoundland, British Columbia Vancouver Island only), Mexico, USA (New York; eradicated in Delaware).

**Central America and Caribbean**: Costa Rica, Panama.

**South America**: Throughout the high Andean region: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Venezuela. More southerly in range than *G. pallida*.

**Oceania**: Australia (two outbreaks, one in Western Australia in 1986, the other in Victoria in 1991; both are subject to official eradication programmes), New Zealand, Norfolk Island.

**EU**: Present.

#### 5.3.10.5 Hazard Identification Conclusion

Considering the facts that *G. rostochiensis*

- is not known to be present in Bangladesh [EPPO, 1997; CABI, 2007].
- is potentially economic important to Bangladesh because these are the important pest of tomatoes, brinjal and potatoes in Asia including India, Japan, Pakistan, Sri Lanka (EPPO, 2006) from where both vegetables and planting materials such as seeds, nursery stocks and others above mentioned agricultural crops are imported to Bangladesh.
- This nematode has no natural means of dispersal, and can only move the short distances travelled by juveniles attracted towards roots in the soil. They are spread into new areas as cysts on, in order of importance, seed potatoes, nursery stock, soil, flower bulbs, potatoes for consumption or processing. The last named are only important if there is a risk of their being planted or if care is not taken with disposal of waste soil.
- *G. rostochiensis* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

#### 5.3.10.6 Determine likelihood of pest establishing in tour country via this pathway

**Table 10.1.** – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **a. Has this pest been established in several new countries in recent years?-Yes,**<br>• Golden cyst nematode is A2 quarantine pests for EPPO (OEPP/EPPO, 1978; 1981). It has also have quarantine significance for APPPC and NAPPO. In addition, *G. rostochiensis* is a quarantine pest for CPPC and IAPSC.<br>• The nematodes are already established in most or all areas in the EPPO region that are important for the cultivation of potatoes for consumption or the production of starch; therefore, regular attention to control is needed in such areas. Where domestic legislative measures are in force, import regulations are justified to ensure comparable standards for imported material. It is essential that areas of seed potato production be kept as free as possible from these nematodes.<br>**b. Posibility of survival during transport, storage and transfer? Yes**<br>• In general, the cyst nematodes can survive in any environment where | **YES and HIGH** |

| | |
|---|---|
| potatoes can be grown. A period of 38-48 days (depending on soil temperature) is required for a complete life cycle of the potato cyst nematodes (Chitwood and Buhrer, 1945).<br>• Cyst nematode eggs can remain dormant and viable within the cyst for 30 years (Winslow and Willis, 1972). After mating, each female produces approximately 500 eggs (Stone, 1973b). Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Internationally, *G. rostochiensis* is liable to be carried on tomatoes, brinjal and potatoes for planting, which are the main means of dispersal of this pest [EPPO, 2006].<br>• Golden cyst nematode eggs can remain dormant and viable within the cyst for 30 years (Winslow and Willis, 1972). After mating, each female produces approximately 500 eggs (Stone, 1973b).<br>**c. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• The preferred tomatoes, potatoes and aubergines are three major cultivated hosts (aubergines, tomatoes and potatoes) widely distributed in many Asian countries including Japan, China, Thailand, India (CABI, 2015), and these crops are also common in **Bangladesh**.<br>• The optimum temperature for the hatch of *G. rostochiensis* is about 15°C (Evans, 1968).<br>• These climatic requirements for growth and development of *G. rostochiensis* are more or less similar with the climatic condition during summer season of **Bangladesh**. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

**5.3.10.7 Determine the Consequence establishment of this pest in Bangladesh**

**Table 10.2.**– Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• Golden cyst nematodes are major pests of the potato crop in cool-temperate areas. This is particularly the case when, because of the pathotypes present, no resistant cultivars are available for planting. This situation is, at present, more serious in the case of *G. rostochiensis* because of the lack of commercially available potato cultivars having resistance to this species.<br>• The amount of damage, particularly in relation to the weight of tubers produced, is closely related to the number of nematode eggs per unit of | **Yes and High** |

| | |
|---|---|
| soil. It has been estimated that approximately 2 t/ha of potatoes are lost for every 20 eggs/g soil (Brown, 1969). Up to 80% of the crop can be lost when nematode populations are raised to very high levels by repeated cultivation of potatoes.<br>• This is a fairly serious pest of several important other crops rather than flowers for Bangladesh.<br>**b. Economic impact and yield loss**<br>• Crop losses induced by the golden nematode range 20-70% (Greco, 1988). It has been estimated that approximately 2 t/ha of potatoes are lost for every 20 eggs/g soil (Brown, 1969). Up to 80% of the crop can be lost when nematode populations are raised to very high levels by repeated cultivation of potatoes.<br>• In Chile, yield losses of 20, 50 and 90% were obtained with population densities of 9, 28 and 128 eggs/g soil (Moreno *et al.*, 1984; Greco and Moreno, 1992). Rhizoctonia and other fungal diseases associated with nematode feeding may also contribute to the yield loss. In Canada, *Globodera rostochiensis* was found in Newfoundland in 1962 and 800,000$Can /year has been spent on control and research of golden cyst nematode (Miller, 1986).<br>• Besides that, affected plants suffer tubers are smaller (CABI, 2006). This means it effects on quality of potato tubers as well as seed potatoes. Control on golden cyst nematode*, Globodera rostochiensis* is major by soil fumigants but fumigant nematicides are toxic and expensive (Mazin, 1991).<br>• Moreover, golden cyst nematode (*Globodera rostochiensis*) is quarantine pest for EPPO, APPPC, NAPPO (OEPP/EPPO, 1978; 1981). Therefore, the presence of the potato cyst nematodes in potato growing areas prevents the export of potatoes to international markets due to the restrictions imposed by many countries against this pest.<br>• Based on these Economic Impacts, the Potato cyst nematodes could become established in Bangladesh with **High Risk** potential.<br>**c. Environmental Impact**<br>• Introduction of *Globodera rostochiensis* into Bangladesh is likely to initiate chemical, because it is a serious pest of economically important crops.<br>• The fumigation to control this nematode may also harm to the beneficial organisms available to the soils.<br>• This species has the potential to attack plants (Solanum) that are main crop in Bangladesh. As a large chemical will be used for it's controlling. Therefore, it can impacts on ecological system. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.10.8 Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

**Table 10.3.** – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.10.9 Risk Management Measures

- Measures to prevent the introduction of the nematodes to areas where they are not already established include soil sampling surveys and regulations concerning movement of brinjal seeds, nursery stock, flower bulbs and soil. These apply nationally as well as internationally (CEC, 1969).
- Consignments of potato tubers, rooted plants and bulbs from countries where the nematodes occur may be examined to check amounts of adhering soil, if any, or to take samples of soil for laboratory examination.
- Additional safeguards during transit of consignments could be washing of tubers and flower bulbs to remove soil, although it should be noted that cysts can remain embedded in tubers, especially in the eyes. Alternatively, tubers may be dipped in dilute sodium hypochlorite solution (Wood & Foot, 1975).
- The EPPO specific quarantine requirements (OEPP/EPPO, 1990) for these nematodes require that the field in which seed potatoes or rooted plants being imported were grown was inspected by taking soil samples according to an EPPO-recommended method (OEPP/EPPO, 1991) and found free from viable cysts of both species. The sampling must have been performed after harvest and after removal of the previous potato crop.

### 5.3.10.10 References


Behrens, E. (1975) [*Globodera* Skarbilovich, 1959 an independent genus in the subfamily Heteroderinae Skarbilovich, 1949 (Nematoda: Heteroderidae)]. *Vortragstagung zu Aktuellen Problemen der Phytonematologie* No. 1, pp. 12-26.

Brown, E.B. (1969) Assessment of the damage caused to potatoes by potato cyst eelworm *Heterodera rostochiensis* Woll. *Annals of Applied Biology* **63**, 493-502.

CABI (2007). Crop Protection Compendium, 2006 Edition. CAB International, Wallingford, UK.

Canto-Saenz, M.; Mayer de Scurrah, M. (1978) Races of potato cyst nematode in the Andean region and a new system of classification. *Nematologica* **23**, 340-349.

CEC (1969) Council Directive 69/465/EEC of 8 December 1969 on control of potato golden nematode. *Official Journal of the European Communities* No. L323, pp. 3-4.

Golden, A.M.; Ellington, D.M.S. (1972) Redescription of *Heterodera rostochiensis* (Nematoda: Heteroderidae) with a key and notes on closely related species. *Proceedings of the Helminthological Society of Washington* **39**, 64-78.

Jones, F.G.W.; Jones, M.G. (1974) *Pests of field crops*, 448 pp. Arnold, London, UK.

Kort, J. (1974) Identification of pathotypes of the potato cyst nematode. *Bulletin OEPP/EPPO Bulletin* **4**, 511-518.

Kort, J.; Ross, H.; Rumpenhorst, H.J.; Stone, A.R. (1977) An international scheme for the identification of pathotypes of potato cyst nematodes *Globodera rostochiensis* and *G. pallida*. *Nematologica* **23**, 333-339.

Mugniéry, D.; Phillips, M.S.; Rumpenhorst, H.J.; Stone, A.R.; Treur, A.; Trudgill, D.L. (1989) Assessment of partial resistance of potato to, and pathotype and virulence differences in, potato cyst nematodes. *Bulletin OEPP/EPPO Bulletin* **19**, 7-25.

Mulvey, R.H.; Stone, A.R. (1976) Description of *Punctodera matadorensis* n.gen., n.sp. (Nematoda: Heteroderidae) from Saskatchewan with lists of species and generic diagnoses of *Globodera*) (n. rank), *Heterodera*, and *Sarisodera*. *Canadian Journal of Zoology* **54**, 772-785.

OEPP/EPPO (1978) Data sheets on quarantine organisms No. 124, *Globodera pallida*. *Bulletin OEPP/EPPO Bulletin* **8** (2).

OEPP/EPPO (1981) Data sheets on quarantine organisms No. 125, *Globodera rostochiensis*. *Bulletin OEPP/EPPO Bulletin* **11** (1).

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

OEPP/EPPO (1991) Quarantine procedure No. 30, *Globodera pallida* & *G. rostochiensis*, soil sampling methods. *Bulletin OEPP/EPPO Bulletin* **21**, 233-240.

Skarbilovich, T.S. (1959) On the structure of the systematics of nematode order Tylenchida Thorne, 1949. *Acta Parasitologica Polonica* **7**, 117-132.

Southey, J.F. (1986) *Laboratory methods for work with plant and soil nematodes. Ministry of Agriculture, Fisheries and Food Reference Book* No. 402, 202 pp. HMSO, London, UK.

Stelter, H. (1971) [The potato cyst nematode (*Heterodera rostochiensis* Wollenweber)]. *Wissenschaftliche Abhandlungen der Deutschen Akademie der Landwirtschaftswissenschaften zu Berlin* No. 59, 290 pp.

Stone, A.R. (1973a) *Heterodera pallida* n. sp. (Nematoda: Heteroderidae), a second species of potato cyst nematode. *Nematologica* **18**, 591-606.

Stone, A.R. (1973b) *Heterodera pallida* and *Heterodera rostochiensis*. *CIH Descriptions of Plant-parasitic Nematodes* No. 16 and 17. CAB International, Wallingford, UK.

Wood, F.H.; Foot, M.A. (1975) Treatment of potato tubers to destroy cysts of potato cyst nematode: a note. *New Zealand Journal of Experimental Agriculture* **3**, 349-350.

## 5.3.11. Pale cyst nematode: *Globodera pallid*

### 5.3.11.1. Hazard Identification

**Scientific name: *Globodera pollida* (Stone) Behrens**

**Synonyms**: *Heterodera pallida* Stone

*Heterodera rostochiensis* Wollenweber *in partim*

**Common names**: White potato cyst nematode,

Pale potato cyst nematode

**Taxonomic tree**

Kingdom: Animalia

Phylum: Nematoda

Class: Secernentea

Order: Tytenchida

Family: Heteroderiidae

Genus: *Globodera*

Species: *Globodera pallida*

**EPPO Code:** HETDRO. This pest has been included in EPPO A2 list: No. 124

**Bangladesh status:** Not present in Bangladesh [EPPO, 1997; CABI, 2007].

### 5.3.11.2 Biology

Second-stage juveniles hatch, under stimulus from host root exudates, from eggs within cysts in the soil, and invade the roots. Each individual nematode feeds on a group of cells in the pericycle, cortex or endodermis, transforming them into a syncytium or transfer cell. The nematode remains here for the rest of its development, as it passes through two more juvenile stages to become either male or female. Females swell and break through the root surface but remain attached. They are fertilized by the vermiform, actively moving males. After copulation the males die and the females remain on the roots while eggs develop within them. Females are white when they protrude from the root surface and those of *G. pallida* remain so. When the females are fully mature they die and their skin hardens and turns brown to become a protective cover (the cyst) around the eggs within. There are, on average, 500 eggs per cyst. At this point they generally drop from the surface of the root into the soil, where the eggs can either hatch immediately to attack the crop or remain dormant to act as a source of inoculum for future crops. Cysts can remain infective for many years in the absence of solanaceous hosts (Stelter, 1971; Stone, 1973b; Jones & Jones, 1974).

### 5.3.11.3 Hosts

Potatoes are by far the most important host crop. Tomatoes and aubergines are also attacked. Other *Solanum* spp. and their hybrids can also act as hosts.

Both species of *Globodera* have several different pathotypes (Kort, 1974). The pathotypes are characterized by their ability to multiply on certain tuberous *Solanum* clones and hybrids used in breeding. Three pathotypes are recognized within *G. pallida* (Pa1-Pa3) (Kort *et al*., 1977).

### 5.3.11.4 Geographical distribution

The centre of origin of the two species is in the Andes Mountains in South America from where they were introduced to Europe with potatoes, probably in the mid-19th century. From there, they were spread with seed potatoes to other areas. The present distribution covers temperate zones down to sea level and in the tropics at higher altitudes. In these areas, distribution is linked with that of the potato crop.

**EPPO region**: Algeria, Austria, Belgium, Cyprus, Faroe Islands, France, Germany, Greece (Crete only), Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal (mainland), Russia (unconfirmed in European Russia), Slovakia, Spain (including Canary Islands), Sweden, Switzerland, Tunisia, UK (England, Scotland, Channel Islands), Yugoslavia.

**Asia**: Cyprus, India (Himachal Pradesh, Kerala, Tamil Nadu), Pakistan.

**Africa**: Algeria, Tunisia, South Africa.

**North America**: Canada (Newfoundland).

**Central America and Caribbean**: Panama.

**South America**: Throughout the high Andean region. Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Venezuela.

**Oceania**: New Zealand.

**EU**: Present.

### 5.3.11.5 Hazard Identification Conclusion

Considering the facts that *G. pallida*

- is not known to be present in Bangladesh [EPPO, 1997; CABI, 2007].
- is potentially economic important to Bangladesh because these are the important pest of tomatoes, brinjal and potatoes, but not of flowers in Asia including India, Japan, Pakistan, Sri Lanka (EPPO, 2006) from where both field crops and horticultural crops and their planting materials like seeds, nursery stocks etc are imported to Bangladesh.
- This nematode has no natural means of dispersal, and can only move the short distances travelled by juveniles attracted towards roots in the soil. They are spread into new areas as cysts on, in order of importance, seed potatoes, nursery stock, soil, flower bulbs, potatoes for consumption or processing. The last named are only important if
- *G. pallida* are the **quarantine pests** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 5.3.11.6 Determine likelihood of pest establishing in tour country via this pathway

**Table 11.1.** – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **A. Has this pest been established in several new countries in recent years,-Yes,**<br>• Both species of potato cyst nematode are A2 quarantine pests for EPPO (OEPP/EPPO, 1978; 1981). They are also of quarantine significance for APPPC and NAPPO. In addition, *G. pallida* is a quarantine pest for CPPC and IAPSC.<br>• The nematodes are already established in most or all areas in the EPPO region that are important for the cultivation of potatoes for consumption or the production of starch; therefore, regular attention to control is needed in such areas. Where domestic legislative measures are in force, import regulations are justified to ensure comparable standards for imported material. It is essential that areas of seed potato production be kept as free as possible from these nematodes.<br>**b. Posibility of survival during transport, storage and transfer of this pest? Yes**<br>• In general, the cyst nematodes will survive in any environment where potatoes can be grown. A period of 38-48 days (depending on soil temperature) is required for a complete life cycle of the potato cyst nematodes (Chitwood and Buhrer, 1945).<br>• Cyst nematode eggs can remain dormant and viable within the cyst for 30 | **YES and HIGH** |

| | |
|---|---|
| years (Winslow and Willis, 1972). After mating, each female produces approximately 500 eggs (Stone, 1973b). Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process. Therefore, this pest is rated with High (3) risk potential<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Internationally, *G. pallida* is liable to be carried on tomatoes, brinjal and potatoes for planting, which are the main means of dispersal of this pest [EPPO, 2006].<br>• Potato cyst nematode eggs can remain dormant and viable within the cyst for 30 years (Winslow and Willis, 1972). After mating, each female produces approximately 500 eggs (Stone, 1973b).<br>**D. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• The preferred tomatoes, potatoes and aubergines are three major cultivated hosts (aubergines, tomatoes and potatoes) widely distributed in many Asian countries including Japan, China, Thailand, India (CABI, 2015), and these crops are also common in **Bangladesh**.<br>• The optimum temperature for the hatch of *G. pallida* is about 15°C (Evans, 1968).<br>• These climatic requirements for growth and development of *G. pallida* are more or less similar with the climatic condition during summer season of **Bangladesh**. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

### 5.3.11.7 Determine the <u>Consequence</u> establishment of this pest in Bangladesh

**Table 11.2.**– Which of these descriptions best fit of this pest?

| Description | **Consequence potential** |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• Yellow cyst nematode is the major pest of the potato crop in cool-temperate areas. This is particularly the case when, because of the pathotypes present, no resistant cultivars are available for planting. This situation is, at present, more serious in the case of *G. pallida* because of the lack of commercially available potato cultivars having resistance to this species.<br>• The amount of damage, particularly in relation to the weight of tubers produced, is closely related to the number of nematode eggs per unit of soil. It has been estimated that approximately 2 t/ha of potatoes are lost for every 20 eggs/g soil (Brown, 1969). Up to 80% of the crop can be lost when nematode populations are raised to very high levels by repeated cultivation of potatoes.<br>• This is a fairly serious pest of several important other crops rather than | **Yes and High** |

| | |
|---|---|
| flowers for Bangladesh.<br><br>**b. Economic impact and yield loss**<br>• Crop losses induced by the golden nematode range 20-70% (Greco, 1988). It has been estimated that approximately 2 t/ha of potatoes are lost for every 20 eggs/g soil (Brown, 1969). Up to 80% of the crop can be lost when nematode populations are raised to very high levels by repeated cultivation of potatoes.<br>• In Chile, yield losses of 20, 50 and 90% were obtained with population densities of 9, 28 and 128 eggs/g soil (Moreno et al., 1984; Greco and Moreno, 1992). Rhizoctonia and other fungal diseases associated with nematode feeding may also contribute to the yield loss. In Canada, Globodera rostochiensis was found in Newfoundland in 1962 and 800,000$Can /year has been spent on control and research of golden cyst nematode (Miller, 1986).<br>• Besides that, affected plants suffer tubers are smaller (CABI, 2006). This means it effects on quality of potato tubers as well as seed potatoes. Control on golden cyst nematode, Globodera rostochiensis is major by soil fumigants but fumigant nematicides are toxic and expensive (Mazin, 1991).<br>• Moreover, golden cyst nematode (Globodera rostochiensis) is quarantine pest for EPPO, APPPC, NAPPO (OEPP/EPPO, 1978; 1981). Therefore, the presence of the potato cyst nematodes in potato growing areas prevents the export of potatoes to international markets due to the restrictions imposed by many countries against this pest.<br>• Based on these Economic Impacts, the Potato cyst nematodes could become established in Bangladesh with High Risk potential.<br>**c. Environmental Impact**<br>• Introduction of Globodera rostochiensis into Bangladesh is likely to initiate chemical, because it is a serious pest of economically important crops.<br>• The fumigation to control this nematode may also harm to the beneficial organisms available to the soils.<br>• This species has the potential to attack plants (Solanum) that are main crop in Bangladesh. As a large chemical will be used for it's controlling. Therefore, it can impacts on ecological system. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.11.8 Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

**Table 11.3.** – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |

| | | |
|---|---|---|
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.11.9 Risk Management Measures

- Measures to prevent the introduction of the nematodes to areas where they are not already established include soil sampling surveys and regulations concerning movement of seed potatoes, nursery stock, flower bulbs and soil. These apply nationally as well as internationally (CEC, 1969).
- Consignments of potato tubers, rooted plants and bulbs from countries where the nematodes occur may be examined to check amounts of adhering soil, if any, or to take samples of soil for laboratory examination.
- Additional safeguards during transit of consignments could be washing of tubers and flower bulbs to remove soil, although it should be noted that cysts can remain embedded in tubers, especially in the eyes. Alternatively, tubers may be dipped in dilute sodium hypochlorite solution (Wood & Foot, 1975).
- The EPPO specific quarantine requirements (OEPP/EPPO, 1990) for these nematodes require that the field in which seed potatoes or rooted plants being imported were grown was inspected by taking soil samples according to an EPPO-recommended method (OEPP/EPPO, 1991) and found free from viable cysts of both species. The sampling must have been performed after harvest and after removal of the previous potato crop.

### 5.3.11.10 References


Behrens, E. (1975) [*Globodera* Skarbilovich, 1959 an independent genus in the subfamily Heteroderinae Skarbilovich, 1949 (Nematoda: Heteroderidae)]. *Vortragstagung zu Aktuellen Problemen der Phytonematologie* No. 1, pp. 12-26.

Brown, E.B. (1969) Assessment of the damage caused to potatoes by potato cyst eelworm *Heterodera rostochiensis* Woll. *Annals of Applied Biology* **63**, 493-502.

CABI (2006). Crop Protection Compendium, 2006 Edition. CAB International, Wallingford, UK.

Canto-Saenz, M.; Mayer de Scurrah, M. (1978) Races of potato cyst nematode in the Andean region and a new system of classification. *Nematologica* **23**, 340-349.

CEC (1969) Council Directive 69/465/EEC of 8 December 1969 on control of potato golden nematode. *Official Journal of the European Communities* No. L323, pp. 3-4.

Golden, A.M.; Ellington, D.M.S. (1972) Redescription of *Heterodera rostochiensis* (Nematoda: Heteroderidae) with a key and notes on closely related species. *Proceedings of the Helminthological Society of Washington* **39**, 64-78.

Jones, F.G.W.; Jones, M.G. (1974) *Pests of field crops*, 448 pp. Arnold, London, UK.

Kort, J. (1974) Identification of pathotypes of the potato cyst nematode. *Bulletin OEPP/EPPO Bulletin* **4**, 511-518.

Kort, J.; Ross, H.; Rumpenhorst, H.J.; Stone, A.R. (1977) An international scheme for the identification of pathotypes of potato cyst nematodes *Globodera rostochiensis* and *G. pallida*. *Nematologica* **23**, 333-339.

Mugniéry, D.; Phillips, M.S.; Rumpenhorst, H.J.; Stone, A.R.; Treur, A.; Trudgill, D.L. (1989) Assessment of partial resistance of potato to, and pathotype and virulence differences in, potato cyst nematodes. *Bulletin OEPP/EPPO Bulletin* **19**, 7-25.

Mulvey, R.H.; Stone, A.R. (1976) Description of *Punctodera matadorensis* n.gen., n.sp. (Nematoda: Heteroderidae) from Saskatchewan with lists of species and generic diagnoses of *Globodera*) (n. rank), *Heterodera*, and *Sarisodera*. *Canadian Journal of Zoology* **54**, 772-785.

OEPP/EPPO (1978) Data sheets on quarantine organisms No. 124, *Globodera pallida*. *Bulletin OEPP/EPPO Bulletin* **8** (2).

OEPP/EPPO (1981) Data sheets on quarantine organisms No. 125, *Globodera rostochiensis*. *Bulletin OEPP/EPPO Bulletin* **11** (1).

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

OEPP/EPPO (1991) Quarantine procedure No. 30, *Globodera pallida & G. rostochiensis*, soil sampling methods. *Bulletin OEPP/EPPO Bulletin* **21**, 233-240.

Skarbilovich, T.S. (1959) On the structure of the systematics of nematode order Tylenchida Thorne, 1949. *Acta Parasitologica Polonica* **7**, 117-132.

Southey, J.F. (1986) *Laboratory methods for work with plant and soil nematodes. Ministry of Agriculture, Fisheries and Food Reference Book* No. 402, 202 pp. HMSO, London, UK.

Stelter, H. (1971) [The potato cyst nematode (*Heterodera rostochiensis* Wollenweber)]. *Wissenschaftliche Abhandlungen der Deutschen Akademie der Landwirtschaftswissenschaften zu Berlin* No. 59, 290 pp.

Stone, A.R. (1973a) *Heterodera pallida* n. sp. (Nematoda: Heteroderidae), a second species of potato cyst nematode. *Nematologica* **18**, 591-606.

Stone, A.R. (1973b) *Heterodera pallida* and *Heterodera rostochiensis*. *CIH Descriptions of Plant-parasitic Nematodes* No. 16 and 17. CAB International, Wallingford, UK.

Wood, F.H.; Foot, M.A. (1975) Treatment of potato tubers to destroy cysts of potato cyst nematode: a note. *New Zealand Journal of Experimental Agriculture* **3**, 349-350.

## 5.3.12. *Tobacco ringspot nepovirus*

### 5.3.12.1 Hazard Identification

**Preferred Name:** *Tobacco ringspot nepovirus*

**Synonyms**: *Tobacco ringspot No. 1 Nicotiana virus 12*

**Common names**: Tobacco ring spot virus (TRSV)
Ring spot (in tobacco and various hosts),
Bud blight (in soyabean),
Necrotic ring spot,
Pemberton disease (in blueberry),
Necrosis (in anemone) (English)

**Taxonomic tree**

Group : Group IV ((+)ssRNA)
Order : Picornavirales
Family : Secoviridae
Subfamily: Comovirinae
Genus : *Nepovirus*
Species : *Tobacco ringspot virus*

**EPPO Code:** TORSXX. This pest has been included in EPPO A2 list: No. 228

**Bangladesh status:** Not present in Bangladesh

### 5.3.12.2 Biology

In its native range, TRSV is transmitted by the nematode *Xiphinema americanum*, which in the part of North America concerned is most probably *X. americanum sensu stricto*, and also *X. rivesi* (Brown & Trudgill, 1989; EPPO/CABI, 1996c). The virus is acquired within 24 h and is transmitted by both adult and larval stages (Stace-Smith, 1985). The nematode can transmit to many different host species, at high efficiency (Douthit & McGuire, 1978). A number of other vectors have been suggested: *Thrips tabaci* and *Melanoplus differentialis* (a grasshopper) for the disease on soyabeans, *Tetranychus* spp., *Epitrix hirtipennis* and aphids. The virus is readily transmitted mechanically to herbaceous hosts.

Seed transmission has been reported in several hosts, such as *Cucumis sativus* and *Glycine max* (up to 100% in the latter, in which it is the main form of transmission). It probably occurs to some extent in most hosts (Stace-Smith, 1985).

### 5.3.12.3 Hosts

**Major hosts:** Tobacco, aubergines (*Solanum melongena*), soyabeans, grapevine and *Vaccinium* spp., especially *V. corymbosum* and Cucurbitaceae.

**Minor hosts:** Herbaceous ornamentals (*Anemone*, *Gladiolus*, *Iris*, *Narcissus*, *Pelargonium*), *Anemone*, apples (*Malus pumila*), blackberries (*Rubus fruticosus*), *Capsicum*, cherries (*Prunus avium*), *Cornus*, *Fraxinus*, *Gladiolus*, grapes (*Vitis vinifera*), *Iris*, *Lupinus*, *Mentha*, *Narcissus pseudonarcissus*, pawpaws (*Carica papaya*), *Pelargonium*, *Petunia*, *Sambucus* and various weeds.

### 5.3.12.4 Geographical distribution

Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Lithuania, Morocco, Netherlands, Poland, Romania, Russia, Spain, Switzerland, UK, Ukraine, Yugoslavia, China, Georgia, India, Indonesia, Iran, Japan, Kyrgyzstan, Russia, Sri Lanka, Taiwan, Malawi, Morocco, Nigeria, Zaire, Canada, Mexico, USA, Cuba, Dominican Republic, Brazil, Uruguay, Australia New Zealand, Papua New Guinea (EPPO, 2006).

### 5.3.12.5 Hazard Identification Conclusion

Considering the facts that *Tobacco ringspot virus* -

- is not known to be present in Bangladesh.
- is potentially economic important to Bangladesh because it is an important pest of vegetable in Asia including China, India (Tamil Nadu), Japan from where vegetable and planting material like seeds, nursery stocks etc are imported to Bangladesh.
- Long-range dispersal in trade is in host plants and parts of plants, including seeds; accompanying soil may harbour infective seeds and the nematode vector.

- *Tobacco ringspot virus* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 5.3.12.6 Determine likelihood of pest establishing in tour country via this pathway.

**Table 12.1** Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **a. This pest has established in several new countries in recent years, and Yes.**<br>• TRSV has its origin in central and eastern North America, but there are now scattered records from many countries around the world, most of which are probably associated with material exported from North America. Since the virus mostly does not cause striking symptoms or spread rapidly, it is difficult to determine from the published literature whether TRSV has established in the various countries in which it has been detected.<br><br>**b. Posibility of survival during transport, storage and transfer of this pest? Yes**<br>Long-range dispersal in trade is in host plants and parts of plants, including seeds; accompanying soil may harbour infective seeds and the nematode vector.<br><br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? Yes**<br>• In tobacco, TRSV causes ring and line patterns on the foliage and stunting (Gooding, 1991). In cucurbits, leaves are mottled and stunted, and fruits are deformed (Sinclair & Walker, 1956).<br>• In soyabean, plants are most severely affected when they are infected young (less than 5 weeks old or from seed), the virus spreading systemically in the plant (Demski & Kuhn, 1989). The terminal bud is curved to form a crook (bud blight), and other buds become brown, necrotic and brittle. Brown streaks can be seen in the pith of stems and branches, and occasionally on petioles and leaf veins. Leaflets are dwarfed and rolled. Pods develop poorly and late.<br>• Grapevine shows symptoms of decline, exactly as with ToRSV, i.e. new growth is weak and sparse, internodes are shortened, leaves are small and distorted, and plants are stunted. Berries are sparse and develop unevenly (Gonsalves, 1988).<br>• *Vaccinium corymbosum* shows stem dieback and stunting. On a susceptible cultivar such as Pemberton, leaves are deformed and somewhat thickened, become chlorotic and show necrotic spots, and may drop giving a shothole or tattered effect (Ramsdell, 1987).<br>• In cherry, in which the disease has only ever been seen in a few individual trees, young leaves show irregular chlorotic blotching over the whole leaf blade, and the leaf margins are deformed and lobed. These symptoms are seen in scattered leaves throughout the crown. Fruits mature late on infected trees (Stace-Smith & Hansen, 1974). | **YES and HIGH** |

| | |
|---|---|
| • Long-range dispersal in trade is in host plants and parts of plants, including seeds; accompanying soil may harbour infective seeds and the nematode vector.<br><br>d. **Its host(s) are fairly common in Bangladesh and the climate is similar to places it is established – Yes**<br><br>• The common hosts of this virus are Tobacco, soyabeans, grapevine and *Vaccinium* spp., especially *V. corymbosum* and Cucurbitaceae. The other hosts of this virus are the herbaceous ornamentals including *Anemone*, *Gladiolus*, *Iris*, *Narcissus*, *Pelargonium* etc; *Petunia*, *Mentha*, *Carica papaya* and various weeds. These hosts are common in Bangladesh.<br><br>• The climatic conditions of India, Japan, China, Taiwan, Indonesia, where this pest is available are more or less similar with Bangladesh. There a possibility to establish this pest in Bangladesh. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

### 5.3.12.7 Determine the Consequence establishment of this pest in Bangladesh

**Table12. 2.** – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| a. Is this is a serious pest of **Bangladesh?** Yes<br><br>• The only really serious disease caused by TRSV is bud blight of soyabean in USA (Demski & Kuhn, 1989), which can involve serious damage to plants, yield losses of 25-100%, and poor seed quality. Although described on tobacco and widespread on this crop in the USA, TRSV causes only minor damage (Gooding, 1991). The same applies on cucurbits (Sinclair & Walker, 1956), and on a number of ornamentals.<br>• On woody fruit crops, TRSV has a certain impact on grapevines in northeastern USA, causing a decline. *Vitis vinifera* is most readily affected, but is relatively little grown in that area compared with interspecific hybrids which are less affected (Gonsalves, 1988). TRSV causes blueberry necrotic ringspot disease of susceptible cultivars of *Vaccinium corymbosum*. Infected bushes show a slow but steady decline in productivity (Ramsdell, 1978). TRSV is much more important in *Vaccinium* than ToRSV (Ramsdell, 1987). TRSV has been recorded in a few individual cherry trees, and rather more often from ornamental *Prunus* spp. (*P. serrulata*, *P. incisa*, *P. serrula*) (Uyemoto *et al*., 1977).<br>• It has been recorded once from apple (Lana *et al*., 1983), once from *Rubus fruticosus* and also from wild *Rubus* spp. in North Carolina (USA) (Stace-Smith, 1987). With the exception of | **Yes and High** |

| | |
|---|---|
| *Vaccinium* and *Vitis*, TRSV has very minor impact on fruit crops, the records on some species being no more than scientific curiosities of no practical importance.<br>• This is a fairly serious pest of several important vegetables and other crops for Bangladesh.<br>**b. Economic impact and yield loss**<br>• The rapid spread of TomRSV in grapes in New York has led to a serious decline, particularly of the cultivar Cascade (Siebel 13053) (Uyemoto, 1975). In Oregon, fruit from TomRSV-infected raspberry canes weighed 21% less individually than from healthy canes, and the yield was more than halved, since TomRSV has a particularly adverse effect on drupelet set of certain cultivars (Daubeny et al., 1975; Freeman et al., 1975).<br>• In addition, fruit quality is reduced, the fruits being crumbly and therefore unmarketable (Mircetich, 1973). The progressive decline in raspberries is such that, by the third year of infection, up to 80% of fruiting canes may be killed. The virus is of some economic importance in those EPPO countries where it occurs. An isolate of TomRSV from Pelargonium in the UK (probably imported from the USA) caused severe symptoms on several glasshouse crops; thus, the virus presents a serious threat to the glasshouse industry, especially where salad and ornamental crops are grown together.<br>• It is possible that European Xiphinema species, such as X. pachtaicum, which is widespread in the EPPO region, could transmit the virus. This species has a wide host range, including many hosts of TomRSV. However, there are no reports of transmission experiments with X. pachtaicum and TomRSV. In North America, X. rivesi has been implicated as a vector of TomRSV; although present in Europe, it has a very limited host range and would not probably play a significant role in virus distribution.<br>**c. Environmental Impact**<br>• Control of TomRSV in established plantings of fruit tree or berry crops is difficult. The use of resistant cultivars (e.g. for grapes) and the use of healthy planting material can reduce the disease. In addition, it is necessary to achieve good control of weeds.<br>• *TomRSV* represents a potential threat to many crops. The establishment of it could trigger chemical control programs by using different insecticides that are toxic and harmful to the environment. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.12.8 Calculating the Risk of this Pest via this pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

**Table 12.3.** – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |

| | | |
|---|---|---|
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

### 5.3.12.9 Possible Phytosanitary Measures

- Planting material of should be derived from certification schemes guaranteeing freedom from TRSV (OEPP/EPPO, 1991).
- Seeds should be free from TRSV.

### 5.3.12.10 References


Asjes, C.J. (1979) Viruses and virus diseases in Dutch bulbous irises (*Iris hollandica*) in the Netherlands. *Netherlands Journal of Plant Pathology* 85, 269-279.

Bellardi, M.G.; Marani, F. (1985) Nepoviruses isolated from gladiolus in Italy. *Acta Horticulturae* No. 164, 297-308.

Demski, J.W.; Kuhn, C.W. (1989) Tobacco ringspot virus. In: *Compendium of soybean diseases* (3rd edition), pp. 57-59. American Phytopathological Society, St. Paul, USA.

EPPO, 2006. PQR database. Paris, France: European and Mediterranean Plant Protection Organization. http://www.eppo.int/DATABASES/pqr/pqr.htm

Gonsalves, D. (1988) Tomato ringspot virus decline; tobacco ringspot virus decline. In: *Compendium of grape diseases*, pp. 49-51. American Phytopathological Society, St. Paul, USA.

Gooding, G.V. (1991) Diseases caused by viruses. In: *Compendium of tobacco diseases*, pp. 41-46. American Phytopathological Society, St. Paul, USA.

Hollings, M. (1965) Anemone necrosis, a disease caused by a strain of tobacco ringspot virus. *Annals of Applied Biology* 55, 447-457.

Lana, A.F.; Peterson, J.F.; Rouselle, G.L.; Vrain, T.C. (1983) Association of tobacco ringspot virus with a union incompatibility of apple. *Phytopathologische Zeitschrift* 106, 141-148.

Lister, R.M. (1963) Nematode-borne viruses. In: *Annual Report of the Scottish Horticultural Research Institute for 1961-1962*, p. 66. SHRI, Dundee, UK.

Makutenajte, M.K. (1977) [Internal symptoms caused by tobacco ringspot virus on ornamental plants in Lithuania]. *Mikrobiologichnii-Zhurnal* 39, 741-742.

Mickovski, J. (1969) [Tomato spotted wilt virus of tobacco in Yugoslavia - tobacco ringspot]. *Zastita Bilja* 20, 203-214.

Murav'eva, M.F. (1976) [Virus diseases of soybean]. *Zashchita Rastenii* No. 11, 45.

Ramsdell, D.C. (1978) A strain of tobacco ringspot virus associated with a decline diseases of Jersey highbush blueberry. *Plant Disease Reporter* 62, 1047-1051.

Ramsdell, D.C. (1987) Necrotic ringspot of blueberry. In: *Virus diseases of small fruits, Agriculture Handbook* No. 631, pp. 114-116. USDA/ARS, Washington, USA.

Sinclair, J.B.; Walker, J.C. (1956) A survey of ringspot on cucumber in Wisconsin. *Plant Disease Reporter* 40, 19-20.

Stace-Smith, R. (1987) Tobacco ringspot virus in *Rubus*. In: *Virus diseases of small fruits, Agriculture Handbook* No. 631, pp. 227-228. USDA/ARS, Washington, USA.

Stace-Smith, R.; Hansen, A.J. (1974) Occurrence of tobacco ringspot virus in sweet cherry. *Canadian Journal of Botany* 52, 1647-1651.

Stone, O.M. (1980) Nine viruses isolated from pelargonium in the United Kingdom. *Acta Horticulturae* No. 110, 177-182.

Uyemoto, J.K.; Welsh, M.F.; Williams, E. (1977) Pathogenicity of tobacco ringspot virus in cherry. *Phytopathology* 67, 439-441.

## 5.3.13. *Pepper veinal mottle virus*

### 5.3.13.1 Hazard Identification

**Preferred Name:** *Pepper veinal mottle virus*

**Synonyms**: *Pepper veinal mottle potyvirus*

**Common names**: PVMV

### Taxonomic tree

Domain: Virus
Group: "Positive sense ssRNA viruses"
Group: "RNA viruses"
Family: Potyviridae
Genus: Potyvirus
Species: Pepper veinal mottle virus

**EPPO Code:** PVMV00.

**Bangladesh status:** Not present in Bangladesh [CABI,2016].

### 5.3.13.2. Biology

*Pepper veinal mottle potyviruses*, a new potyvirus with distinctive properties was found widely distributed in Shewa and Welega provinces. The virus, tentatively designated Ethiopian pepper mottle potyvirus, had filamentous particles c. 700-750 nm in length. It had an unusually narrow experimental host range, and was nonpersistently transmitted by *Myzus persicae. Pepper veinal mottle virus (PVMV)*, a previously undescribed virus widespread in *Capsicum annuum* and *C. frutescens* in the Eastern Region of Ghana, is acquired and inoculated in 2 min feeding periods by aphids (*Myzus persicae* and *Aphis gossypii*); it is transmissible by inoculation of sap to eleven of fifteen Solanaceae and to five of forty-six other species within three of seventeen other families. The virus was propagated in *Nicotiana clevelandii* and *Petunia hybrida*, and assayed in *Chenopodium quinoa, C. amaranticolor* and *C. murale*

### 5.3.13.3. Hosts

a. **Major hosts:** The main crop species attacked by *Pepper veinal mottle, are Abelmoschus esculentus* (okra)*, Solanum melongena (aubergine), Capsicum annuum* (bell pepper)*, Capsicum frutescens* (chilli)*, Datura metel* (Hindu datura)*, Nicotiana tabacum* (tobacco)*, Solanum lycopersicum* (tomato)*, Solanum nigrum (*black nightshade)*.*

b. **Minor hosts:** The minor or other hosts include ornamentals such as china aster (*Callisterphus chinensis*), chrysanthemum (*Chrysanthemum indicum*)*,* Gerbera, sunflower, carnation etc, wild plants, weeds and shade trees (e.g. *Leucaena leucocephala*, the shade tree of cocoa plantations in Indonesia).

### 5.3.13.4. Distribution

**Asia**: Afghanistan (Lal & Singh, 1988), India (Andhra Pradesh, Karnataka) (Jagadeeshwar *et al*., 2005, Nagaraju, & Reddy, 1980; Bidari & Reddy, 1983; Nagaraju, & Reddy, 1981;

Gowda & Reddy, 1985; Gowda & Reddy, 1989; Bidari & Reddy, 1989; Bidari & Reddy, 1990; Prasad Rao et al., 1980), Taiwan (Cheng et al., 2009).

**Africa**: Benin, Burkina Faso, Cameroon, Cape Verde, Côte d'Ivoire, Egypt, Equatorial Guinea, Eritrea, Gambia, Ghana, Kenya, Libya, Nigeria, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Togo (Brunt et al., 1978; Lamptey, 1978; Brunt & Kenten, 1972) .

**EU**: Absent.

### 5.3.13.5. Hazard Identification Conclusion

Considering the facts that *Pepper veinal mottle virus* -

- is not known to be present in Bangladesh [CABI,2016];
- is potentially economic important to Bangladesh because it is an important pest of various vegetables like tomato, okra, chilli etc in Asia including Afganistan, India, Taiwan (Bidari & Reddy, 1990), from where flowers are imported to Bangladesh.
- can become established in Bangladesh through imports of such vegetables and planting materials like seeds, nursery stocks and others. It has capability to cause direct economic and ecological damage to many valuable cultivated crops, because this pest has high reproductive potential, high dispersal ability for long distance and high survivability at adverse environment, the risk rating for establishment potential is high**.**
- *Pepper veinal mottle virus* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 5.3.13.6. Determine likelihood of pest establishing in tour country via this pathway.

Table 13.1.– Which of these descriptions best fit of this pest?

| Description | Establishment Potential is: |
|---|---|
| **A. Has this pest been established in several new countries in recent years,-Yes,**<br>• This pest has been established in many Asian countries including Afganistan, India, Taiwan (Bidari & Reddy, 1990)<br>• CPPC, NAPPO and OIRSA also consider this species of quarantine significance. *Pepper veinal mottle* is already fairly widespread in Asian, Mediterranean and African countries.<br>**B. Posibility of survival during transport, storage and transfer of this pest? Yes**<br>• The brinjal seeds and fruits are transported from India, China, Japan, Thailand, Taiwan and Vietnam to Bangladesh mainly by Airfreight, and or Landport. Therefore, the period of time taken for shipment through these transportation pathways from the exporting countries to Bangladesh is very short. It is transmissible by inoculation of sap to eleven of fifteen Solanaceae and to five of forty-six other species within three of seventeen other families. The virus was propagated in *Nicotiana clevelandii* and *Petunia hybrida*, and assayed in *Chenopodium quinoa, C. amaranticolor* and *C. murale.* Internationally, *Pepper veinal mottle virus* is liable to be carried on any plant parts like flowers, inflorescences, cones, calyx,fruits, leaves, roots, seedlings, stems etc for planting and nursery stocks, which are the main means of dispersal of this pest the pests could survive during transporting process. Therefore, this pest is rated with High risk potential. | **YES and HIGH** |

| | |
|---|---|
| **c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Internationally, *Pepper veinal mottle virus* is liable to be carried on any plant parts like flowers, inflorescences, cones, calyx,fruits, leaves, roots, seedlings, stems etc for planting and nursery stocks, which are the main means of dispersal of this pest [CABI, 2016].<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• *Pepper veinal mottle virus* species is totally polyphagous The main crop species attacked by *Pepper veinal mottle*, are *Abelmoschus esculentus* (okra), *Solanum melongena* (aubergine), *Capsicum annuum* (bell pepper), *Capsicum frutescens* (chilli), *Datura metel* (Hindu datura), *Nicotiana tabacum* (tobacco), *Solanum lycopersicum* (tomato), *Solanum nigrum* (black nightshade) among these hosts many of them mostly common in **Bangladesh**.<br>• more or less similar with the climatic condition of **Bangladesh**. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

**5.3.13.7. Determine the Consequence establishment of this pest in Bangladesh**

**Table 13.2.** – Which of these descriptions best fit of this pest?

| Description | Consequence potential is: |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *The main crop species attacked by Pepper veinal mottle, are Abelmoschus esculentus* (okra)*, Solanum melongena* (aubergine)*, Capsicum annuum* (bell pepper)*, Capsicum frutescens* (chilli)*, Datura metel* (Hindu datura)*, Nicotiana tabacum* (tobacco)*, Solanum lycopersicum* (tomato)*, Solanum nigrum* (black nightshade)*.* Most of the main vegetables in Bangladesh and this virus are capable to damage at any growing stage. So it is an extremely serious pest for Bangladesh.<br>**B. Economic impact and yield loss**<br>• PMMV causes considerable yield losses (ca 20-30%) in field-grown and protected infected pepper crops as well as causing significant loss of quality of fruits (e.g., Conti and Marte, 1983; Marte and Wetter, 1986; Alonso et al., 1989). In addition, rogueing of infected and adjacent plants to minimize secondary spread of infection in protected crops also results in greatly reduced potential yields. Even the mild strain used for cross protection in Italy has some debilitating effect on protected plants (Cartia *et al.,* 1985). None of several attenuated strains of PMMoV failed to confer significant levels of cross-protection in Japan (Tsuda *et al.,* 2007).<br>• Total infection can occur in field-grown crops resulting in greatly reduced yields of marketable fruit (Conti and Marte, 1983; Marte and Wetter, | Yes<br>and<br>High |

| | |
|---|---|
| 1986)<br>**c. Environmental Impact**<br>• PMMV represents a potential threat to many crops. The establishment of it could trigger chemical control programs by using different insecticides that are toxic and harmful to the environment. | |
| • Not as above or below | **Moderate** |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

**5.3.13.8. Calculating the Risk of this Pest via this pathway for Bangladesh**

Establishment Potential X Consequence Potential = Risk

Table13.3. – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | High | High |
| High | **Moderate** | **High** |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

**5.3.13.9. Risk Management Measures**

- Avoid importation of flowers and foliages from countries, where this disease is available. Disease-free seeds should be used.

**5.3.13.10. References**

Bidari VB, Reddy HR, 1983. Prevalence of chilli viruses in Dharwad district. Plant Pathology Newsletter, 1(1):11-12

Bidari VB, Reddy HR, 1989. Etiological agents of chilli 'murda' in Karnataka. Journal of Plantation Crops, 17(1):50-53

Bidari VB, Reddy HR, 1990. Identification of naturally occurring viruses on commercial cultivars of chilli. Mysore Journal of Agricultural Sciences, 24(1):45-51

Brunt AA, Kenten RH, 1972. Pepper veinal mottle virus. CMI/AAB Descriptions of Plant Viruses No. 104. Wellesbourne, UK: Association of Applied Biology

Brunt AA, Kenten RH, Phillips S, 1978. Symptomatologically distinct strains of pepper veinal mottle virus from four West African solanaceous crops. Annals of Applied Biology, 88(1):115-119

CABI (2007). Crop Protection Compendium, 2006 Edition. CAB International, Wallingford, UK.

Cheng YH, Wang RY, Chen CC, Chang CA, Jan FJ, 2009. First report of Pepper veinal mottle virus in tomato and pepper in Taiwan. Plant Disease, 93(1):107. HTTP://www.apsnet.org

Gowda KTP, Reddy HR, 1985. Distribution of chilli mosaic viruses in some parts of Kolar District. Current Research, University of Agricultural Sciences, Bangalore, 14(1/3):16-17

Gowda KTP, Reddy HR, 1989. Aphid transmitted viruses infecting chilli. Current Research - University of Agricultural Sciences (Bangalore), 18(5):71-72

Jagadeeshwar R, Babu RR, Rao RDVJP, Reddy DRR, 2005. Identification of naturally occurring chilli mosaic virus in northern Telangana zone of Andhra Pradesh. Indian Journal of Plant Protection, 33(2):235-240.

Lal S.B. and Singh S., (1988). Identification of some virus diseases of vegetable crops in Afghanistan. Plant Protection Bulletin (Faridabad), 36(2):83-89.

Lamptey P, 1978. Ultrastructure of pepper veinal mottle virus in host cells. Ghana Journal of Agricultural Science, 11(1-3):59-61.

Nagaraju, Reddy HR, 1980. Natural occurrence of pepper veinal mottle virus on bell pepper. Indian Phytopathology, 33(2):282-284

Nagaraju, Reddy HR, 1981. Occurrence and distribution of bell pepper viruses around Bangalore. Current Research, University of Agricultural Sciences, Bangalore, 10(9/10):155

Prasad Rao RDVG, Yaraguntaiah RC, Govindu HC, 1980. Reaction of chilli (Capsicum spp.) cultures, varieties, and species to six chilli viruses. Mysore Journal of Agricultural Science, 14:11-14.

## 5.3.14. Parthenium weed: *Parthenium hysterophorus*

### 5.3.14.1 Hazard Identification

**Scientific name:** *Parthenium hysterophorus* L.

**Synonyms**: *Parthenium hysterophorus* var. *lyratum* A.Gray
*Argyrochaeta bipinnatifida* Cav.
*Argyrochaeta parviflora* Cav.
*Echetrosis pentasperma* Phil.
*Parthenium glomeratum* Rollins,
*Parthenium lobatum* Buckley,
*Parthenium pinnatifidum* Stokes,
*Villanova bipinnatifida* Ortega

**Common names**: Parthenium weed, bitter weed, bitter-broom, bitterweed, carrot grass, congress grass, false camomile, false ragweed, feverfew, parthenium, parthenium weed, ragweed, ragweed parthenium, Santa Maria, Santa Maria feverfew, white top, whitehead, whitetop

**Taxonomic tree**

Kingdom: Plantae
Order: Ateriales
Family: Asteraceae
Genus: *Parthnium*
Species: *Parthenium hysterophorus*

**EPPO Code:** PTNHY. This pest has been included in EPPO A2 list: No. 383

**Bangladesh status:** Present in restricted areas of Bangladesh possibly introduced from India.

### 5.3.14.2 Biology

*P. hysterophorus* reproduces only by seeds and is known to be highly prolific, as a single plant produces 15 000 seeds on average and up to 100 000 seeds (GISD Database, Global Invasive Species Database, 2010). Seed viability is high, 85% or higher (Navie et al., 1998). Buried seeds have been found to last longer than seeds on the soil surface, and a significant proportion can still germinate after 8–10 years. Freshly produced seeds demonstrate a degree of dormancy (up to several months) (Navie et al., 1998). In addition, the species is an opportunistic germinator. Seeds can germinate at any time of the year provided moisture is available but they require bare soil to do so (Parsons & Cuthbertson, 1992). The plant flowers 4 – 8 weeks after germination and flowering continue until drought or frost kills the plant. Under favourable conditions, 2 – 3 life cycles can be completed per year (Fatimah & Ahmad, 2009).

### 5.3.14.3 Hosts or habitats

- *P. hysterophorus* grows in a wide range of habitats, including degraded and disturbed lands and streams and rivers. It is a pioneer species that can invade grazing land and degraded pastures, crops, orchards, summer crops, disturbed and cultivated areas, forests, railway tracks and roadsides, recreation areas, as well as river banks and floodplains (Navie*et al*. 1996a).
- According to the Corine Land Cover nomenclature, the following habitats are invaded: arable land, permanent crops (e.g. vineyards, fruit tree and berry plantations, olive), pastures, riverbanks / canalsides (dry river beds), road and rail networks and associated land, other artificial surfaces (wastelands).
- In Australia, the main impact of *P. hysterophorus* has been in the pastoral region of Queensland, where it replaces forage plants, thereby reducing the carrying capacity for grazing animals (Haseler, 1976; Chippendale and Panetta, 1994). Serious encroachment and replacement of pasture grasses has also been reported in India (Jayachandra, 1971) and in Ethiopia (Tamado, 2001; Taye, 2002).
- *P. hysterophorus* is now being reported from India as a serious problem in cotton, groundnuts, potatoes and sorghum, as well as in more traditional crops such as okra (*Abelmoschus esculentus*), brinjal (*Solanum melongena*), chickpea and sesame (Kohli and Rani, 1994), and is also proving to be problematic in a range of orchard crops, including cashew, coconut, guava, mango and papaya (Tripathi et al., 1991; Mahadevappa, 1997).
- Similar infestations of sugarcane and sunflower plantations have recently been noted in Australia (Parsons and Cuthbertson, 1992; Navie et al., 1996). In Ethiopia, parthenium weed was observed to grow in maize, sorghum, cotton, finger millet (*Eleusine coracana*), haricot bean (*Phaseolus vulgaris*), tef (*Eragrostis tef*), vegetables (potato, tomato, onion, carrot) and fruit orchards (citrus, mango, papaya and banana) (Taye, 2002). In Pakistan, the weed has been reported from number of crops, including wheat, rice, sugarcane,

sorghum, maize, squash, gourd and water melon (Shabbir 2006; Shabbir et al. 2011; Anwar et al. 2012).

### 5.3.14.4 Geographical distribution

**Native distribution:** *P. hysterophorus* is native to the area bordering the Gulf of Mexico, and has spread throughout southern USA, the Caribbean and Brazil.

- **North America**: Bermuda, Mexico, USA (Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Hawaii, Illinois, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Missouri, Mississippi, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Texas, Virginia).
- **Central America and Caribbean**: Belize, Costa Rica, Cuba, Dominican Republic, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Netherlands Antilles, Nicaragua, Puerto Rico, Saint Barthelemy, Republic of Panama, Trinidad, Trinidad and Tobago.
- **South America**: Argentina, Bolivia, Brazil, Chile, Ecuador, French Guiana, Guyana, Peru, Paraguay, Suriname, Uruguay, Venezuela.

**Exoticdistribution**

- **EPPO region**: Israel.
- **Africa:** Comores, Egypt, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Mauritius, Mayotte, Mozambique, Reunion, Seychelles, Somalia,South Africa, Swaziland, Tanzania, Uganda and Zimbabwe.
- **Asia:** Bangladesh,Bhutan, China (south of country), India, Oman and Yemen, Israel, Nepal, Pakistan, Sri Lanka, Japan, Republic of Korea, Taiwan and Vietnam.
- **Oceania:** Australia (Queensland, New South Wales, Northern Territory, Western Australia), French Polynesia, several Pacific islands including Bermuda, New Caledonia, Vanuatu and Christmas island.

### 5.3.14.5 Hazard identification conclusion

Considering the facts that *P. hysterophorus* -

- is not known to be present in all areas of Bangladesh;
- is potentially economic important to Bangladesh because it is an important pest of flowers and foliages in Asia including China, India, Nepal, Pakistan, **Japan** [EPPO, 2014; CABI/EPPO, 1999] from where agricultural crops and flowers are imported to Bangladesh.
- can become established in Bangladesh through the transportation of agricultural equipment and imports of the agricultural planting materials including flowers and foliages.
- *Parthenium hysterophorus* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 5.3.14.6 Determine likelihood of pest establishing in Bangladesh via this pathway

**Table 14.1.** – Which of these descriptions best fit of this pest?

| Description | Establishment Potential |
|---|---|
| **A. Has this pest been established in several new countries in recent years?-Yes,**<br>• The genus *Parthenium* contains 15 species, all native to North and South America. *P. hysterophorus* has a native range in the subtropical regions of North to South America. It is thought that the species originated in the region | |

| | |
|---|---|
| surrounding the Gulf of Mexico, including southern USA, or in central South America (Dale, 1981; Navie et al., 1996), but is now widespread in North and South America and the Caribbean, and Fournet and Hammerton (1991) indicate that it occurs in 'probably all islands' of the Lesser Antilles.<br>• Since its accidental introduction into Australia and India in the 1950s, probably as a contaminant of grain or pasture seeds, it has achieved major weed status in those countries. It was first recorded in southern Africa in 1880 but was not reported as a common weed in parts of that region until the mid-1980s following extensive flooding on the east coast (McConnachie et al., 2011). Recent reports of the weed from other countries indicate that its geographic range continues to increase.<br>• Because *P. hysterophorus* has shown invasive behaviour where it has been introduced elsewhere in the world and has a highly restricted distribution in the EPPO region, it can be considered an emerging invader in the EPPO region (EPPO, 2012).<br>**b. Posibility of survival during transport, storage and transfer? Yes**<br>• *P. hysterophorus* reproduces only by seeds and is known to be highly prolific, as a single plant produces 15000 seeds on average and up to 100000 seeds (GISD Database, Global Invasive Species Database, 2010). Seed viability is high, 85% or higher (Navie et al., 1998). Buried seeds have been found to last longer than seeds on the soil surface, and a significant proportion can still germinate after 8–10 years. Freshly produced seeds demonstrate a degree of dormancy (up to several months) (Navie et al., 1998). In addition, the species is an opportunistic germinator. Seeds can germinate at any time of the year provided moisture is available but they require bare soil to do so (Parsons & Cuthbertson, 1992). Therefore, the seeds of this weed can survive during transport, storage and transfer of the commodity.<br>c. **Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Entries as a contaminant of agricultural produce and machinery have historically been important pathways for the introduction of *P. hysterophorus* in new regions.<br>• **Contaminant of used machinery:** *P. hysterophorus* can enter new territories as a contaminant of used machinery, either as seeds, e.g. lodged on the radiators and grills of automobiles, or as seeds in soil attached to machinery, such as harvesters, road construction and maintenance machinery, military equipment and other vehicles. Vehicles and harvesters may circulate quite frequently across EPPO countries. The release of seeds of *P. hysterophorus* from the vehicles on the roads networks may facilitate its transfer to other unintended habitats connected by roads.<br>• **Contaminant of grain:** *P. hysterophorus* was accidentally introduced into Israel in 1980 most likely through import of contaminated grains from the USA for fishponds (Dafni& Heller 1982). Wheat and other cereals were reported for the introduction of *P. hysterophorus* in India (Sushilkumar&Varshney, 2010), and sorghum is also reported to be infested in Ethiopia (Tamado*et al*., 2002). | **YES and HIGH** |

| | |
|---|---|
| • **Contaminant of seed:**<br>- Pasture seeds (grass) from Texas into central Queensland (Everist, 1976), as well as in Egypt from Texas in the 1960s (Boulos& El-Hadidi, 1984);<br>- Cereal seed from the United States in Africa, Asia and Oceania (Bhomik&Sarkar, 2005);<br>- Soybean seed from the USA in the Shandong Province in China in 2004 (Li & Gao, 2012).<br>**d.Are the host(s) and habitats of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• *P. hysterophorus* grows in a wide range of habitats, including degraded and disturbed lands and streams and rivers. It is a pioneer species that can invade grazing land and degraded pastures, crops, orchards, summer crops, disturbed and cultivated areas, forests, railway tracks and roadsides, recreation areas, as well as river banks and floodplains (Navie*et al*. 1996a).<br>• *P. hysterophorus* is now being reported from India as a serious problem in cotton, groundnuts, potatoes and sorghum, as well as in more traditional crops such as okra (*Abelmoschus esculentus*), brinjal (*Solanum melongena*), chickpea and sesame (Kohli and Rani, 1994), and is also proving to be problematic in a range of orchard crops, including cashew, coconut, guava, mango and papaya (Tripathi et al., 1991; Mahadevappa, 1997).<br>• Where climatic conditions are appropriate (e.g. Mediterranean area, Black Sea, Eastern Asia, the warmest temperate area) there are numerous suitable habitats. Consequently, for these areas, the probability of establishment is high with low uncertainty.<br>• Therefore, the hosts and habitats as well as climatic requirements for this weeds are mostly common in Bangladesh. | |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, and<br>• The pathway does not appears good for this pest to enter your country and establish, and<br>• Its host(s) are not common in your country and your climate is not similar to places it is established | Low |

### 5.3.14.7 Determine the Consequence establishment of this pest in Bangladesh

**Table 14.2** – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *P.hysterophorus*is a major pestinpastures and crops in its exotic range, and has major detrimental impact on human and animal health through allergies and dermatitis.<br>• If introduced in the area of potential establishment, eradication or containment would be unlikely to be successful due to its high reproductive potential and high spread capacity through human activities.<br>• This is a **fairly serious pest** of several important crops and human health rather than flowers for Bangladesh. | **Yes and High** |

| | |
|---|---|
| **b. Economic impact and yield loss**<br>• The main impact of parthenium weed on crops relates to its allelopathic properties. The water soluble phenolics; caffeic acid, ferulic acid, vanicillic acid, anisic acid and fumaric acid; and sesquiterpene lactones, mainly parthenin and/or hymenin, occur in all parts of the plant and significantly inhibit the germination and subsequent growth of a wide variety of crops including pasture grasses, cereals, vegetables, other weeds and tree species (Navie *et al.,* 1996; Evans, 1997a).<br>• Few critical assessments of yield losses have been made, although it has been determined that almost 30% grain loss can occur in irrigated sorghum in India (Channappagoudar *et al.,* 1990). As *Parthenium* pollen is also allelopathic (Kanchan and Jayachandra, 1980), heavy deposits on nearby crop plants may result in failure of seed set, and losses of up to 40% have been reported in maize yield in India (Towers *et al.,* 1977). In eastern Ethiopia, parthenium weed is the second most frequent weed after *Digitaria abyssinica* (Tamado and Milberg, 2000) and sorghum grain yield was reduced from 40 to 97% depending on the year and location (Tamado, 2001).<br>• Although *P. hysterophorus* is not yet considered to be a major crop weed in Australia (Navie *et al.,* 1996), it has started to spread into sorghum, sugarcane and sunflower growing areas and negatively affect yields (Parsons and Cuthbertson, 1992). Also, Chippendale and Panetta (1994) estimate that cultivation costs may be doubled since the prepared ground has to be re-worked to eliminate the emergent parthenium weed seedlings.<br>**c. Environmental Impact**<br>• Parthenium weed lacks predators, and cattle and livestock usually do not feed on it. As a result, the food chain is disturbed and the trophic structure changes, leading to an ecological imbalance in the invaded area.<br>• It causes a prolonged toxic effect to the soil environment – for instance, Kanchan and Jayachandra (1981) reported that the leachates from parthenium weed have an inhibitory effect on nitrogen fixing and nitrifyingbacteria.<br>Parthenium weed is also an environmental weed that can cause irreversible habitat changes in native grasslands, woodlands, river banks and floodplains in both India and Australia (Jayachandra 1971; McFadyen, 1992; Evans, 1997a; Kumar and Rohatgi, 1999).<br>• Parthenium weed, due to its allelopathic potential, replaces dominant flora and suppresses natural vegetation in a wide range of habitats and thus becomes a big threat to biodiversity. Batish et al. (2005) recorded 39 plant types in a *Parthenium*-free area, but only 14 were present in an infested area, and very little or sometimes no vegetation can be seen in some *Parthenium*-dominated areas (Kohli, 1992). Wherever it invades, it forms a territory of its own, replacing indigenous grasses and weeds which are supposedly useful for the grazing animals (De and Mukhopadhyay, 1983). Parthenium weed has an adverse effect on a variety of natural herbs which are the basis of traditional systems of medicines for the treatment of several diseases in various parts of the world (Mahadevappa *et al.,* 2001; Shabbir and Bajwa, 2006). | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 5.3.14.8 Calculating the Risk of this Pest via this pathway for Bangladesh

**Establishment Potential X Consequence Potential = Risk**

**Table 14.3** – Calculating risk rating

| Establishment Potential | Consequence Potential | Risk Rating |
|---|---|---|
| **High** | **High** | **High** |
| High | Moderate | High |
| Moderate | High | High |
| High | Low | Moderate |
| Low | High | Moderate |
| Moderate | Moderate | Moderate |
| Moderate | Low | Low |
| Low | Moderate | Low |
| Low | Low | Low |

**Calculated Risk Rating – High**

### 5.3.14.9 Risk Management Measures

**a. Contaminant of used machinery**

- Cleaning or disinfection of machinery/vehicles in combination with internal surveillance and/or eradication or containment campaign.

**b. Contaminant of grain:** Measures related to the crop or to places of production:

- Pest-free area
- Pest-free place of production/production site consist in the following combination of measures: visual inspection at the place of production, specified treatment of the crop, testing of the commodity, internal surveillance and/or eradication or containment campaign.
- Certification scheme
- Import under special licence/permit and specified restrictions (for grain which is aimed to be crushed or transformed).

**c. Contaminant of seeds**: Measures related to the crop or to places of production:

- Pest-free area
- Pest-free place of production/production site consist in the following combination of measures: visual inspection at the place of production, specified treatment of the crop, testing of the commodity, internal surveillance and/or eradication or containment campaign.
- Certification scheme for seeds.

**d. Contaminant of growing media adherent to plants for planting**: Measures related to the crop or to places of production:

- Pest-free area
- Pest-free place of production/production site consist in the following combination of measures: visual inspection at the place of production, specified treatment, growing in glasshouses and in sterilized soil, internal surveillance and/or eradication or containment campaign.
- Certification scheme for plants for planting
- Removal of the growing medium from plants for planting.

**e. Contaminant of travelers (tourists, migrants, etc.) and their clothes, shoes and luggage**

*Systems approach:*

- Publicity to enhance public awareness on pest risks
- Internal surveillance and/or eradication or containment campaign.

### 5.3.14.10 References


Ayele S (2007) Impact of Parthenium (*Partheniumhysterophorus* L.) on the range ecosystem dynamics of the Jijiga Rangeland, Ethiopia. M.Sc. Thesis, Haramaya University.134 pp.

Basappa H (2005) Parthenium an alternate host of sunflower necrosis disease and thrips, In *Second International Conference on Parthenium Management.*eds T. V. Ramachandra Prasad, H. V. Nanjappa, R. Devendra, A. Manjunath, Subramanya, S. C. Chandrashekar, V. K. KiranKuman, K. A. Jayaram, and T. K. PrabhakaraSetty, University of Agricultural Sciences, Bangalore, India, pp. 83-86.

Bhomik PC &Sarkar D (2005) *Partheniumhysterophorus*: its world status and potential management. In *Proceedings of the Second International Conference on Parthenium Management*, eds TV Ramachandra Prasad, HV Nanjappa, R Devendra, A Manjunath, Subramanya, SC Chandrashekar, VK Kiran Kumar, KA Jayaram& TK PrabhakaraSetty, University of Agricultural Sciences, Bangalore, India, pp. 1-5.

Boulos L & El-Hadidi MN (1984). The Weed Flora of Egypt.American University of Cairo Press, Cairo, 178pp.

Channappagoudar BB, Panchal YC, Manjunath S, Koti RV, 1990. Studies on influence of parthenium on sorghum growth under irrigated conditions. Farming Systems, 6(3-4):102-104

Chippendale JF & Panetta, FD (1994) The cost of parthenium weed to the Queensland cattle industry. *Plant Protection Quarterly***9**, 73–6.

Chippendale JF, Panetta FD, 1994. The cost of parthenium weed to the Queensland cattle industry. Plant Protection Quarterly, 9(2):73-76; 14 ref.

DafniA& Heller D (1982) Adventive flora of Israel: phytogeographical, ecological and agricultural aspects. *Plant Systematics and Evolution***140**, 1-18.

Dale IJ (1981) Parthenium weed in the Americas: A report on the ecology of *Partheniumhysterophorus* in South, Central and North America.*Australian Weeds***1**, 8-14.

De GC, Mukhopadhyay SK, 1983. Parthenium hysterophorus L. - a national hazard. Pesticides, 17:31-36.

EPPO (2012) EPPO Prioritization process for invasive alien plants. PM5/6.*Bulletin OEPP/EPPO Bulletin* **42**(3), 463-474.

Evans HC, 1997. Parthenium hysterophorus: a review of its weed status and the possibilities for biological control. Biocontrol News & Information, 18:89-98.

Everist SL (1976) Parthenium weed. *Queensland Agricultural Journal***102**, 2.

Govindappa MR, Chowda Reddy RV, Devaraja, Colvin J, Rangaswamy KT &Muniyappa, V (2005) *Partheniumhysterophorus*: a natural reservoir of Tomato Leaf Curl Begomovirus, In *Second International Conference on Parthenium Management.* (eds), T.V. Ramachandra Prasad, H. V. Nanjappa, R. Devendra, A. Manjunath, Subramanya, S. C. Chandrashekar, V. K. KiranKuman, K. A. Jayaram and T. K. PrabhakaraSetty, (University of Agricultural Sciences, Bangalore, India, pp. 80-82.

Jayachandra, 1971. Parthenium weed in Mysore State and its control. Current Science, 40:568-569.

Jayasuriya AHM (2005) Parthenium weed – status and management in Sri Lanka, In *Second International Conference on Parthenium Management.* eds. T. V. Ramachandra Prasad, H. V. Nanjappa, R. Devendra, A. Manjunath, Subramanya, S.C. Chandrashekar, V.K. KiranKuman, K.A. Jayaram and T.K. PrabhakaraSetty, University of Agricultural Sciences, Bangalore, India, pp. 36-43.

Kanchan S, Jayachandra, 1980. Pollen allelopathy - a new phenomenon. New Phytologist, 84:739-746.

Kololgi PD, Kololgi SD &Kologi NP (1997) Dermatologic hazards of parthenium in human beings. In Mahadevappa M &Patil VC (Eds) First International Conference on Parthenium Management Vol 1.Pp 18-19.

Kriticos, D J, Webber, B L, Leriche, A, Ota, N, Bathols, J, Macadam, I & Scott, J K (2012) CliMond: global high resolution historical and future scenario climate surfaces for bioclimatic modelling. *Methods in Ecology and Evolution***3**, 53-64.

Kumar S, Rohatgi N, 1999. The role of invasive weeds in changing floristic diversity. Annals of Forestry, 71(1):147-150.

Lakshmi C &Srinivas CR (2007) Parthenium: a wide angle view. *Indian Journal of Dermatology, Venerology and Leprology***73**, 296-306

Li M &Gao X (2012) Occurrence and management of parthenium weed in Shandong Province, China. In Shabbir S & Adkins SW (Eds) (2012) International Parthenium news. Number 6, July 2012. 5-6.

Mahadevappa M, Das TK, Ashok Kumar, 2001. Parthenium: a curse for natural herbs. Paper presented in the National Research Seminar on "Herbal Conservation, Cultivation, Marketing and Utilization with Special Emphasis on Chhattisgarh, The Herbal State". Raipur, Chhattisgarh, India: Srishti Herbal Academy & Research Institute (SHARI).

McFayden RE (1992) Biological control against parthenium weed in Australia. *Crop Protection***11**, 400-407.

Mirek Z, Piękoś-Mirkowa H, Zając A &Zając M (2002) Flowering plants and pteridophytes of Poland. A Checklist.*Biodiversity Poland***1**, 9-442.

More PR, Vadlamudi VP &Qureshi MI (1982). Note on the toxicity of *Partheniumhysterophorus* in livestock. *Indian Journal of Animal Science***52**, 456-457.

Narasimhan TR, Ananth M, NaryanaSwamy M, RajendraBabu M, Mangala A &SubbaRao PV (1977a) Toxicity of *Partheniumhysterophorus* L. to cattle and buffaloes. *Experientia***33**, 1358-1359.

Narasimhan TR, Ananth M, NaryanaSwamy M, RajendraBabu M, Mangala A &SubbaRao PV (1977b) Toxicity of *Partheniumhysterophorus* L. *Current Science*, **46**, 15-16.

Navie SC, McFadyen RA, Panetta FD & Adkins SW (1996a) A comparison of the growth and phenology of two introduced biotypes of *Partheniumhysterophorus*. 11th Australian Weeds Conference Proceedings, pp 313-316

Navie SC, McFadyen RE, Panetta FD & Adkins SW (1996b) The Biology of Australian Weeds 27. *Partheniumhysterophorus* L. *Plant Protection Quarterly***11**, 76-88.

Navie SC, McFadyen RE, Panetta FD, Adkins SW, 1996. The biology of Australian weeds. 27. Parthenium hysterophorus L. Plant Protection Quarterly, 11(2):76-88; 4 pp. of ref.

Ovies J &Larrinaga L (1988) Transmisson de *Xanthomonascampestris* PV *Phaseoli*mediante un hospedantesilvertre. *Ciencias Y Tecnica en la Agricultura***11**, 23-30.

Parsons WT, Cuthbertson EG, 1992. Noxious Weeds of Australia. Melbourne, Australia: Inkata Press, 692 pp.

PrasadaRao RD, Govindappa VJ, Devaraja MR &Muniyappa V (2005) Role of parthenium in perpetuation and spread of plant pathogens, In *Proceedings of the Second International Conference on Parthenium Management*, eds TV Ramachandra Prasad, HV Nanjappa, R Devendra, A Manjunath, Subramanya, SC Chandrashekar, VK Kiran Kumar, KA Jayaram& TK PrabhakaraSetty, University of Agricultural Sciences, Bangalore, India, pp. 65-72.

Ramachandra Prasad TV, Denesh GR, Kiran Kumar VK & Sanjay MT (2010) Impact of *Partheniumhysterophorus* L. on bio-diversity, ill effects and integrated approaches to manage in Southern Karanataka. International Conference on Biodiversity, 206-211.

Reddy KN & Bryson CY (2005) Why ragweed parthenium is not a pernicious weed in the continental USA? In *Proceedings of the Second International Conference on*

*Parthenium Management*, eds TV Ramachandra Prasad, HV Nanjappa, R Devendra, A Manjunath, Subramanya, SC Chandrashekar, VK Kiran Kumar, KA Jayaram& TK PrabhakaraSetty, University of Agricultural Sciences, Bangalore, India, pp. 61-64.

Saxena U, Gupta T, Gautam S, Gautam CPN, Khan AM &Gautam RD (2010) Faunal diversity of Partheniumhysterophorus in Delhi. In. Scientific Presentations - Third International Conference on Parthenium, December 8-10, 2010, IARI, New Delhi, p.41-43.

Shabbir A (2012) Towards the improved management of parthenium weed: complementing biological control with plant suppression. PhD thesis, The University of Queensland, Australia.

Shabbir AK, Dhileepan K, O'Donnell C & Adkins SW (2013) Complementing biological control with plant suppression: implications for improved management of parthenium weed (*Parthenium hysterophorus* L.). *Biological* Control **64**(3), 270-275.

Sharma VK &Sethuraman G (2007) *Parthenium* dermatitis.*Dermatitis***18**, 183-190.

Siebert, S, Doll, P, Hoogeveen, J, Faures, J M, Frenken, K & Feick, S (2005) Development and validation of the global map of irrigation areas. *Hydrology and Earth System Sciences***9**, 535-547.

Sushilkumar&Varshney JG (2010) Parthenium infestation and its estimated cost management in India.*Indian Journal of Weed Science***42**, 73-77.

SwaminathanC, VinayaRai RS & Suresh, KK (1990) Allelopathic effects of *Partheniumhysterophorus* on germination and seedling growth of a few multi-purpose trees and arable crops.*The International Tree Crops Journal***6**, 143-150.

Tamado T, 2001. Biology and management of parthenium weed (Parthenium hysterophorus L.) in Eastern Ethiopia. Acta Universitatis Agriculturae Sueciae - Agraria, No.311:80 pp.; 29 ref.

Tamado T, Milberg P, 2000. Weed flora in arable fields of eastern Ethiopia with emphasis on the occurrence of Parthenium hysterophorus. Weed Research (Oxford), 40(6):507-521; 38 ref.

Tamado T, Ohlander L & Milberg P (2002) Interference by the weed *Partheniumhysterophorus* L. with grain sorghum: influence of weed density and duration of competition. *International Journal of Pest Management***48**(3), 183-188

Timsina, B, BabuShrestha B, BahadurRokaya M &Munzbergova, Z (2011) Impact of *Partheniumhysterophorus* L. invasion on plant species composition and soil properties of grassland communities in Nepal. *Flora***206**, 233-240.

Tiwari JP, Bisen CR, 1984. Ecology of Parthenium hysterophorus. Indian Journal of Weed Science, 16(3):203-206

Towers GHN, Mitchell JC, Rodriguez E, Bennett FD, Subba Rao PV, 1977. Biology and chemistry of Parthenium hysterophorus L: a problem weed in India. Journal of Scientific & Industrial Research, 36:672-684.

Verloove F (2006) Catalogue of neophytes in Belgium (1800-2005).Meise, National Botanic Garden of Belgium.89 p.

Wise RM, van Wilgen BW, Hill MP, Schulthess F, Tweddle D, Chabi-Olay A& Zimmermann HG (2007) The Economic Impact and Appropriate Management of Selected Invasive Alien Species on the African Continent. Finale report.Global Invasive Species Programme.64 p.

## 5.4. Conclusion: Pest Risk Potential and Pests Requiring Phytosanitary Measures

The Pest Risk Assessment (PRA) is based on the International Standard for Phytosanitary Measures No 11 (2004) and the PRA scheme developed by CAB Internation (2007) and EPPO (European and Mediterranean Plant Protection Organization) (1997).

From the quantitatively risk analysts of quarantine pests likely to be associated and follow the eggplants pathway to Bangladesh from India, China, Thailand, and Japan and other exporting countries, the among 14 potential hazard organisms, all of these hazard organisms were identified with high risk potential.

The overall pest risk potential ratings of 14 quarantine pests of brinjal for Bangladesh have been included in the following Table:

**Table 9: The Overall Pest Risk Potential Rating**

| Sl. No. | Potential Hazard Organism | Common name | Family | Order | Pest Risk Potential |
|---|---|---|---|---|---|
| **Insect** | | | | | |
| 1 | Malaysian fruit fly | *Bactrocera latifrons* | Tephritidae | Diptera | **High** |
| 2 | Serpentine leaf miner | *Liriomyza trifolii* | Agromyzidae | Diptera | **High** |
| 3 | Pea leaf miner | *Liriomyza huidobrensis* | Agromyzidae | Diptera | **High** |
| 4 | Silver leaf whitfly | *Bemisia tabaci (B biotype)* | Aleurodidae | Homoptera | **High** |
| 5 | Vegetable weevil | *Listroderes costirostris* | Thripidae | Thysanoptera | **High** |
| 6 | Alfafa thrips | *Frankliniella occidentalis* | Thripidae | Thysanoptera | **High** |
| 7 | Cotton leaf worm | *Spodoptera littoralis* | Noctuidae | Lepidoptera | **High** |
| **Mite** | | | | | |
| 8 | *Tetranychus evansi* | Red tomato spider mite | Tetranychidae | Acarina | **High** |
| **Fungus** | | | | | |
| 9 | *Phytophthora megasperma* | Phytopthora root rot | Peronosporaceae | Peronosporales | **High** |
| **Nematode** | | | | | |
| 10 | *Globodera rostochiensis* | Golden cyst nematode | Heteroderidae | Tylenchida | **High** |
| 11 | *Globodera pallid* | Pale cyst nematode | Heteroderidae | Tylenchida | **High** |
| **Virus** | | | | | |
| 12 | Tobacco ringspot virus | *Tobacco ringspot nepovirus* | *Secoviridae* | *Picornavirales* | **High** |
| 13 | Pepper vein mottle virus | *Pepper veinal mottle virus* | Potyviridae | Unassigned (+)ssRNA | **High** |
| **Weed** | | | | | |
| 14 | Parthenium weed | *Parthenium hysterophorus* | Asteraceae | Asterales | **High** |

# CHAPTER 5

## RISK MANAGEMENT

### 6.1. Risk Management Options and Phytosanitary Procedures

Pest risk management evaluates and selects options for measures to reduce the risk of entry, establishment or spread of quarantine pests assessed to pose an unacceptable level of risk to Bangladesh via the importation of commercially produced brinjal from India, China, Thailand and Japan or any other countries of flower export (i.e. produced under standard cultivation, harvesting and packing activities). Plant Quarantine Wing of Bangladesh considers that the risk management measures proposed below is commensurate with the identified risks.

#### 6.1.1. Pre-harvest Management Options

The in-field pest management practises for the production of flowers are in brief:

- Pre-flowering pesticide treatments for arthropods and fungi above threshold levels;
- Post-flowering pesticide treatments above threshold levels for specific pests;
- Flower gardent hygiene which involves removal of fallen leaves and crop residues under a Good Agricultural Practise (GAP);

#### 6.1.2. Post-Harvest Procedures

The procedure is to sorting/grading to remove damaged/infested/infected flowers. The grading process is likely to remove flowers showing obvious signs of fungal and bacterial disease as well as the presence of aphids, mealybugs, scale insects, leaf miner, caterpillars etc.

#### 6.1.3. Visual Inspection

Visual inspection of flowers occurs at several points during the routine production and post-harvest pathway for flowers and foliages. These include:

- In-field monitoring during the growing season
- Harvesting
- Post-harvesting sorting and grading
- Packaging flowers for treatment
- Packaging of flowers for export
- Visual phytosanitary inspection

#### 6.1.4. Application of phytosanitary measures

A number of different phytosanitary measures may be applied to pests based on the outcome of an import or pest risk analysis. Required measures may include:

- Surveillance for pest freedom;
- Testing prior to export for regulated pests which cannot be readily detected by inspection (e.g. viruses on propagating material);
- Specific pre-shipment pest control activities to be undertaken by the supply contracting party;
- The application of a pre-shipment treatment;
- Inspection of the export consignment;
- Treatment on arrival in Bangladesh.

### 6.1.5. Pre-shipment requirements

**Inspection of the consignment:** Inspection of the consignment according to official procedures for all the visually detectable regulated pests specified by Plant Quarantine Wing (PQW) of the Department of Agriculture Extension of Bangladesh.

**Treatment of the consignment**

The eggplants from which these would be collected, should be treated as specified by PQW of Bangladesh.

**Documentation**

- Bilateral quarantine arrangement: Required.
- Phytosanitary certificate: Required.
- Import permit/Authorisation to import: Required.

### 6.1.6. Phytosanitary certification

A completed phytosanitary certificate issued by the NPPO of the country of origin must accompany all eggplant consignment exported to Bangladesh.

Before a phytosanitary certificate is to be issued, the NPPO of the country of origin must be satisfied that the following activities required by Ministry of Agiculture of Bangladesh have been undertaken.

The eggplants have:

v) been visually inspected in accordance with appropriate official procedures and found to be free from any regulated pests

AND,

vi) undergone appropriate pest control activities that are effective against: *Bemisia tabaci*

OR

vii) been sourced from a pest free area (verified by an official detection survey) free from a regulated pest(s).

AND

viii) undergone an agreed measure that is effective against associated fruit fly species of economic significance

### 6.1.7. Additional declarations to the phytosanitary certificate

If satisfied that the pre-shipment activities have been undertaken, the NPPO of the country of origin must confirm this by providing the following additional declarations to the phytosanitary certificate:

"The eggplants in this consignment have been:

- inspected according to appropriate official procedures and are considered to be free from the regulated pests specified by Plant Quarantine Wing under Department of Agriculture of Bangladesh, and to conform with Banglasesh’s current phytosanitary requirements”.

AND

- have undergone appropriate pest control activities that are effective against those regulated high impact pests

AND;

- have been sources from an area free from those regulated high impact pests;

### 6.1.8. Transit requirements

The eggplants must be packed and shipped in a manner to prevent infestation and/or contamination by regulated pests.

Where a consignment is split or has its packaging changed while in another country (or countries) *en route* to Bangladesh, a "Re-export Certificate" is required. Where a consignment is held under bond as a result of the need to change conveyances and is kept in the original shipping container, a "Re-export Certificate" is not required.

### 6.1.9. Inspection on arrival in Bangladesh

Plant Quarantine Wing of DAE of Bangladesh will check the accompanying documentation on arrival to confirm that it reconciles with the actual consignment.

### 6.1.10. Testing for regulated pests

PQW of DAE of Bangladesh may, on the specific request of the Director, PQW, test the consignment for regulated pests.

### 6.1.11. Actions undertaken on the interception/detection of organisms/contaminants

If regulated pests are intercepted/detected on the commodity, or associated packaging, the following actions will be undertaken as appropriate (depending on the pest identified):

- Treatment (where possible) at the discretion of the Director, PQW of Bangladesh;
- Reshipment of the consignment;
- Destruction of the consignment;
- The suspension of trade, until the cause of the non-compliance is investigated, identified and rectified to the satisfaction of PQW of DAE of Bangladesh.

Actions for the interception/detection of regulated non-plant pests will be in accordance with the actions required by the relevant government department.

### 6.1.12. Biosecurity clearance

If regulated pests are not detected, or are successfully treated following interception/detection, and there is no evidence to suggest the plant material is propagatable, biosecurity clearance will be given.

### 6.1.13. Feedback on non-compliance

The NPPO will be informed by the Director, Plant Quarantine Wing of Bangladesh, of the interception (and treatment) of any regulated pests, “unlisted” pests, or non-compliance with other phytosanitary requirements.

## 6.2 Risk Management Conclusions

All the pests assessed requires mitigative measures, however, due to the diverse nature of these pests, it is unlikely that a single mitigative measure will be adequate to reduce the risk to acceptable levels. Consequently, a combination of measures is being suggested as a feasible approach.