Government of the People's Republic of Bangladesh
Ministry of Agriculture
Department of Agricultural Extension
Plant Quarantine Wing
Strengthening Phytosanitary Capacity in Bangladesh Project

# Pest Risk Analysis (PRA) of Guava in Bangladesh

May 2017

# Pest Risk Analysis (PRA) of Guava in Bangladesh

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# FORWARD

The Strengthening Phytosanitary Capacity in Bangladesh (SPCB) Project under Plant Quarantine Wing (PQW), Department of Agricultural Extension (DAE), Ministry of Agriculture conducted the study for the "**Pest Risk Analysis (PRA) of Guava in Bangladesh"** according to the provision of contract agreement signed between SPCB-DAE and Eusuf and Associates (Pvt.) Limited on December 2016. The PRA study is a five month assignment commencing from 1 January 2017 under the SPCB-DAE.

The overall objectives of this Pest Risk Analysis are to identify the pests and/or pathways of quarantine concern for a specified area of Guava and evaluate their risk, to identify endangered areas, and if appropriate, to identify risk management options. To carry out the PRA study, the consulting firm conducted field investigations in 67 upazila under 28 major Guava growing districts of Bangladesh. As there is no comprehensive list of insect and mite pests, diseases and other pests of guava in Bangladesh, so it is needed to study PRA for listing of insect and mite pests, diseases and weeds of guava in Bangladesh. The study covered the interview 6700 Guava growers; 138 field level officers and 28 Policy Level officers Additional Deputy Director (Plant Protection), total of 30 key personnel were interviewed using a semi-structured KII Checklist. The key informant interviews were conducted with the extension personnel at field and headquarter level of DAE, officials of Plant Quarantine Centres at Sea and land ports; officials of Ministry of Agriculture; Entomologist and Plant Pathologist of BARI, Agricultural Universities. The survey was also covered 28 FGDs each of which conducted in one district for qualitative data and visits of the Guava fields under sampled districts. The consultants also reviewed secondary sources of information related to PRA of Guava.

The study findings evidenced that a total of 38 pests of Guava were recorded in Bangladesh, of which 13 were arthropod pests, 8 species of pathogenic microorganisms and 17 weeds. The study also revealed that 15 pests of Guava were identified as quarantine importance for Bangladesh that included 11 insect pests, 3 disease causing pathogen including one fungus, one bacterium, one algae and one weed that could be introduced into Bangladesh through importation of commercially produced Guava. The consultant team also conducted the risk assessment for each quarantine pest individually based on the consequences and potential of introduction of each quarantine pest and a risk rating was estimated for each. Based on the risk assessment and risk rating, out of fifteen (15) potential hazard organisms, 12 hazard organisms were identified with high risk potential, one identified with moderate risk potential and one with low risk rating. These mean that these pests pose unacceptable phytosanitary risk to Bangladesh's agriculture.

The findings of the PRA study had been presented in the National Level Workshop organized by the SPCB-PQW of DAE. The concerned professionals represented from the country's reputed agricultural universities, research organizations and other relevant personnel from different organizations attended in the workshop. The online version of this report is available in the official website of DAE at www.dae.gov.bd

I would like to congratulate study team for conducting the PRA study successfully and also the concerned SPCB professionals in making the total endeavor a success. I express my heartfelt thanks to the officials of DAE, Ministry of Agriculture, BARI, SCA, Agricultural Universities, research organizations and Guava importer and exporters' associations for their assistance and cooperation extended in conducting the PRA study. Thanks are also due to all members of Technical Committees for cooperation. Special thanks to the Secretary, Additional Secretary, DG (Seed Wing), Additional Secretary (Extension), Director General of DAE, Director (Plant Quarantine Wing) and other high officials under the Ministry of Agriculture for providing us valuable advice and guidance. I hope that the report certainly would contribute to enhance the exports and imports of Guava.

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# PREFACE

This report intends to respond to the requirement of the client according to the provision of contract agreement signed between Project Director of Strengthening Phytosanitary Capacity in Bangladesh (SPCB) and the Eusuf and Associates (Pvt.) Limited for **"Conducting Pest Risk Analysis (PRA) of Guava in Bangladesh"** under Plant Quarantine Wing (PQW), Department of Agricultural Extension (DAE), Ministry of Agriculture (MOA), Government of the Peoples Republic of Bangladesh. The PRA study is a five month assignment commencing from 1 January 2017 under the SPCB-DAE.

Consultancy services for "Conducting Pest Risk Analysis (PRA) of Guava in Bangladesh" was provided by the Eusuf and Associates (Pvt.) Limited, Bangladesh. The study team consists of five senior level experts including field and office level support staffs. The major objective of the study is to listing of major and minor pests of Guava, identification of pests likely to be associated with pathway, identification of potential for entry, establishment and spread, identification of potential economic and environmental impact, identification of control measures and potential impacts of such measures, assessment of potential loss by the pests, preparation of report on risk analysis of the pests following the relevant ISPMs and make recommendation.

This report includes study design, sampling framework and data collection instruments, guidelines and checklists, details of survey and data collection method, data management and analysis and survey finding as well as the stages of PRA, risk assessment strategies of the pests likely to be associated with the commodity to be imported from the exporting countries and the risk management options as recommendations. The report had been reviewed and discussed thoroughly by the SPCB officials along with other experts and representatives through several discussion meetings. This report had been presented in the national level workshop for further comments and suggestions. The consultants finally revised and prepared this report of the PRA study based on comments and suggestions of the client and experts.

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## ACKNOWLEDGEMENTS

It is indeed a great honor for us that Strengthening Phytosanitary Capacity in Bangladesh (SPCB) Project under Plant Quarantine Wing (PQW) of Department of Agricultural Extension (DAE) has entrusted Eusuf and Associates (Pvt.) Limited to carry out the "**Conducting Pest Risk Analysis (PRA) of Guava in Bangladesh"**. This report has been prepared based on the past five months (January 2017 to May 2017) activities of the survey study in major 28 Guava growing districts of Bangladesh as well as on the review of secondary documents. In the process of working on the setting indicators and sampling as well as for revising the questionnaires for the field survey and data collection, monitoring and supervision, data analysis and report writing, we have enjoyed the support of SPCB-PQW. The principal author is Dr.SK. Hemayet Hossain, Team Leader with inputs from Dr. S.M. Abul Hossain, (Entomologist), Dr. Md. Anwar Hossain (Plant Pathologist), Md. Lutfor Rahman (Agronomist) of the PRA study team.

The authors are grateful to all persons involved in the PRA study. Our special gratitude to Md. Golam Maruf, Director General, DAE, Bangladesh, who provided his extended support and gave us an opportunity to meet Director of Plant Quarantine Wing (PQW) of DAE. Special thanks to Dr. Mohammad Ali, Project Director, Strengthening Phytosanitary Capacity in Bangladesh (SPCB) Project; Mr. Md. Ahsan Ullah, Consultant (PRA); Mrs. Marina Jebunehar, Senior Monitoring and Evaluation Officer, SPCB for their valuable cooperation, guidance and suggestions to the study team in line with the activities performed during study and report preparation. Our special grateful thanks are also given to Mohammad Mohsin, Director, PQW of DAE for his kind cooperation and suggestions during the study period. The active support and inspiration and cooperation of Dr. Mohammad Eusuf Ali, President, Eusuf and Associates are praise-worthy during the entire period of study.

**(Dr.SK. Hemayet Hossain)**
Team Leader

# ACRONYMS

| | |
|---|---|
| AEZ | Agro-Ecological Zone |
| BADC | Bangladesh Agriculture Development Corporation |
| BARI | Bangladesh agricultural Research Institute |
| BBS | Bangladesh Bureau of Statistics |
| CABI | Center for Agriculture and Bioscience International |
| DAE | Department of Agricultural Extension |
| DG | Director General |
| Dr. | Doctor |
| *e.g.* | For Example |
| EPPO | European and Mediterranean Plant Protection Organization |
| *et al.* | and associates |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| FAOSTAT | Food and Agriculture Organization Statistics |
| FGD | Focus Group Discussion |
| GoB | Government of Bangladesh |
| IPPC | International Plant Protection Convention |
| IPM | Integrated Pest Management |
| ISPM | International Standard For Phytosanitary Measures |
| *J.* | Journal |
| KII | Key Informant Interview |
| Ltd | Limited |
| NGO | Non-Government Organization |
| No. | Number |
| NPPO | National Plant Protection Organization |
| $^{o}$C | Degree Celsius |
| PD | Project Director |
| PFA | Pest Free Area |
| PPW | Plant Protection Wing |
| PQW | Plant Quarantine Wing |
| PRA | Pest Risk Analysis |
| Pvt. | Private |
| RH | Relative Humidity |
| SCA | Seed Certification Agency |
| SID | Statistics and Informatics Division |
| SPCB | Strengthening Phytosanitary Capacity Project in Bangladesh |
| UK | United Kingdom |
| USA | United States of America |
| USDA | United States Department of Agriculture |
| % | Percentage |

# EXECUTIVE SUMMARY

The study "Pest Risk Analysis (PRA) of Guava in Bangladesh" documents the pests of guava fruitsavailable in Bangladeshand the risks associated with the import pathway of guava from the exporting countries namelyThailand, India, Myanmar or other exporting countries of the worldinto Bangladesh.

The findings evidenced that the forty three (43) pests of guava were recorded in Bangladesh, of which 15 arthropod pests that included 13 insect pests and 2 mite pests; 11 disease causing pathogens and 17 weeds. The incidences of insect pests of guava recorded in Bangladesh were guava fruit fly (*Bactrocera correcta*), oriental fruit fly (*Bactrocera dorsalis),* peach fruit fly (*Bactrocera zonata),* Malaysian fruit fly (*Bactrocera latifrons*), spiraling whitefly (*Aleurodicus disperses),* cottony cushion scale (*Icerya purchase),* green shield scale (*Pulvinaria psidii),* pineapple mealy bug (*Dysmicoccus brevipes),* pink hibiscus mealybug (*Maconellicoccus hirsutus),* guava mealy bug (*Ferrisia virgata),* castor capsule borer (Z*ongethes (Dichocrocis) punctiferalis* Guenée), fruit borer (*Rapala varuna)*, oriental yellow scale (*Aonidiella citrina*) and black scale (*Saissetia oleae*), where as two mite pests of guava was recorded in Bangladesh named red and black flat mite (*Brevipalpus phoenicis)* and false spider mite (*Brevipalpus californicus).* Among these insect and mite pests of guava, guava fruit fly was more damaging than other arthropod pests. The guava fruit fly was designated as major pest of guava and caused damage with high infestation intensity. The pest status of all other insect and mite pests was minor significance and caused low level of infestation.

A total number of eleven (11) species of disease causing pathogens of guava were recorded in Bangladesh, among which 9 diseases were caused by fungi, 1 caused by nematode and 1 diseases of guava was caused by virus. The incidences of fungal diseases of guava reported in Bangladesh were anthracnose (*Glomerella cingulata),* basal rot (*Fusarium oxysporum),* brown rot *(Diplodia netalensis Evans),* fruit canker (*Pestalotia psidii* Pat), Botryosphaeria rot (*Botryosphaeria ribis* Gross. & Duggar), Mucor rot (*Mucor hiemalis),* grey leaf spot (*Cercospora* sp.), die back (*Phytophthora* sp.) and guava wilt (*Fusarium oxysporum* Sch. f. sp*. psidii*).The nemic disease of guava was root knot nematode (*Meloidogyne incognita*). The viral disease of guava reported in Bangladesh was *Cotton leaf curl virus (CLCuV*). Among these diseases, Anthracnose was more damaging than others. But diseases were reported as minor importance for guava and caused damage with low infection intensity in Bangladesh.

A total number of seventeen (17) weeds were recorded as the problem in the field of guava in Bangladesh. The incidences of weeds in the field of guava were bermuda grass (*Cynodon dactylon* L. *),* egyptian crowfoot grass (*Dactyloctenium aegyptium* (L.)), cogon grass (*Imperata cylindrical* (L.)), quack grass (*Agropyron repens* (L.)), Indian goose grass (*Eleusine indica (*L.)), johnson grass (*Sorghum helepense* (L.)), coat buttons (*Tridax procumbens* L.), beggar-ticks (*Bidens pilosa* L.), amaranth (*Amaranthus viridis* L.), asthma herb (*Euphorbia hirta* L.), perthenium weed (*Parthenium hysterophorus* L), horse purslane (*Trianthema portulacastrum* L.), common Purslane (*Portulaca oleracea* L), purple nut sedge (*Cyperus rotundus* L.), flat sedge (*Cyperus iria* L.), yellow nutsedge (*Cyperus esculentus* L.) and small-floweed umbrella sedge (*Cyperusdifformis*L.). The parthenium weed (*Partheniumhysterophorus*)was recorded and found in some restricted areas of Bangladesh namely Rajshahi, Natore, Pabna, Kustia, Jessore districts. These districts are nearly attached with the Western border of Bangladesh and Eastern border of West Bengall of India. 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. 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 seventeen weeds were reported as minor importance with low infestation intensity in guava fields.

Information on pests associated with guava in the exporting countriesThailand, India, China, Myanmar and other exporting countries—revealthat pests of quarantine importance exist. The study also revealed fifteen (15) pest species of quarantine importance that included 10 insect pests, 4 disease causing pathogens including 2 fungi, 1 bacterium and 1 algae; and 1 weed. Without mitigation, these pests could be introduced into Bangladesh through importation of commercially produced guava. Pests of quarantine importance includedinsect pests namely Queensland fruit fly (*Bactrocera tryoni),* Mediterranean fruit fly (*Ceratitis capitata),* green scale (*Coccus viridis),* spiked mealybug (*Nipaecoccus nipae),* long-tailed mealybug (*Pseudococcus longispinus),* tea mosquito bug (*Helopeltis antonii* Signoret), guava aphid (*Aphis punicae* Passerini), red banded thrips (*Selenothrips rubrocinctus),* anar butterfly (*Virachola isocrate*) and guava stem borer (*Apriona* sp.).

The quarantine pathogens of guava included four (4) disease causing pathogens have been identified as quarantine pests of guava for Bangladesh. Among these, 2 were quarantine fungi namely brown rot (*Monilinia fructigena*) and guava rust (*Puccinia psidii*); 1 quarantine bacteria namely guava bacteriosis (*Erwinia psidii)*; 1 species of algae namely algal leaf and fruit spot (*Cephaleuros virescens)*. The quarantine weed identified for Bangladesh included *Parthenium hysterophorus* L.

The consequences and potential/likelihood of introduction of each quarantine pest were assessed individually, and a risk rating estimated for each. The consequence and potential of introduction value was estimated assessing biology, host, distribution, hazard identification, risk assessment, consequence assessment, risk estimation and risk management of the pests: The two values were summed to estimate an overall Pest Risk Potential, which is an estimation of risk in the absence of mitigation.

Out of 16quarantine pests associated with the pathway risk assessed. Out of fifteen (15) potential hazard organisms, 12 hazard organisms were further analyzed for risk assessment and 3 organisms remained as uncertainty namely guava stem borer (*Apriona* sp.), guava rust (*Puccinia psidii*) and bacteriosis (*Erwinia psidii*) due to lack of its detail information. Among 12 hazard potential those were further analyzed for risk assessment, 10 hazards were identified with high risk potential, 1 identified with moderate risk potential and 1 with low risk rating. These mean that these pests pose unacceptable phytosanitary risk to Bangladesh's agriculture. Visual inspection at ports-of-entry for high risk potential pests is insufficient to safeguard Bangladesh's fruit industry and specific phytosanitary measures are strongly recommended. While for moderate risk potential pest, specific phytosanitary measures may be necessary to reduce pest risk.

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# CHAPTER 1

## SCOPE AND METHODOLOGY OF PEST RISK ANALYSIS

### 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 a 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 and economic evidence. If the risk is deemed unacceptable, the analysis may continue by suggesting management options that can reduce the risk to an acceptable level. Subsequently, pest risk management options may be used to establish phytosanitary regulations. For some organisms, it is known beforehand that they are pests, but for others, the question of whether or not they are pests should initially be resolved.

The pest risks posed by the introduction of organisms associated with a particular pathway, such as a commodity, should also be considered in a PRA. The commodity itself may not pose a pest risk but may harbour organisms that are pests. Lists of such organisms are compiled during the initiation stage. Specific organisms may then be analyzed individually, or in groups where individual species share common biological characteristics.Less commonly, the commodity itself may pose a pest risk. When deliberately introduced and established in intended habitats in new areas, organisms imported as commodities (such as plants for planting, biological control agents and other beneficial organisms, and living modified organisms (LMOs)) may pose a risk of accidentally spreading to unintended habitats causing injury to plants or plant products. Such risks may also be analyzed using the PRA process.

The PRA process is applied to pests of cultivated plants and wild flora, in accordance with the scope of the IPPC. It does not cover the analysis of risks beyond the scope of the IPPC. Provisions of other international agreements may address risk assessment (e.g. the Convention on Biological Diversity and the Cartagena Protocol on Biosafety to that convention).

Bangladesh has been importing guava and its planting materials from different exporting counties such as India, Thailand, China, Myanmar, Japan, Vietnam, Indonesia, or other counties of the world. But there is no risk analysis of imported guava. So, there is a scope of introducing alien pests including insect pests, diseases, weeds and other associated pests into Bangladesh which may potentially damage guava plants and agricultural crops. In this context, the Pest Risk Analysis (PRA) of Guava in Bangladesh is indispensable. Thus, the assignment on PRA of Guava in Bangladesh was undertaken aiming to identify the major and minor insect pests, diseases, weeds and other associated pests of guava in major crop growing areas of Bangladesh and quarantine pests of guava and evaluate their risk as well as to identify risk management options. However, assessment of the potential risk of introduction of pests with this commodity to Bangladesh and the probability of their Establishment in Bangladesh condition has not yet been performed. Recently, Plant Quarantine Wing, Department of Agricultural Extension (DAE) felt that an analysis of the biosecurity risks of guava pests is required. Hence, the present activities were taken up. Here, pests are referred to insect pests, diseases and weeds of guava and the PRA areas were the selected 26 major agricultural crop growing districts of Bangladesh.

### 1.2 Scope of the Risk Analysis

The scope of this analysis is to find out the potential hazard organisms such as insect pests, diseases, weeds or other pests associated withguava imported from different exporting countries such asIndia, Thailand, China, Myanmar, Japan, Vietnam, Indonesia, or other counties of the world. 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 guava which brings along with them a certain risk of the introduction of diseases and pests that are harmful to agriculture.

According to the Terms and Reference (ToR) of the study, the consulting firm is required to identify the major and minor pests of guava in Bangladesh and to identify quarantine pests of guava for Bangladesh that follow the pathway(s), evaluate their risk, and risk management options etc.

### 1.4 PRA Areas

The entire Bangladesh is considered as PRA area in this risk analysis because guava is grown almost all over the country. Moreover guava is imported through different land and or sea ports or airports, which are located all regions of Bangladesh. However, survey on insect pests, diseases, weeds and other hazard organisms was done in major guava growing districts of Bangladesh.

### 1.5 Methodology of Pest Risk Analysis

PRA process includes three major stages such as Initiation, Pest Risk Assessment and Pest Risk Management as adapted from ISPM No. 2 (2007). The following methods were sequentially followed to conduct PRA of Guava.The process and methodology for undertaking import risk analyses are shown in Figure 1.

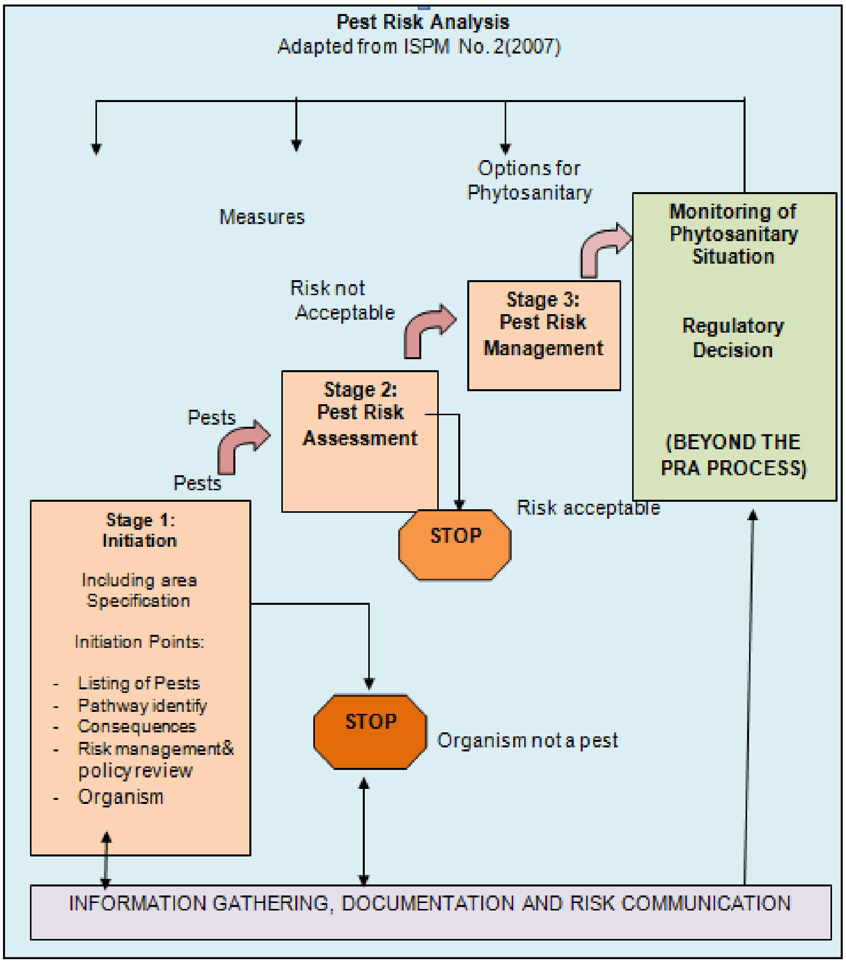



**Figure 1: Schematic Diagram of Pest Risk Analysis**

### 1.6 Methodology of Data Collection

Bangladesh till to date do not have any pest list of guava, so, to conduct PRA we first require an updated pest list of guava. Accordingly we conducted a survey program and take help from the Universities and Research Institutes, Extentionists, relevant stakeholders and from CABI, EPPO to make a pest list of guava in Bangladesh. After completing the pest lists we have tried to asses the import risk of guava from the mentioned countries.

#### 1.6.1 Introduction

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, weeds and other associated pests of guava, 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.

#### 1.6.2 Field survey

The study survey was conducted with the direct interview of guava growers in 28 major guava producing districts of Bangladesh for quantitative data aiming to identify insect pests, diseases, weeds and other pests, their status, damage 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 guava growers and through key informant interviews (KII) with extension personnel at field and headquarer level of DAE, 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, BADC etc.

#### 1.6.2 Secondary data collection and review

The current PRA related secondary data were collected and gathered from secondary sources such as journals, books, reports, proceedings, CD-ROM (CABI) search etc. The documents were then critically reviewed, synthesized in relation to identify the quarantine pests of guava available in the guava exporting counties namelyThailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Ecuador,India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy as well as PRA related activities performed there. Ultimately, formulated all of these synthesized information based on the requirement of the current PRA.

#### 1.6.4 Internet browsing

The PRA related information on pests of guava were also collected and gathered through internet browsing especially through websites of CAB International, EPPO Bulletin and different e-Journals etc. The documents were then critically reviewed, synthesized in relation to identify the quarantine pests of guava available in the exporting counties of commodities as well as PRA related activities performed there. Ultimately, formulated all of these synthesized information based on the requirement of the current PRA.

#### 1.6.5 Listing of pests of guava

There is no comprehensive list of guava pests in Bangladesh. Therefore, it is required to make a comprehensive list of guava pests in Bangladesh through primary and secondary data collection for conducting the risk analysis of guava pests. The insect pests, diseases, weeds and other associated pests of guava 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 guava 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 guava in Bangladesh were also listed.

### 1.6.6 PRA Location and Study Sampling

The survey study sas conducted in the 28 major guava 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 67 upazilas were selected under the 28 sampled distrcts, where 10 agricultural blocks were covered under each upazilla and 10 guava growers were interviewed in each block through pre-tested questionnaire. Thus, a total of 6700 growers/farmers were interviewed from all of 28 sampled districts. The focus group discussion (FGD) meeting was also conducted for each of 28 sampled districts with the participation of at least 10 guava growers aiming to gather qualitative data. Besides, one officer designated as Additional Deputy Director (Plant Protection) for each district had also been interviewed through semi-structured key informant interview (KII) checklist. The district and upazila wise distribution of respondents is given below:

**Table 1: Distribution of the Respondents in Major Guava Growing Districts of Bangladesh**

| SN | District | Upazilla | No. of Block | No. of Farmers | No. of FGD | KII |
|---|---|---|---|---|---|---|
| 1 | Pabna | Ishawardi | 10 | 100 | 1 | 1 |
| | | Sadar | 10 | 100 | | |
| | | Sujanagar | 10 | 100 | | |
| 2 | Nator | Sadar | 10 | 100 | 1 | 1 |
| | | Baghatipara | 10 | 100 | | |
| 3 | Rajshahi | Godagari | 10 | 100 | 1 | 1 |
| | | Sadar | 10 | 100 | | |
| 4 | Porojpur | Nesarabad | 10 | 100 | 1 | 1 |
| | | Nazirpur | 10 | 100 | | |
| 5 | Jalokathi | Sadar | 10 | 100 | 1 | 1 |
| | | Rajapur | 10 | 100 | | |
| 6 | Chittagong | Chandanaish | 10 | 100 | 1 | 1 |
| | | Patia | 10 | 100 | | |
| | | Satkania | 10 | 100 | | |
| 7 | Comilla | Sadar | 10 | 100 | 1 | 1 |
| | | Barura | 10 | 100 | | |
| 8 | Gazipur | Kapasia | 10 | 100 | 1 | 1 |
| | | Sreepur | 10 | 100 | | |
| | | Kaliakor | 10 | 100 | | |
| 9 | Norsindhi | Shibpur | 10 | 100 | 1 | 1 |
| | | Raipur | 10 | 100 | | |
| 10 | Sirajgonj | Sadar | 10 | 100 | 1 | 1 |
| | | Kamarkhanda | 10 | 100 | | |
| 11 | Cox'sbazar | Chokoria | 10 | 100 | 1 | 1 |
| | | Ramu | 10 | 100 | | |
| 12 | Joypurhat | Akkelpur | 10 | 100 | 1 | 1 |
| | | Sadar | 10 | 100 | | |
| | | Panchibibi | 10 | 100 | | |
| 13 | Chapainwabgonj | Gomastapur | 10 | 100 | 1 | 1 |

| SN | District | Upazilla | No. of Block | No. of Farmers | No. of FGD | KII |
|---|---|---|---|---|---|---|
| | | Sadar | 10 | 100 | | |
| | | Nachol | 10 | 100 | | |
| 14 | Bagerhat | Sadar | 10 | 100 | 1 | 1 |
| | | Chitolmari | 10 | 100 | | |
| 15 | Chuadanga | Jibon Nagor | 10 | 100 | 1 | 1 |
| | | Dmurhuda | 10 | 100 | | |
| 16 | Meharpur | Sadar | 10 | 100 | 1 | 1 |
| | | Mujib Nagor | 10 | 100 | | |
| 17 | Rajshahi | Godari | | 100 | 1 | 1 |
| | | Baghmara | 10 | 100 | | |
| 18 | Sherpur | Sreebordi | 10 | 100 | 1 | 1 |
| | | Jenaigati | 10 | 100 | | |
| | | Sadar | 10 | 100 | | |
| 19 | Mymensingh | Valuka | 10 | 100 | 1 | 1 |
| | | Fulbaria | 10 | 100 | | |
| | | Gouripur | 10 | 100 | | |
| 20 | Kishoregonj | Sadar | 10 | 100 | 1 | 1 |
| | | Bhairab | 10 | 100 | | |
| | | Katoadi | 10 | 100 | | |
| | | Kuliarchar | 10 | 100 | | |
| 21 | Noagaon | Manda | 10 | 100 | 1 | 1 |
| | | Porsa | 10 | 100 | | |
| | | Neamotpur | 10 | 100 | | |
| 22 | Joypurhut | Sadar | 10 | 100 | 1 | 1 |
| | | Panchbibi | 10 | 100 | | |
| 23 | Khagrachari | Sadar | 10 | 100 | 1 | 1 |
| | | Matiranga | 10 | 100 | | |
| 24 | Bandarban | Sadar | 10 | 100 | 1 | 1 |
| | | Naikhangchari | 10 | 100 | | |
| 25 | Bogra | Shibgonj | 10 | 100 | 1 | 1 |
| | | Kahalu | 10 | 100 | | |
| 26 | Dhaka | Savar | 10 | 100 | 1 | 1 |
| | | Dhamrai | 10 | 100 | | |
| 27 | Khagrachari | Manikchari | 10 | 100 | 1 | 1 |
| | | Matiranga | 10 | 100 | | |
| | | Ramgrah | 10 | 100 | | |
| 28 | Tangail | Sukhipur | 10 | 100 | 1 | 1 |
| | | Modhupur | 10 | 100 | | |
| **Total= 28** | | **67** | **670** | **6700** | **28** | **28** |

### 1.6.7 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 28 major guava growing districts of Bangladesh through face to face interview with 6700guava growers using a set of pre-designed and pre-tested questionnaire (**Appendix-1)** encompassing the relevant study indicators.

**Focus Group Discussion (FGD) guidelines:** For qualitative analysis, 28 FGD meetings were organized considering one FGD for each sampled districts with the participantion of at least 10 guava growers for each. The FGD meetings were conducted using pre-designed FGD guidelines (**Appendix-2**).

**Key Informant Interview (KII) checklists:** The key informant interviews were conducted with the extension personnel at field and headquarer level of DAE, officials of Plant Quarantine Centres at Sea and land ports; officials of Ministry of Agriculture; Entomologist and Plant Pathologist of BARI, Agricultural Universities. A total of 30 key personnel were interviewed using a semi-structured KII Checklist (**Appendix 3-6)** encompassing the qualitative issues of the study.

**Field visit/physical observation chicklists:** 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**.**

# CHAPTER 2

## METHODOLOGY OF RISK ANALYSIS

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:

### 2.1 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

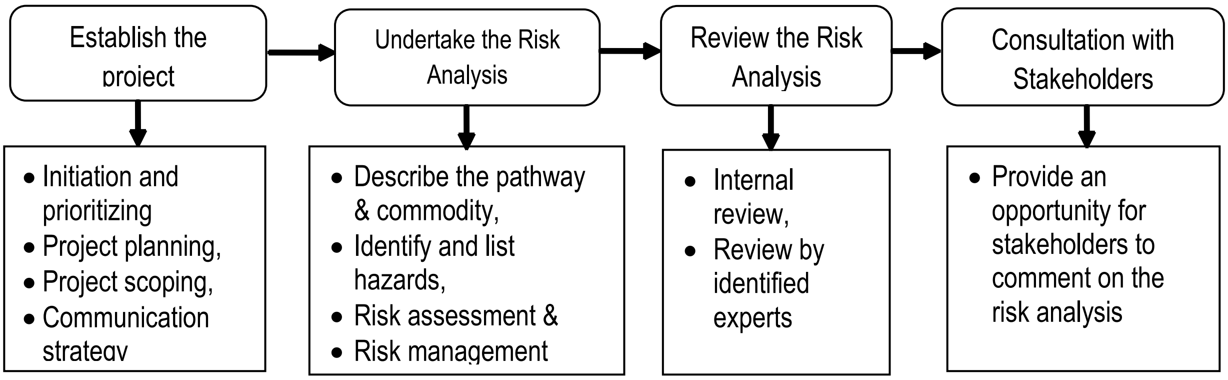
In most cases, these steps were applied sequentially in a PRA but it is not essential to follow a particular sequence. Pest risk assessment needs to be only as complex as is technically justified by the circumstances. This standard allows a specific PRA to be judged against the principles of necessity, 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 2: A summary of the risk analysis development process**




## 2.2 Pathway Description

### 2.2.1 Import Pathways of Guava

For the purpose of this risk analysis, guava are presumed to be from anywhere in exporting countries such as Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Ecuador,India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy.

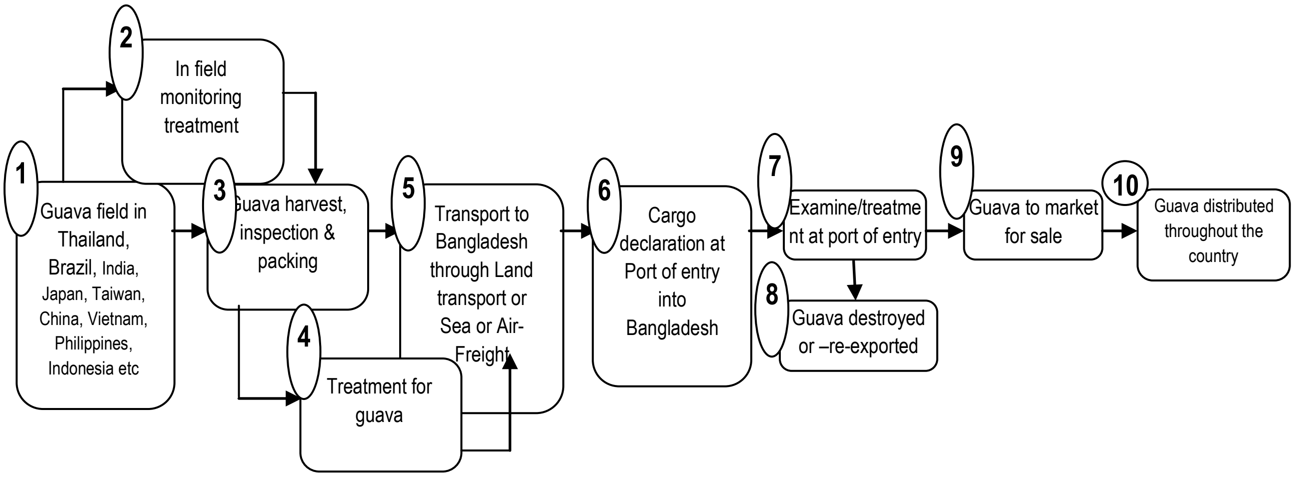
To comply with existing Bangladesh import requirements for guava, the commodity would need to be prepared for export to Bangladesh by ensuring certain pests (insect & mite pests, diseases, weeds or any othe pests) are not associated with the product. Commodity would then be sea or land or air freighted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

### 2.2.2 Pathway Description

- Guava in Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Ecuador,India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy are being grown in the field, either as a single crop or beside other field or horticultural crops.
- Monitoring of the insect & mite pests, diseases, weeds and any other pests of guava is undertaken, with appropriate controls applied.
- Guavas are being harvested, inspected and the best quality washed, pre-treated and packed in boxes.
- Post harvest disinfestations including fumigation or cold disinfestations are being undertaken either before or during transport of the guava to Bangladesh.
- Transport to Bangladesh is by air or sea or land port.
- Each shipment must be accompanied by the appropriate certification, e.g. a phytosanitary certificate attesting to identity the guava, any treatments completed, or other information required to help mitigate risks.
- Guavas are examined at the border to ensure compliance.

- Any guava not complying with Bangladesh biosecurity requirements (e.g. found harboring pest organisms) are either treated re-shipped or destroyed.
- Beside these, natural entry of some pests of guava may occure from other neighbouring country(ies) into Bangladesh. For example, queensland fruit fly can fly 50-100 Km. (Fletcher, 1989).
- Possibility of entry of pests of guava from exporting country(ies) into Bangladesh through transportation of commodities by escaping the phytosanitary inspection in the port of entry. For example, the infestation and symptoms of long tailed mealybug can not ditected by necked eyes. So it can be escaped easily at the time of transportation.
- Guavas are stored before being distributed to market for sale.
- Dealers and sellers of guava stock and these are bought to users and or farmers within the local area these are sold in.The linear pathway diagram of import risk of guava is furnished below:

**Figure 3: Linear Pathway Diagram for Identification of Guava Pest Infestation**




## 2.3 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 or any oth pests of guavawhich could be introduced into Bangladesh by risk goods, and are potentially capable of causing harm to guava production, must be identified. This process begins with the collection of information on insect pests, diseases (pathogen) or weed or any other pests of guavapresent 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 4.

## 2.4 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. A risk assessment consists of four inter-related steps:

- Assessmentof likelihood of entry,
- Assessment of likelihood of exposure and establishment, and
- Assessment of 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 the following figure.

## 2.5 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.

## 2.6 Risk Management

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 selected on the basis of a precautionary approach. The rationale for selecting measures must be made apparent.

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

## 2.7 Risk Evaluation

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

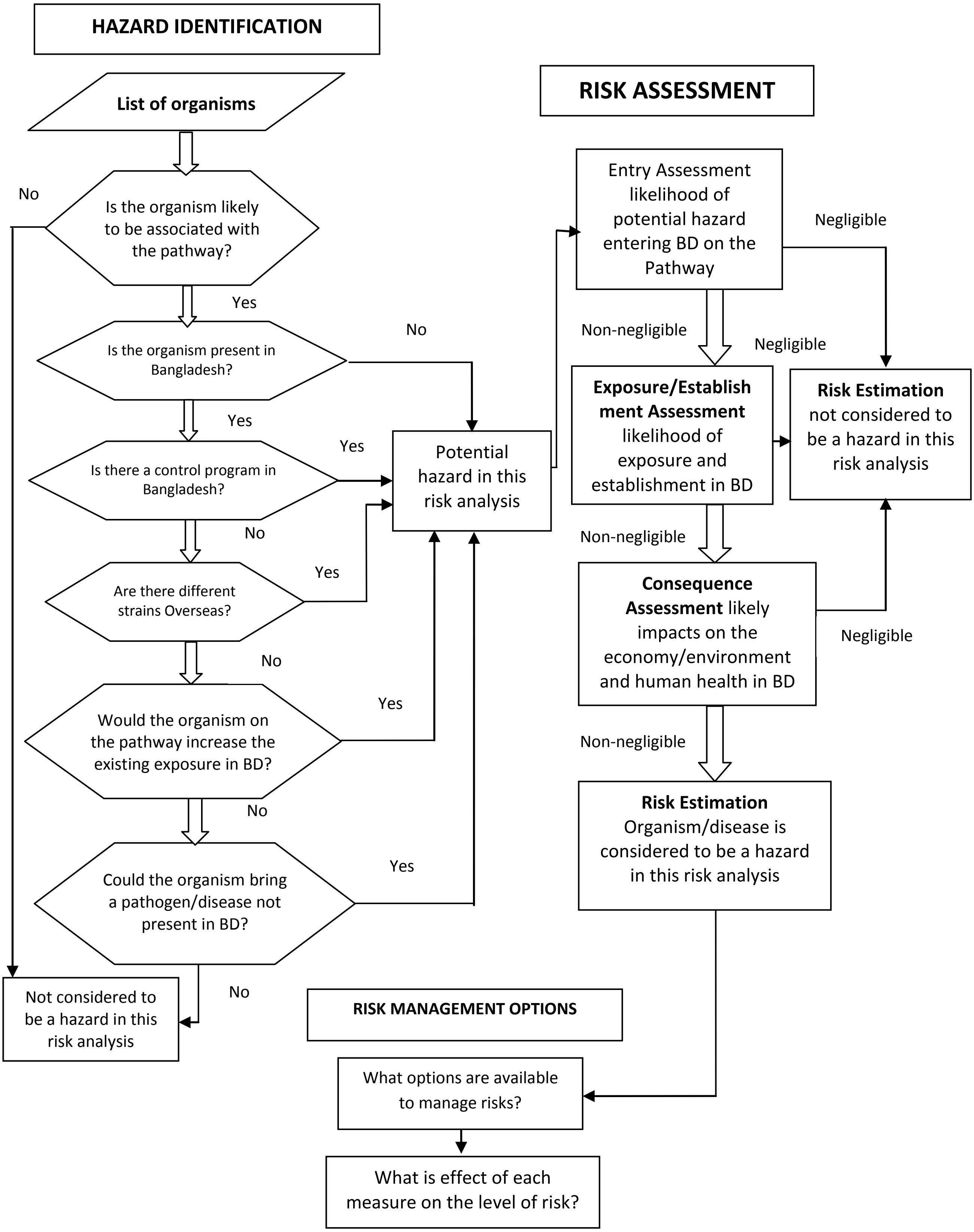
### 2.8 Option Evaluation

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 (Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Ecuador,India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy) for guavafruits and seeds 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.

### 2.9 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.

**Figure 4: Diagram of the Risk Analysis Process: the three main aspects of analysis include hazard identification, risk assessment and risk management**



# CHAPTER 3

## INITIATION

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 guava. 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.

### 3.1 Commodity Description

#### 3.1.1 Introduction

Guava (*Psidium* sp.) the apple of the tropics, belongs to the family Myrtaceae which comprises more than 150 species, is one of the major fruits of Bangladesh. Only twenty of them are capable to producing edible fruits, of which the most commonly cultivated are the common guava i.e. *Psidium guajava* L. (Pathak and Ojha, 1993). It is considered the most important fruit in area and production after jackfruit, pineapple, mango and melon in Bangladesh (BBS, 2008).

It grows everywhere in the country, homestead gardens but commercially cultivated in Barisal, Sylhet, Chittagong, and north western region of Bangladesh.

Nutritionally Guava is the best fruit of the world. Guava is higher in vitamin C (560 mg/100 g) (Phandis, 1970), which is the second after Anola (600 mg/100 g) and 2 to 5 times higher than fresh orange juice. Guava fruits are also a good source of pectin, which may have Industrial use for jelly production (Bose and Mitra, 1990). It is a good source of vitamin A, calcium (0.01-0.06%) and phosphorus (0.02-0.04%). It contains much iron (1.0-1.2%), but 80% of this is in seeds (Millar and Bazore, 1945). One hundred g of guava per capita is sufficient for meeting the daily requirement of vitamin C and iron. Calcium, phosphorus, potassium, sulphur, sodium, chlorine, iron and magnesium are more or less available in guava (FAO, 2009). For higher nutritional value it is popular among the rich and poor people in Bangladesh due to its comparative low price than some other fruits, nourishing value and good taste.

In Bangladesh, several varieties namely, Swarupkathi, Mukundapuri, Kanchannagor are cultivated commercially for long time. Some introduced varieties, Kazi, Shilong, Kashi are now cultivated. Among the introduced varieties, Kazipiara is now cultivated in many areas commercially and also grown extensively in homestead. It produces bigger fruits than all other varieties. Swarupkathi and Mukundapuri are liked by many people due to its better edible qualities.

#### 3.1.2 History

The guava has been cultivated and distributed by man, by birds, and sundry 4-footed animals for so long that its place of origin is uncertain, but it is believed to be an area extending from southern Mexico into or through Central America. It is common throughout all warm areas of tropical America and in the West Indies (since 1526), the Bahamas, Bermuda and southern Florida where it was reportedly introduced in 1847 and was common over more than half the State by 1886. Early Spanish and Portuguese colonizers were quick to carry it from the New World to the East Indies and Guam. It was soon adopted as a crop in Asia and in warm parts of Africa. Egyptians have grown it for a long time and it may have traveled from Egypt to Palestine. It is occasionally seen in Algeria and on the Mediterranean coast of France. In India, guava cultivation has been estimated at 125,327 acres (50,720 ha) yielding 27,319 tons annually.

### 3.1.3 Kinds of Guava in Bangladesh

Mainly two types of guava are cultivated in our country commercially.

1. Kazi Peara (guava)

2. Bari Peara

Kazi Peara : Year round high yielding variety fruit weight 445.5 gm, shape pear to round length 9.37 cm, breadth 9.66 cm, skin colour yellowish green flesh colour whitish texture crispy taste slightly sour TSS 8.2-13.2% vitamin c content 202.4 mg/100 g fruit. Shelf life 7-10 days. Yield 84 kg/plant. Released from the horticulture research centre Joydebpur, Gazipur.(BARI, 2003)

Bari Peara- 2: Year round high yielding variety fruit weight 240 gm shape roundish length 6.4 cm breadth 7.4 cm skin colour greenish yellow flesh colour whitish texture crispy taste sweet TSS 7.8-12.8%. Shelf life 7 days. Yielding 90kg/plant. Released from the regional horticulture research station Akbarpur, Moulovibazar.(BARI, 2003)

### 3.1.4 Morphological Characteristics

Guava (*Psidium guajava*) is an evergreen fruit tree, between 3 and 6m up. (Up to 10m.). In nontropical climates, guava is a deciduous tree.

The guava fruit thereof, is surely one of the best known Myrtaceae fruits. They belong to the same family of allspice (*Pimienta dioica*), which is used in food as a type of pepper, eucalyptus, cloves or guarapurÃº or jaboticaba (*Myrciaria cauliflora*) that produces the fruit ibapurÃº.

- The stem is thick, usually inclined and branched into several branches, drawing an open crown, irregular, with dense quadrangular twigs. It has a thin bark, cream colored with pink spots, which is easily removed in long strips.

- The leaves are simple, with short petioles, oblong or elliptical, 3 to 16cm. long by 36 wide, bright green. Limbo bright pubescent undersides of leaves with prominent veins. The leaves have entire margins, oilbearing glands that release a pleasant fragrance. This is a common feature in all plants of the Myrtaceae family.

- The inflorescences are cymes, or sometimes solitary flowers (1 to 3 flowers) that grow in the leaf axils.

- The flowers are large, stalked (1-2cm.), actinomorphic, showy, with white petals, giving off a pleasant smell. They are hermaphrodites, possessing numerous stamens and one pistil. The flowers are pollinated by insects such as bees, which feed on nectar, so it is a honey plant.

- This tropical tree is in bloom throughout the year. In subtropical climates, it blooms from March to September.

- The fruits are globose berries, sometimes ovoid, measuring between 415cm. long by 48cm. in diameter. Calyx persistent at the apex. Fruits are aromatic, bittersweet, and the pulp is viscous.

- Inside they contain numerous seeds, tiny, yellowish 3 to 5mm. long. The fruit is dispersed by animals following ingestion and excretion, birds, turtles, pigs, rats, monkeys, cattle, etc.

- It is a long-lived tree, that can live between 30 and 50 years, although is no longer productive when older that 15.

### 3.1.6 Cultivation

Guava is propagated both by seeds and vegetatively. In the wild, the seeds are spread by birds and in some places it has become a troublesome weed of pastures. Average yields of fruit from improved trees may be between 12-15 t/ha and up to 50 t/ha have been obtained. Guava trees that have been vegetatively propagated start bearing fruit 2-3 years after planting and are fully productive at 8-9 years. Guava trees propagated from seed require more time for fruit production. In India, 8-10 year old trees from seedlings may produce 400-500 fruits per year while grafted trees at the same age may produce 1000-2000 fruits (Ecocrop, 2015). Guava can be harvested all year round. The fruit is ready to be harvested when it is yellow. In agroforestry systems, guava can be intercropped with fodders plants such as maize, sorghum and cowpea (Orwa *et al.,* 2009). The fruits are most commonly harvested by hand (El Boushy *et al.,* 2000).

### 3.1.7 Climatic Requirements

Owing to its hardy nature, guava is grown successfully in tropical and subtropical regions up to 1,500 m (4,900 ft) above mean sea-level. Best quality guavas are obtained where low night temperatures, 10°C (50°F), prevail during winter. It tolerates high temperatures and drought conditions in North India during summers but it is susceptible to severe frost as it can kill the young plants. An annual rainfall of about 100 cm (39 in) is sufficient during the rainy season (July–September). The rains during harvesting period, however, deteriorate the quality of fruits.

Guava is cultivated on varied types of soils- heavy clay to very light sandy soils. Nevertheless, very good quality guavas are produced in river-basins. It tolerates a soil pH of 4.5-8.2. Maximum concentration of its feeding roots is available up to 25 cm (9.8 in) soil depth. Thus the top soil should be quite rich to provide enough nutrients for accelerating new growth which bears fruits.

### 3.1.8 Guava imports from Exporting Countries into Bangladesh

**Guava seed imports**

According to the record provided by the Plant Quarantine Wing (PQW) of Department of Agricultural Extension (DAE), Bangladesh imports guava seeds.The most exporting countries of guava are Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Ecuador,India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, and Italy. The fruits, seeds and other planting materials of different guava types are being imported from these exporting countries through Air Freight.

### 3.1.10 Uses of Guava

**Fruit**: It is also known as guava. It is nutritionally important for being a fruit rich in vitamin C and carotene. White Guavas contain more vitamin C than pink. AS food, it is consumed fresh, whole, in juices or shakes. You can also eat it cooked, in which case it has a milder flavor, in jams, preserves, jellies, syrups, cakes, etc.

**Leaves**: They produce a black dye used for dyeing silk and cotton.

**Wood**: It is reddish yellow, being used to make handicrafts and turnery (handles, cutlery, combs, etc.). It can also be used for firewood and charcoal. The bark is used for tanning leather, because of its high tannin content (1030% in cortex).

**Medicinal:** Guava roots, leaves and fruits are used medicinally since antiquity. Mainly for its astringent tannin content, the roots and leaves are used to treat dysentery and diarrhea. The fruits are rich in vitamins.

### 3.1.11 Pests of guava

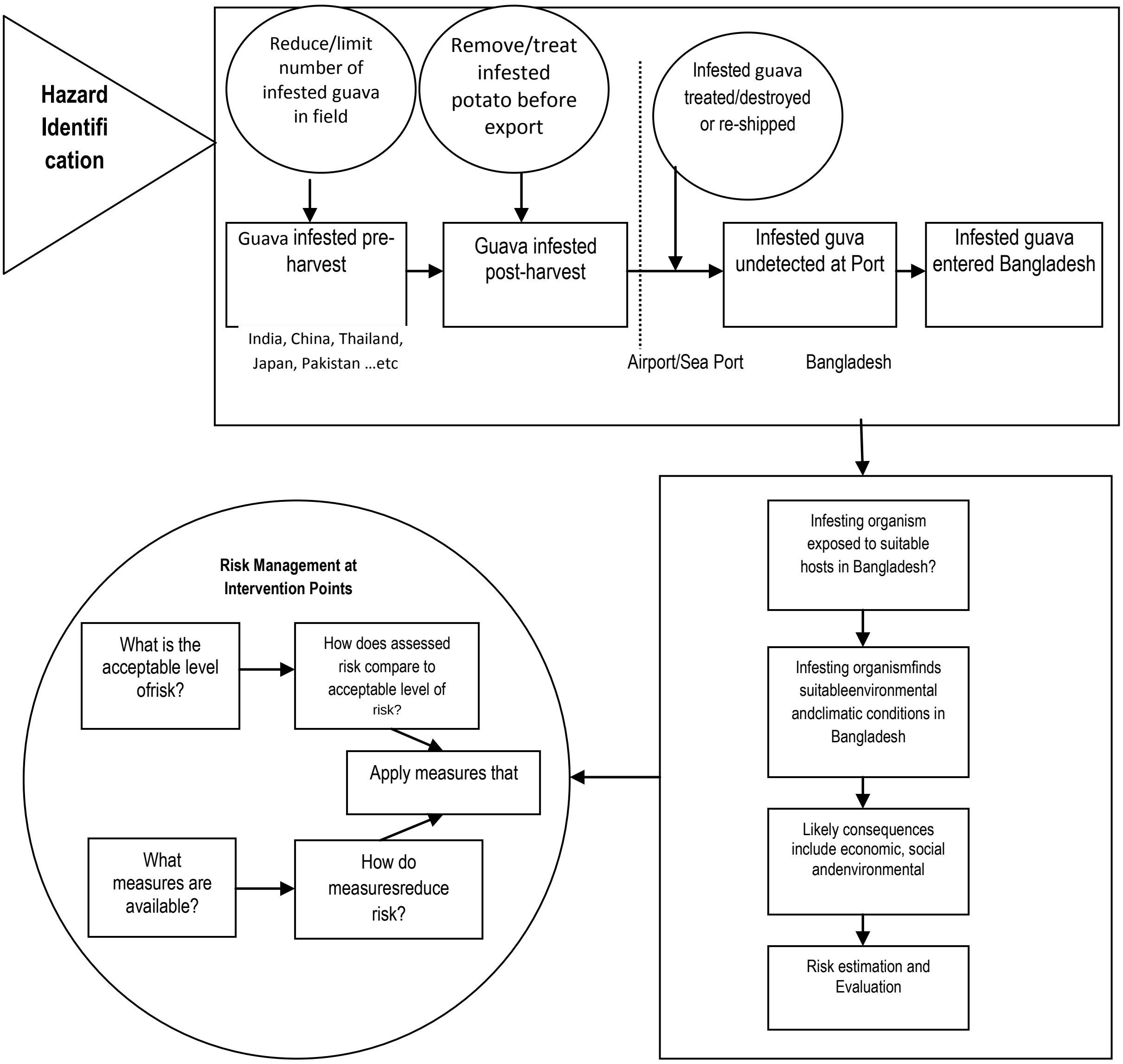
**Insect pests:** Several insect pests attack guava. The major insect pests of guava in Bangladesh Fruit fly, Guava fruit borers/ pomegranate butterfly, Castor capsule borer, Bark eating caterpillar, Tea mosquito bug, Mealy bug, Aphid, Whitefly etc.

**Diseases:** The diseases of guava commonly found in Bangladesh are powdery mildew, Bacteriosis, Fruit canker, anthracnose, Pseudocercospora leaf spot, Leaf curl, wilt, fruit rot, root-knot, foot/root rot, ring spot virus, soft rot, Rust, downy mildew etc.

## 3.2 Description of the Import Pathway

For the purpose of this risk analysis, guava are presumed to be from anywhere in Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Ecuador,India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy (DAE, 2016). To comply with existing Bangladesh import requirements for guava, the commodity would need to be prepared for export to Bangladesh by ensuring certain pests are not associated with the product. Guava would then be sea or air freighted to Bangladesh where it go to a holding facility before being distributed to dealers, distributors, markets, sellers and farmers for cultivation and uses of the imported guava. The proposed import pathway of guavaindicating how the risk analysis process applied at the pathway level is given below:

**Figure 5: Import pathway of guava**



## 3.3 Exporting Countries—General Climate

### 3.3.1 India—General Climate

**General Climate:**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 a 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.

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)

### 3.3.2 Thailand—General Climate

Thailand's Climate can be described as tropical monsoonclimate. 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 aclimate, a hot, humid climate with all months above 18°C (WeatherOnline, 2015c).

### 3.3.3 China—General Climate

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 is 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.

### 3.4 Bangladesh—General Climate

**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

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# CHAPTER 4

## HAZARD IDENTIFICATION

### 4.1 Introduction

This chapter outlines the potential hazards associated with guavain India, Thailand, China, and any other guava exporting countries and considerssome of the major risk characteristics of the commodity and its hazards.

An initial hazard list was made of all pests and pathogens associated with guava found in India, Thailand, China, and any other guava exporting countries of the world such as Brazil, Mexico, Peru, Philippines, Spain, Netherland, Chile, Ecuador, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy. The Plant Quarantine Wing of theDepartment of Agricultural Extension (DAE) in Bangladesh list for pests of guava from these exporting countries was used as its basis, withvarious species added or excluded after considerations of association. This original list waslater refined to include only those organisms directly associated with guava and found tobe present in these exporting countries. Some hitch-hiker pests are included in the pest analyses where entryand establishment of a species into the country would cause potential economic, environmental or health consequences. The following a list of those organisms assessed anddiscarded as likely hazards based on biology, and lack of association with the commodity. Then all potential hazards and individual pest riskassessments and recommend measures where required.

### 4.2 Potential Hazard Groups

Pests and pathogens can be grouped in two main ways regarding their association with thecommodity. Under their taxonomic category, i.e. Lepidoptera, Coleoptera, Acari, Fungi etc, orwithin 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 organismsare grouped according to their general taxonomic category. Where a genus contains more thanone species, information on all species is contained within one pest risk assessment. Iforganisms 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

### 4.3 Interception of Pests on Guava from Existing Pathways

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

### 4.4 Review of earlier PRA

No PRA on Guava had been done in Bangladesh earlier. However, damage assessment and other studies on insect pests, diseases or other pests associated with guava in Bangladesh and abroad helped to prepare this PRA report.

### 4.5 Organism Interception on Commodity from Existing Pathways

In the past, there was no previous pest risk assessment on guava from any of the exporting countries including the Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Chile, Ecuador, India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany and Italy. As reported by the Plant Quarantine Wing (PQW) under Department of Agricultural Extension (DAE), Bangladesh, during inspection in port of entry of guava from these exporting counties, not a pest had been intercepted yet today on the commodity imported into Bangladesh.

### 4.6 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.

#### 4.6.1 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 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.

#### 4.6.2 Symptomless Micro-organisms

Pests such as microbes and fungi infect guava before transit and may not produce symptomsmaking them apparent only when they reach a suitable climate to sporulate or reproduce.

Many fungi can infect guavaafter arrival making it difficult to distinguish the origin ofsaprobes and pathogens without adequate identification. Consumers tend to throw awaymoulded guava rather than take it to a diagnostic laboratory so there is little data on post entryappearance of “invisible organisms”.

### 4.7 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 guavain Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Chile, Ecuador, India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy and other countries of guava 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 guavain the importing countries, and preferably, any information on incidence level in pests infested guava consignments or lots would be valuable.

Thus, the assessment of uncertainties and assumptions for each organism often covers similar areasof 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.

### 4.8 Assumptions and Uncertainties around Hazard Biology

- The species of mealybug (*Pseudococcus* spp.) and fruit fly (*Bactrocera* spp.) are the well known hitch-hiker species, and has been associated with guavain Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Chile, Ecuador, India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany and Italy. 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 have in a new environment, particularly if it has not become established as a pest elsewhere outside its natural range. Therefore, there 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.

### 4.9 Assumption and Uncertaintiesaround the Inspection Procedure

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

### 4.10 Assumption around Transit Time of Commodity on the Air Pathway

- An assumption is made around the time the fresh guava take to get from the field in Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Chile, Ecuador, India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany and Italy to Bangladesh ready for wholesale if it is transported by Landport or Sea shipment.

### 4.11 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 guava 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 5

## REVIEW OF MANAGEMENT OPTIONS

### 5.1 Introduction

The following assessment of preand post-harvest practices reflects the current systems approach for risk management employed for commercially produced guava. 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 guava from exporting countries. The management options for different insect and mite pests as well as diseases of guava crops have been reviewed and presented below:

### 5.2 Insect and Mite Pest Management of Guava

Guavais the most common fruit grown in Bangladesh.There are a large variety of insects such as fruit flies, mealybug, scale insect, fruit borer, tea mosquito bug, thrips, aphid, castor capsule borer, green stink bugs, whiteflies, and mites are infested the guava. The timing of control tactics is critical for many of these pests-miss the window and the crop can be severely affected. Some growers choose to spray weekly thinking this  lead to good control, but not only does this lead instead to wasted resources and ineffective controls, excessive sprays also lead to secondary pest outbreaks and the development of resistance by pests to some chemical controls.

The key to any successful pest management program is to develop a regular scouting plan to gain information on insect pest populations that is used to determine if insecticide applications are needed. Monitoring can consist of sampling groups of 10 plants which are randomly selected at different locations in a field. Samples should be distributed throughout the field so that plants near the edges and middle of the field are examined. In recent years there has been a great increase in new control technologies available to growers, this makes management of insect pests in guava an ongoing process. The new insecticides generally act against a narrower range of pest species than the older, broadspectrum materials. Therefore, it is critical to properly identify the pest to be controlled and to determine its potential for damage. The only way to obtain this information is through routine scouting. The purpose of this guide is to serve as a reference for insect pest identification and for general management guidelines.

#### 5.2.1 Fruit fly

*B. dorsalis* is a very serious pest of a wide variety of fruits and vegetables throughout its range and damage levels can be anything up to 100% of unprotected fruit. As a result of its widespread distribution, pest status, invasive ability and potential impact on market access, *B. dorsalis* is considered to be a major threat to many countries, requiring costly quarantine restrictions and eradication measures.

**Management**

Due to its nature of infestation, it is very difficult to control the pest. A cluster method have been developed and suggested by Kapoor (1993) to control these pests. Among all these methods, the chemical control method is still popular to the Bangladeshi farmers because of its quick and visible results.Approaches of IPM are the thought to be the best and very effective in many countries of the world as well as in Bangladesh, to control fruit pests. In the contemporary usage, IPM is not limited to deal with pesticides and management; in fact IPM has a holistic approach to crop production based on sound ecological understanding and in this sense, IPM could even be termed as Eco-friendly pest management. “IPM targets changing of the farmer’s practices toward growing a healthy crop and increasing the farm output and farmers income on a sustainable basis while improving the environment and community health".

Fruit fly is the most damaging pest of guava and considered as an important obstacle for economic production of these crops. The uses of alternatives to toxic chemicals for the management of fruit fly are as follows:

**Management of fruit fly by bagging:** This method has been tried with the use of colorless polythene bags having a few holes made with an ordinary pin (Narayer and Batra, 1960). Aktaruzzamn *et al.* (1999) reported that the mean of all stages of fruit fly infestation was significantly lower (5.53%),where bagging of fruits at 3 days after anthesis was made and retained for 5 days.

**Management of fruit fly by cultural & mechanical control:** Several authors highly advocated hand picking of infested fruits to reduce fruit fly damage on guava. Nasiruddin & Karim (1992) recommended collection and destruction of infested fruits with larvae inside for reducing fruits fly population on snake gourd. Mitchell and Soul (1990) reported that this practice is widely used in USA for suppressing Mediterranean fruit fly *Ceratitis capitata*. Atwal (1993) suggested such mechanical control measures in farmer's fields as normal practice for effective control against this pest in India. Several authors recommended field sanitation for suppression of fruit fly population in many countries (Agarwal *et al.* 1987; Mitchell and Saul 1990; Smith 1992).

**Management of fruit fly by indigenous bait traps:** A poison-bait gave good control of fruit flies (Steiner *et al.* 1998). An experiment was conducted by Nasiruddin and karim (1992) on the evaluation of potential control measure for fruit fly. They observed that fruit fly infestation rates of fruits in bait trap treatment plot was 4.9% against 22.5% infested fruits in the control plot which differed significantly ($P<0.05$; Table 4) . They also observed that 78.4% reduction of fruit infestation over the infestation rate in the control

**Comparative effectiveness of pheromone dispensers and bait traps:** Fruit fly capture in pheromone dispensers and the bait trap differed significantly. Cuelure, methyl eugenol and naled captured significantly more fruit flies (269) than any other treatment. Catches in mashed sweet gourd and methyl eugenol and naled were the lowest, 86 and 18, respectively. The noteworthy feature of the mashed sweet gourd trap was that it captured both male (25) and female (61) fruit flies, indicating its biological impact in the management of guava fruit fly. On the contrary, all the pheromone traps captured only males (Aktaruzzamn *et al.*, 1999).

**Pheromone and indigenous bait trap for fruit fly control:** Aktaruzzamn *et al.* (1999) reported that the fruit fly capture can create a negative impact on fruit infestation. The higher the fruit fly capture the lesser was the fruit infestation and higher was the yield. The pheromone traps captured the highest number of flies, more then 20 times higher than that captured in indigenous mashed sweet gourd traps, and effected 5 times less fruit infestation than the untreated fields. The mashed sweet gourd baits, although captured lower number of fruit flies than the pheromone traps, significantly lessened fruit infestation and produced 35% more yield than the untreated control plot. Cucumber yields in pheromone and sweet gourd baited fields were comparable (Aktaruzzamn *et al.*, 1999).

### 5.2.2 Aphids

**Aphids** of many species can be found in a guava field. Aphids are small, soft-bodied insects that vary in color from pale yellow to red to green to black, depending on the species (with one species capable of having several colors), the host plant, and time of season. Direct-feeding damage by aphids is rarely severe enough to kill plants. They pierce plant tissue with needlelike mouthparts, which may result in blossom shed or curling or stunting of new growth. They also produce a sticky material called honeydew that is a substrate for the sooty mold fungus, if the honey dew gets on the fruit it is difficult to remove making the fruit unmarketable. A**phids** are pear-shaped and vary from yellow to green to darker colors, but always have dark colored cornicles (slender tailpipe-like appendages, red arrows). The **green peach aphid** *(Myzus persicae)* is pear shaped and is pale yellow to green with its cornicles also being green. Adult females give birth to live young, called nymphs. Although slightly smaller than adults, nymphs are similar in color and shape (Gerald Brust, 2009).

Both aphids feed on the underside of leaves, or on the growing tips, sucking nutrients from the plant. The foliage may become chlorotic and die prematurely. The end result of feeding by these aphids is loss of vigor, stunting, or at times even death of the plant. Most importantly both aphids transmit potyviruses, and while there are several other aphid species that also are capable of vectoring viruses, melon and green peach aphids are very proficient at it. The watermelon mosaic virus, zucchini yellow mosaic virus and papaya ringspot virus are transmitted by these aphids despite numerous applications of insecticides because the viruses can be transmitted within seconds of the aphid landing on a plant.

**Management**

Aphids are ubiquitous in the summer and find guava fields. To slow down the numbers that land on plants silver reflective mulches have been used successfully to repel aphids from plants, thus reducing or delaying virus transmission by two to four weeks compared with no mulch or black plastic mulch (Gerald Brust, 2009).

Biological control can have a significant impact on reducing aphid populations, but cannot stop virus transmission, so be sure to evaluate predator and parasite populations when making treatment decisions.

**Biological Control:** Naturally-occurring populations of the convergent lady beetle, *Hippodamia convergens,* may provide effective control throughout the summer. Do not purchase these predators as releases of this beetle are not effective because very few remain in the field following release. Other general predators, such as lacewing and syrphid larvae, and parasitic wasps, including *Aphidius*, *Diaeretiella*, and *Aphelinus* species, also attack aphids. You can maintain natural enemy numbers by not applying weekly or calendar-based insecticide applications.

**Chemical Controls:** Treatment is only needed to reduce large aphid populations and no or very few natural enemies are present. Chemical controls DO NOT stop virus transmission. Organic chemical controls include insecticidal soaps and horticultural oils as well as *Beauveria bassiana*, an insect fungal disease that attack and kill aphids. The *B. bassiana* must be applied 3 times on a 5-7 day schedule to be effective. Reduced risk chemicals include pymetrozine (Fulfill) imidacloprid (Admire) or thiamethoxam (Platinum or Actara). Other chemical controls include endosulfan (Thionex).

### 5.2.3 Whiteflies

**Whiteflies:**The whitefly is small, about inch long and whitish yellow. The head is broad at the antennae and narrow toward the mouthparts. The wings are held roof-like at about a 45-degree angle, whereas other whiteflies usually hold the wings nearly flat over the body. As a result, the silverleaf whitefly appears more slender than other common whiteflies. The eggs are whitish to light beige. The nymphal stage appears glassy to opaque yellow. Its body is flattened and scale-like. The pupa or fourth nymphal instars are somewhat darker beige-yellow and opaque. Silverleaf whiteflies damage plants directly and indirectly. Direct damage results from their feeding activity, which involves them sucking plant sap. Both the adults and nymphs contribute to direct damage. Chlorotic (yellow) spots sometimes appear at the feeding sites on leaves. Heavy infestations cause leaf wilting. In addition, as they feed they excrete honeydew (a sugary substance), which sooty mold fungi grow on. The resulting dark splotches on the leaves may reduce photosynthesis and other physiological functions of the plant. Indirect damage results from their activity as disease vectors. The silverleaf whitefly carries and spreads several important viral diseases of tomatoes, lettuce and melons in the southeastern United States, but does not vector these viruses to any great extent to Maryland vegetable crops (Gerald Brust, 2009).

**Management**

Whiteflies should not become a problem in most fields, but occasionally their populations can increase to such levels that they begin to directly damage the plant. If sooty mold is found on many plants or fruit an insecticide application is needed. This should only occur rarely and in the latter part of the season. Chemicals that work for aphids also work for whitefly (Gerald Brust, 2009).

### 5.2.4 Scale insect

Damage to the plant by *I. purchasi* is mostly caused by sap depletion; the shoots dry up and die, and defoliation occurs. In addition, the copious quantities of honeydew produced by the scales coat the leaves, blocking the stomata and impeding gas exchange. Such fouling frequently results in the growth of sooty moulds over the leaf surfaces, which blocks light from the mesophyll, so reducing photosynthesis.

*I. purchasi* is a particular pest of citrus, Acacia spp., Casuarina spp. and Pittosporum spp., but it can damage many types of fruit and forest trees, and ornamental shrubs and trees. After its introduction into California, USA, in the late nineteenth century, it was recorded devastating citrus orchards, killing even large trees. By 1887, the problem on citrus had increased to such serious proportions that the entire citrus industry of California was threatened with destruction (Bartlett, 1978). Serious damage to citrus orchards by *I. purchasi* was also recorded in many other countries when the cottony cushion scale first arrived (Williams and Watson, 1990), but with successful biological control this insect has become relatively unimportant in fruit orchards today.

In Anhui, China, *I. purchasi* is one of the most important pests of pomegranates (Punica granatum) (Wang *et al.,* 2002), and in Zhejiang, China, the cottony cushion scale is the main pest damaging Liquidambar formosana (Formosan-gum) (Hua *et al.,* 1999). In Israel, the cottony cushion scale was a serious pest in the northern part of the country until biological control became established, which reduced it to minor pest status (Ben-Dov, 1995).

**Management:**

**Chemical Control**

All life stages of *I. purchasi* are covered with wax, which reduces the effectiveness of most chemical insecticides. In addition, the use of insecticides prevents regulation by natural enemies, which has proved to be highly successful with this species. In the Spanish citrus industry, it is important to only use pesticides when absolutely necessary to ensure that the biological control agents of the citrus pests are not significantly injured; side-effect testing of pesticides on the control agents has been routinely carried out in Spain for many years (Jacas Miret and Garcia Mari, 2001).The insect growth regulator pyriproxyfen has been found to be as effective in *controlling I. purchasi* (Gokkes *et al.,* 1989). Good control was achieved when applied alone or with 0.5% mineral oil (Peleg, 1989). Another growth regulator, buprofezin, gave 100% mortality of crawlers and 31% decreased egg hatch when the adults were sprayed with it (Mendel *et al.,* 1991).In Italy, trials on the effect of azadirachtin A (extracted from neem) on the development and fecundity of Rodolia cardinalis indicated that use of this organic insecticide can adversely affect biological control of the cottony cushion scale (Heimbach, 2002).

**BiologicalControl**

The regulation of I. purchasi by natural enemies is one of the classic success stories in biological control. When I. purchasi established in California, USA in 1868/1869, it was apparent that it could be a major impediment to citrus production. In 1888, the United States Department of Agriculture (USDA) imported various natural enemies from Australia, including the vedalia beetle, Rodolia cardinalis. Vedalia immediately proved highly effective in controlling I. purchasi and has subsequently been distributed to about 57 countries (Bartlett, 1978). It has continued to be effective in controlling I. purchasi, except in areas where the indiscriminate use of insecticides has killed the predator. In areas with extreme winters, which kill off the vedalia populations, periodic re-introduction has been necessary. I. purchasi living on plants such as Spartium junceum, which contain alkaloids, are not completely controlled by R. cardinalis. Caltagirone and Doutt (1989) suggested that these plants (with residual populations of the scale) provide permanent sources of vedalia that will disperse into new infestations of scale on citrus and bring them under control.

### 5.2.5 Thrips

**Thrips** are generally a problem early in the season when plants are drought stressed. Thrips are tiny (1/16 inch), slender insects that vary in color from yellow or orange (most common color) to dark brown or black. Thrips overwinter in plant debris or on weeds such as winter annuals found in or near fields. In the spring they can be found on the undersides of leaves producing silver flecking near the large leaf veins. They are more likely to be found on leaves of guava early in the season when these leaves have pine pollen or other types of tree pollen on them. Pine pollen, as well as other tree pollen is quite commonly found on plants in the field in the spring. Thrips then feed on this pollen. These early season thrips populations rarely result in any problems unless plants become drought stressed. There are two larval stages and a pupal stage. Thrips have only the left mandible and use this mouthpart to punch a hole or scrape the leaf surface of the plant disrupting cells and feeding on the cell contents (Gerald Brust, 2009).

### 5.2.6 Mites

The intrinsic rate of natural increase of false spider mite reared under favourable laboratory conditions is fairly low when compared with other phytophagous mites. Nevertheless, the offspring of a single population would soon attain astronomical abundance (20 billion billion in 2 years) if left unchecked (Oomen, 1982), making control measures necessary.

*B. phoenicis* is the main vector of Citrus leprosis virus C (CiLV-C). It is recognized as the most damaging species in citrus-producing areas where the virus has been reported (Guillermo, 2012).

**Management**

**Cultural Methods**

Pruning, one of the main cultural practices in plantations, has been reported by many authors to control the build-up of *B. phoenicis* populations (Baptist and Ranaweera, 1955; Cranham, 1966a; Haramoto, 1969; Oomen, 1982; Muraleedharan, 1990). Pruning (along with the developmental stage of the crop in the pruning cycle) affects the distribution of mites and the intensity of outbreaks, as it removes a large part of the foliage and stem and also the mites feeding on them. Similarly, the intensity of shade tree cover in a plantation increases the mite population; regulated shade and avoidance of alternative hosts would help prevent the incidence of mites and other sucking insects.

## Chemical Control

Chemical control involves costly inputs, including pesticides, fuel, labour and spraying equipment; thus the correct choice of pesticides, their dosage, timing and methods of application are of great importance. The misuse of pesticides and the improper execution of pest control technology may result in crop loss, health hazards, environmental pollution and pest resurgence.

Many chemicals with acaricidal properties have been available, but only a few can be used against this pest due to various limitations. Some pesticides that have been proven effective for the control of the common species of spider mites (Tetranychidae) have been shown to be ineffective against false spider mites (Tenuipalpidae) (Pritchard, 1949; Hamilton, 1953; Morishita, 1954). Some of the pesticides toxic to false spider mite cannot be used on certain kinds of plants because of their phytotoxic nature (for example, most of the organic pesticides were phytotoxic to papaya; Haramoto, 1969).

Muraleedharan (1990) lists the following as effective acaricides against false spider mite - chlorinated hydrocarbons: dicofol, tetradifon; organophosphates: ethion and quinalphos.

Sulfur has been a widely used pesticide against this pest over a long period in almost all crops affected (*Jeppson et al.,* 1975). However, Cranham (1965) indicated that since sulfur does not have an ovicidal effect, it needs to be applied many times, leaving a yellow taint on the plants. Jeppson *et al.* (1975) also state that this mite is susceptible to dicofol, but not to the organophosphorus and carbamate compounds. In particular, the organophosphorus compounds such as malathion, fenitrothion and dimethaote are not generally useful (Cranham, 1966a). Crow (1965) and Prebble (1972) found that dicofol and dinocap were successful against attacks by this mite in Africa. Apart from these chemicals, bromopropylate, chinomethionat and mixtures of dicofol+tetradifon were found to be useful against these mites (Das and Gope, 1983; Oliviera et al., 1983; Roman, 1983). In Africa, permethrin and dimethoate were found to be effective (Sudoi, 1990).

## Biological Control

A number of natural enemies of false spider mite have been recorded, although there are no records of control in the field specifically by this method.

## Integrated Pest Managemen

Although chemicals continue to play an important role as the first line of defence, their over-use poses an acute danger of environmental contamination, pesticidal hazards, resurgence and development of resistance. Hence it has become necessary to minimize their use by other available methods.

Although the use of chemicals against this mite is presently inevitable, their use can be minimized by integrating with other available methods. Mites should be dealt with by judicious use of acaricides and by agronomic practices such as hand plucking, shade regulation, etc.

## 5.3 Disease Management of Guava

## Anthracnose

*Glomerella cingulata* fungus is the responsible for causing this disease.More likely to occur on guava, peace, mango. Appears as tan or brown oval lesions on upper leaf surface; raised acervuli (often salmon-colored) with hair-like setae (whiskers); lesions with fruiting bodies also appear on fruit.

## Management

**Cultural Practices**: Use disease-free seed; follow a 2-year rotation out of guava. Be mindful under moist conditions and high humidity for 24 hrs.

**Chemical Control**: Apply Bravo (**Group M5**) alone or in combination with Topsin M (**Group 1**) in alternation with **Group 11** fungicides (Quadris and Cabrio). If resistance to Quadris occurs in the area, you must use a fungicide from different fungicide group.

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## 5.4 Phytosanitary Measures

### 5.4.1 Post-Harvest Procedures

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

### 5.4.2 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 ofguava.

### 5.4.3 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.

### 5.4.4 General Conditions for Guava

- Guava includes fresh fruits, seeds, seedlings etcintended for consumption and for planting. For the purposes of this standard guava excludes roots.
- Only inert/synthetic material may be used for the protection, packaging and shipping materials of guava and branches.
- Guava and branches shall not be shipped or contained in free-standing water.

### 5.4.5 Pre-shipment Requirements

**Inspection of the consignment:** Bangladesh requires that the NPPO of the country of origin sample and inspect theconsignment according to official procedures for all the visually detectable regulated pestsspecified 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 guava from which the guava were collected, have beentreated as specified by PQW of Bangladesh.

### 5.4.6 Phytosanitary Certification

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

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

The guavahave:

i) been inspected in accordance with appropriate official procedures and found to be freeof any visually detectable regulated pests specified by PQW of Bangladesh.

AND, ONE OR MORE OF THE FOLLOWING;

ii) been sourced from a pest free area that is, as verified by pest surveillance methods (inaccordance with the International Standards for Phytosanitary Measures; Requirementsfor the Establishment of Pest Free Areas, IPPC, FAO, Publication 4, 1996), free from aregulated pest(s).
iii) been sourced from a pest free place of production that is, as verified by pest surveillancemethods (in accordance with the International Standards for Phytosanitary Measures;Requirements for the Establishment of Pest Free Places of Production and Pest Free Production Sites, IPPC, FAO, Publication 10, 1996), free from a regulated pest(s).

AND;

iv) been devitalised (rendered non-propagable) using an effective devitalisation treatmentor process.

### 5.4.7. 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 guava 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 Extension of Bangladesh, and to conform with Bangladesh's current phytosanitary requirements".

AND,

- subjected to an effective devitalisation treatment [details of treatment must be included on the phytosanitary certificate] rendering the consignment non-propagatable."

### 5.4.8 Transit Requirements

The guava 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.

### 5.4.9 Inspection on Arrival in Bangladesh

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

### 5.4.10 Testing for Regulated Pests

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

### 5.4.11 Actions Undertaken on the Interception/Detection of Organisms/Contaminants

If regulated pests are intercepted/detected on the commodity, or associated packaging, the following actions 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 in accordance with the actions required by the relevant government department.

### 5.4.12 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 clearancegiven.

### 5.4.13 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 otherphytosanitary requirements.

# CHAPTER 6

## IDENTIFICATION OF PESTS

### 6.1 Introduction

The pest risk assessment was done with the aim to determine Bangladesh's phytosanitary measure regarding theguavaimported from anyexporting countries ofThailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Chile, Ecuador, India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, and Italyinto Bangladesh.

### 6.2 Pests of Guava Recorded in Bangladesh

The study for "Conducting Pest Risk Analysis (PRA) of Guava in Bangladesh" was done in 28 major guava growing districts of Bangladesh. From the field survey and review of secondary 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:

#### 6.2.1 Insect and Mite Pests of Guava

A total number of 16 arthropod pests of guava, of which 14 insect pests and 2 mite pest were reported in Bangladesh.

The incidences of insect pests of guava recorded in Bangladesh were guava fruit fly (*Bactrocera correcta*) oriental fruit fly (*Bactrocera dorsalis),*peach fruit fly (*Bactrocera zonata),* Malaysian fruit fly (*Bactrocera latifrons*), spiraling whitefly (*Aleurodicus disperses),* cottony cushion scale (*Icerya purchase),* green shield scale (*Pulvinaria psidii),* pineapple mealy bug (*Dysmicoccus brevipes),* pink hibiscus mealybug (*Maconellicoccus hirsutus),* guava mealy bug (*Ferrisia virgata),* castor capsule borer (Z*ongethes (Dichocrocis) punctiferalis* Guenée),fruit borer (*Rapala varuna)*, oriental yellow scale (*Aonidiella citrina*) and black scale (*Saissetia oleae*), whereastwo mite pests of guava was recorded in Bangladesh named red and black flat mite (*Brevipalpus phoenicis)* and false spider mite (*Brevipalpus californicus)* (Table 2).

Among these insect and mite pests of guava, guava fruit fly was more damaging than other arthropod pests. The guava fruit fly was designated as major pest of guava and caused damage with high infestation intensity. The pest status of all other insect and mite pests was minor significance and caused low level of infestation. Usually Bangladesh's farmers always used chemical insecticides and acaricides through which these pests were suppressed in every season.

**Table 2: Insect and mite pests of guava in Bangladesh, their status, plant parts affected and infestation severity**

| SN | Common Name | Scientific name | Family | Order | Plant parts affected | Pest status | Infestation severity |
|---|---|---|---|---|---|---|---|
| **A. Insect pests** | | | | | | | |
| 1 | Guava fruit fly | *Bactrocera correcta* | Tephritidae | Diptera | Fruit, Twig | Minor | Low |
| 2 | Oriental fruit fly | *Bactrocera dorsalis* | Tephritidae | Diptera | Fruit, Twig | Major | High |
| 3 | Peach fruit fly | *Bactrocera zonata* | Tephritidae | Diptera | Fruit, Twig | Major | Medium |
| 4 | Malaysian fruit fly | *Bactrocera latifrons* | Tephritidae | Diptera | Fruit, Twig | Major | Low |
| 5 | Spiraling whitefly | *Aleurodicus disperses* | Aleyrodidae | Homoptera | Fruit, Leaf, Twig | Major | Low |
| 6 | Cottony cushion scale | *Icerya purchase* | Margarodidae | Homoptera | Leaf | Minor | Low |
| 7 | Green shield scale | *Pulvinaria psidii* | Coccidae | Homoptera | Stem, Leaf, Fruit | Minor | Low |
| 8 | Pineapple mealy bug | *Dysmicoccus brevipes* | Pseudococcidae | Homoptera | Stem, Leaf, Fruit | Minor | Low |
| 9 | Pink hibiscus mealybug | *Maconellicoccus hirsutus* | Pseudococcidae | Homoptera | Stem, Leaf, Fruit | Minor | Low |
| 10 | Guava mealy bug | *Ferrisia virgata* | Pseudococcidae | Homoptera | Stem, Leaf, Fruit | Minor | Low |
| 11 | Castor capsule borer | *Congethes (Dichocrocis) punctiferalis* Guenée | Crambidae | Lepidoptera | Fruit | Minor | Low |
| 12 | Fruit borer | *Rapala varuna* Hewitson | Lycaenidae | Lepidoptera | Fruit | Major | Medium |
| 13 | Oriental yellow scale | *Aonidiella citrina* | Diaspididae | Hemiptera | Stem, leaf, fruit | Minor | Low |
| 14 | Black scale | *Saissetia oleae* | Coccidae | Hemiptera | Stem, leaf, fruit | Minor | Low |
| **B. Mite pest** | | | | | | | |
| 15 | Red and black flat mite | *Brevipalpus phoenicis* | Tenuipalpidae | Trombidiformes | Leaf, Fruit | Minor | Low |
| 16 | False spider mite | *Brevipalpus californicus* | Tenuipalpidae | Trombidiformes | Leaf, Fruit | Minor | Low |

**Some pictures of insect and mite pests of guava are presented below:**

Plate 1. Guava leaves infested by whitefly

Plate 2. Guava fruit infested by fruit fly

Plate 3. Cottony cushion scale insect

Plate 4. Green shield scale insect

Plate 5. Pineapple mealy bug insect

Plate 6. Guava mealy bug insect

Plate 7. Castor capsule borer insect    Plate 8. Adult fruit borer

### 6.2.2 Diseases of Guava Recorded in Bangladesh

A total number of 11 species of disease causing pathogens of guava were recorded in Bangladesh, among which 9 diseases were caused by fungi, 1 caused by nematode and 1 diseases of guava was caused by virus (Table 3).

The incidences of fungal diseases of guava reported in Bangladesh were anthracnose (*Glomerella cingulata),* basal rot (*Fusarium oxysporum),*brown rot*(Diplodia netalensis Evans),* fruit canker (*Pestalotia psidii* Pat), Botryosphaeria rot (*Botryosphaeria ribis* Gross. & Duggar), Mucor rot (*Mucor hiemalis),* grey leaf spot (*Cercospora* Sp.), die back (*Phytophthora* Sp.) and guava wilt (*Fusarium oxysporum* Sch. f. sp*. psidii*).The nemic disease of guava was root knot nematode (*Meloidogyne incognita*). The viral disease of guava recorded in Bangladesh was *cotton leaf curl virus (CLCuV)*.

Among these diseases, Anthracnose was more damaging than others. But diseases were reported as minor diseases of guava and caused damage with low infection intensity in Bangladesh. Most of cases, the damage severity was controlled by the farmers through routine application of fungicides and other pesticides in the field of guava.

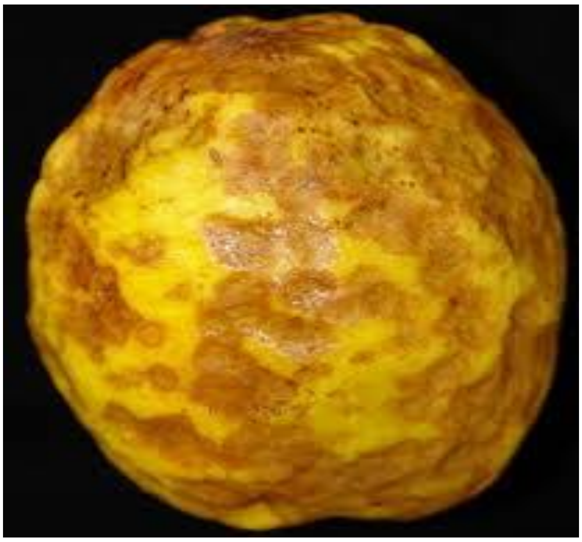
### 6.2.3 Weeds of Guava Recorded in Bangladesh

A total number of 17 weeds were reported as the problem in the field of guava in Bangladesh. The incidences of weeds in the field of guava were bermuda grass (*Cynodon dactylon* L.*),* egyptian crowfoot grass (*Dactyloctenium aegyptium* (L.)), cogon grass (*Imperata cylindrica* (L.)), quack grass (*Agropyron repens* (L.)), Indian goose grass (*Eleusine indica (*L.)), johnson grass (*Sorghum helepense* (L.)), coat buttons (*Tridax procumbens* L.), beggar-ticks (*Bidens pilosa* L.), amaranth (*Amaranthus viridis* L.), asthma herb (*Euphorbia hirta* L.), horse purslane (*Trianthema portulacastrum* L.), common Purslane (*Portulaca oleracea* L), purple nut sedge (*Cyperus rotundus* L.), flat sedge (*Cyperus iria* L.), yellow nutsedge: (*Cyperus esculentus* L.) and small-floweed umbrella sedge (*Cyperus difformis* L.). The parthenium weed (*Parthenium hysterophorus*) was recorded and found in some restricted areas of Bangladesh namely Rajshahi, Natore, Pabna, Kustia, Jessore districts. These districts are nearly attached with the Western border of Bangladesh and Eastern border of West Bengall of India. 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 five weeds, the Parthenium grows in the whole season. 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 four weeds were reported as minor weeds with low infestation intensity in the field guava. Basically Bangladeshi farmers controlled these weeds by weeding during intercultural operations of the field, thus these weeds remain as controlled condition except Parthenium.

**Table 3: Diseases of guava recorded in Bangladesh, 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 | Anthracnose | *Glomerella cingulata* | Sordariomycetidae | Glomerellaceae | Leaf, fruit | Major | High |
| 2 | Basal rot | *Fusarium oxysporum* | Nectriaceae | Hypocreales | Stem, leaf | Minor | Low |
| 3 | Brown rot | *Diplodia netalensis* | Botryosphaeriaceae | Botryosphaeriales | Stem, leaf | Minor | Low |
| 4 | Fruit canker | *Pestalotia psidii* Pat | Amphisphaeriaceae | Xylariales | Leaf, fruit | Minor | Low |
| 5 | Botryosphaeria rot | *Botryosphaeria ribis* | Botryosphaeriaceae | Botryosphaeriales | Stem, leaf | Minor | Low |
| 6 | Mucor rot | *Mucor hiemalis* | Mucoraceae | Mucorales | Stem, leaf | Minor | Low |
| 7 | Grey leaf spot | *Cercospora* Sp. | Mycosphaerellaceae | | Stem, leaf | Minor | Low |
| 8 | Die back | *Phytophthora* Sp. | Pythiaceae | Peronosporales | Stem, leaf | Minor | Low |
| 9 | Guava wilt | *Fusarium oxysporum* Sch. f. sp. *psidii* | Nectriaceae | Hypocreales | Stem, leaf | Minor | Low |
| **Causal organism: Nematode** | | | | | | | |
| 10 | Root-knot nematode | *Meloidogyne incognita* | Meloidogynidae | *Tylenchida* | Root | Minor | Low |
| **Causal organism: Virus** | | | | | | | |
| 11 | Leaf curl | *Cotton leaf curl virus (CLCuV)* | Geminiviridae | Unassigned | Leaf | Minor | Low |

### 6.2.4 Management Options for Guava in Bangladesh

**Insect and mite pest management:** The most effective and commonly practiced management options against the insect pests of guava were spraying of insecticides in the orchard. But bagging, pheromone traps and poison bait traps were used especially for controlling fruit flies in the orchard. Irrigation was done for controlling soil dewelling insect and removal of harmful insects and infested fruits and parts of plants was also done. It was also reported that Integrated Pest Managemend (IPM) was also followed for controlling insect pests of guava. Few cases, especially for thrips and aphid sticky trap was used as well as hand picking was done for controlling beetle.

**Disease management:** The most effective and commonly practiced management options against the diseases of guava were spraying of fungicides in the orchard, seed treatment with fungicides for preventing seed borne diseases, and removal of diseased plants or parts of plants. Other management practices for controlling diseases of guava were removal of weeds and spraying of insecticides in the guava orchard for disease transmitting vector control.

**Weed management:** The most effective and commonly practiced management options for weeds in the orchard of guava were removal of weeds after a regular interval and weeding during intercultural operations. Other options were earthing up at the base of plants, irrigation and use of herbicides.

**Table 4: Weeds of guava recorded in Bangladesh, 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* L. | Poaceae | Poales | Vegetative stage | Minor | Low |
| 2 | Egyptian crowfoot grass | *Dactyloctenium aegyptium* | Poaceae | Cyperales | Vegetative stage | Minor | Low |
| 3 | Cogon grass | *Imperata cylindrica* (L.) | Poaceae | Cyperales | Vegetative stage | Minor | Low |
| 4 | Quack grass | *Agropyron repens* (L.) | Poaceae | Cyperales | Vegetative stage | Minor | Low |
| 5 | Indian goose grass | *Eleusine indica (*L.) | Poaceae | Cyperales | Vegetative stage | Minor | Medium |
| 6 | Johnson grass | *Sorghum helepense* (L.) | Poaceae | Cyperales | Vegetative stage | Minor | Low |
| 7 | Coat buttons | *Tridax procumbens* L. | Fabaceae | Asterales | Vegetative stage | Minor | Low |
| 8 | Beggar-ticks | *Bidens pilosa* L. | Asteraceae | Asterales | Vegetative stage | Minor | Low |
| 9 | Amaranth | *Amaranthus viridis* L. | Amaranthaceae | Caryophyllales | Vegetative stage | Minor | Low |
| 10 | Asthma herb | *Euphorbia hirta* L. | Euphorbiaceae | Euphorbiales | Vegetative stage | Minor | Low |
| 11 | Horse purslane | *Trianthema portulacastrum* | Aizoaceae | Caryophyllales | Vegetative stage | Minor | Low |
| 12 | Common Purslane | *Portulaca oleracea* L | Portulacaceae | Caryophyllales | Vegetative stage | Minor | Low |
| 13 | Purple nut sedge | *Cyperus rotundus* L. | Cyperaceae | Cyperales | Vegetative stage | Minor | Low |
| 14 | Flat sedge | *Cyperus iria* L. | Cyperaceae | Cyperales | Vegetative stage | Minor | Low |
| 15 | Yellow nutsedge: | *Cyperus esculentus* L. | Cyperaceae | Cyperales | Vegetative stage | Minor | Medium |
| 16 | Small-floweed umbrella sedge | *Cyperus difformis* L. | Cyperaceae | Cyperales | Vegetative stage | Minor | Low |
| 17 | Parthenium weed | *Parthenium hysterophorus* | Asteraceae | Asterales | Recorded in limited areas | Minor | Medium |

## 6.3 Pests of Guava in Exporting Countries

The pests associated with fresh guava, seeds and other planting materialsin the world have been categorized and listed below based on their scientific name, taxonomic position, common name, plant parts affected, geographical distribution and their quarantine status for Bangladesh.

Fifty nine (59) species of pests were recorded for guava in the world of which 24 species were insect pests and 2 species were mite pests; the species of disease causing fungi were 11, bacteria 1, nematode 1, algae 1 and virus & viroids was 1. On the other hand, 18 species of weeds for guava were recorded in the world.

Table 6 depicted the lists of pests associated with the guavathat also occur in India, China, Thailand, Japan, or other exporting countriesand the absence or presence of these pests in Bangladesh.

## 6.4 Quaratine Pests of Guava for Bangladesh

Fifteen (15) species of quarantine pests of guava for Bangladesh were identified those were present in Thailand, Brazil, Mexico, Peru, Philippines, Spain, Netherland, Chile, Ecuador,India, China, Pakistan, Japan, Taiwan, UAE, Vietnam, Indonesia, U.S.A, Australia, France, Germany, Italy, but not in Bangladesh. Among these 16 species of quarantine pests, 11 were insect pests,2 fungi, 1 bacteria, 1algae species and weed was 1 species (Table 7).

The quarantine insect pests are Queensland fruit fly (*Bactrocera tryoni),* Mediterranean fruit fly (*Ceratitis capitata),*green scale (*Coccus viridis),* coconut mealybug (*Nipaecoccus nipae),* long-tailed mealybug (*Pseudococcus longispinus),* tea mosquito bug (*Helopeltis antonii* Signoret), guava aphid (*Aphis punicae* Passerini), redbanded thrips (*Selenothrips rubrocinctus),*anar butterfly (*Virachola Isocrate*) and guava stem borer (*Apriona* Sp.).

On the other hand, four (4) disease causing pathogens have been identified as quarantine pests of guava for Bangladesh. Among these, 2 quarantine fungus named brown rot (*Monilinia fructigena*) and guava rust (*Puccinia psidii*);1 quarantine bacteria namely guava bacteriosis (*Erwinia psidii)*; 1 species of algae namelyalgal leaf and fruit spot (*Cephaleuros virescens)*. 1 species of quarantine weed has been identified Bangladesh named parthenium weed (*Parthenium hysterophorus*).

## Table 6: Pests associated with guava in the world and identification of quarantine organisms

| SN | Common Name | Scientific name | Family | Order | Presence in Bangladesh | Quarantine status | References |
|---|---|---|---|---|---|---|---|
| **Arthropod pests** | | | | | | | |
| **A. Insect pests** | | | | | | | |
| 1 | Guava fruit fly | *Bactrocera correcta* | Tephritidae | Diptera | Yes | No | Leblanc *et al.,* 2014 |
| 2 | Oriental fruit fly | *Bactrocera dorsalis* | Tephritidae | Diptera | Yes | No | EPPO, 2014; CABI/EPPO, 2013; Leblanc et al., 2013a |
| 3 | Peach fruit fly | *Bactrocera zonata* | Tephritidae | Diptera | Yes | No | Kapoor, 1993; EPPO, 2014; CABI/EPPO, 2013 |
| 4 | Queensland fruit fly | *Bactrocera tryoni* | Tephritidae | Diptera | No | Yes | EPPO, 2014; CABI/EPPO, 2013 |
| 5 | Malaysian fruit fly | *Bactrocera latifrons* | Tephritidae | Diptera | Yes | No | Leblanc *et al.,* 2014 |
| 6 | Mediterranean fruit fly | *Ceratitis capitata* | Tephritidae | Diptera | No | Yes | EPPO, 2014; CABI/EPPO, 2015 |
| 7 | Spiraling whitefly | *Aleurodicus disperses* | Aleyrodidae | Homoptera | Yes | No | EPPO, 2014 |
| 8 | Cottony cushion scale | *Icerya purchase* | Margarodidae | Homoptera | Yes | No | NHM, 1980 |
| 9 | Green scale | *Coccus viridis* | Coccidae | Homoptera | No | Yes | CABI, 2002 |
| 10 | Green shield scale | *Pulvinaria psidii* | Coccidae | Homoptera | Yes | No | CIE, 1994 |
| 11 | Pineapple mealy bug | *Dysmicoccus brevipes* | Pseudococcidae | Homoptera | Yes | No | Ben-Dov, 1994; CIE, 1972 |
| 12 | Pink hibiscus mealybug | *Maconellicoccus hirsutus* | Pseudococcidae | Homoptera | Yes | No | EPPO, 2014; CABI/EPPO, 2015 |
| 13 | Guava mealy bug | *Ferrisia virgata* | Pseudococcidae | Homoptera | Yes | No | CIE, 1966; APPPC, 1987; Williams, 2004 |
| 14 | Spiked mealybug | *Nipaecoccus nipae* | Pseudococcidae | Homoptera | No | Yes | APPPC, 1987; CABI/EPPO, 2005 |
| 15 | Long-tailed mealybug | *Pseudococcus longispinus* | Pseudococcidae | Homoptera | No | Yes | CIE, 1984; AVA, 2001. |
| 16 | Tea mosquito bug: | *Helopeltis antonii* Signoret | Miridae | Hemiptera | No | Yes | EPPO, 2014; CABI, 2017 |
| 17 | Guava aphid | *Aphis punicae* Passerini | Aphididae | Homoptera | No | Yes | Bhagat, 2012; Blackman and Eastop, 2013; |
| 18 | Redbanded Thrips | *Selenothrips rubrocinctus* | Thripidae | Thysanoptera | No | Yes | H. A. Denmark and D. O. Wolfenbarger, 2012 |
| 19 | Castor capsule borer | *Congethes (Dichocrocis) punctiferalis* Guenée | Crambidae | Lepidoptera | Yes | No | Waterhouse, 1993; Zhang *et al.,* 1994; EPPO, 2013 |
| 20 | Fruit borer | *Rapala varuna* Hewitson | Lycaenidae | Lepidoptera | Yes | No | EPPO, 2013 |

| SN | Common Name | Scientific name | Family | Order | Presence in Bangladesh | Quarantine status | References |
|---|---|---|---|---|---|---|---|
| 21 | Anar/Pomegranate butterfly/ Guava blue butterfly | *Virachola isocrate* | Lycaenidae | Lepidoptera | No | Yes | Bhakare, 2017. Khan, 2016 |
| 22 | Oriental yellow scale | *Aonidiella citrina* | Diaspididae | Homoptera | Yes | No | NHM, 1927 |
| 23 | Black scale | *Saissetia oleae* | Coccidae | Homoptera | Yes | No | CIE, 1973 |
| 24 | Guava stem borer | *Apriona* Sp. | Cerambycidae | Coleoptera | No | Yes | Wikipedia, 2017 |
| **B. Mite pest** | | | | | | | |
| 25 | Red and black flat mite | *Brevipalpus phoenicis* | Tenuipalpidae | Trombidiformes | Yes | No | CABI/EPPO, 2013 |
| 26 | False spider mite | *Brevipalpus californicus* | Tenuipalpidae | Trombidiformes | Yes | No | CABI/EPPO, 2013 |
| **Diseases** | | | | | | | |
| **Causal organism: Fungi** | | | | | | | |
| 27 | Anthracnose | *Glomerella cingulata* | Sordariomycetidae | Glomerellaceae | Yes | No | Mridha et al., 1990 |
| 28 | Basal rot | *Fusarium oxysporum* | Nectriaceae | Hypocreales | Yes | No | CAB Abstracts |
| 29 | Brown rot | *Monilinia fructigena* | Sclerotiniaceae | Helotiales | No | Yes | CABI/EPPO, 2000; EPPO, 2014 |
| 30 | | *Diplodianetalensis* Evans | Botryosphaeriaceae | Botryosphaeriales | Yes | No | PRA of citrus |
| 31 | Fruit canker | *Pestalotia psidii* Pat | Amphisphaeriaceae | Xylariales | Yes | No | Venkatakrishniah, 2016 |
| 32 | Botryosphaeria rot/ fruit rot | *Botryosphaeria ribis* Gross. & Duggar | Botryosphaeriaceae | Botryosphaeriales | Yes | No | Rahman et al., 1983; CABI/EPPO, 2011 |
| 33 | Mucor rot | *Mucor hiemalis* | Mucoraceae | Mucorales | Yes | No | GBIF, 2016 |
| 34 | Grey leaf spot | *Cercospora* Sp. | Mycosphaerellaceae | | Yes | No | Wikipedia, 2017 |
| 35 | Guava rust | *Puccinia psidii* | Pucciniaceae | Pucciniales | No | Yes | EPPO, 2014; CABI/EPPO, 2014 |
| 36 | Die back | *Phytophthora* Sp. | Pythiaceae | Peronosporales | Yes | No | Wikipedia, 2017 |
| 37 | Guava wilt | *Fusarium oxysporum* Sch. f. sp. *psidii* | Nectriaceae | Hypocreales | Yes | No | Prasad *et al.,* 1952; Hussain *et al.,* 2012 |
| **Causal organism: Bacteria** | | | | | | | |
| 38 | Bacteriosis | *Erwinia psidii* | Enterobacteriaceae | Enterobacteriales | No | Yes | KADO, 2014 |
| **Causal organism: Nematode** | | | | | | | |
| 39 | Root-knot nematode | *Meloidogyne incognita* | Meloidogynidae | | Yes | No | Shepherd & Barker, 1990; CABI/EPPO, 2002 |
| **Virus** | | | | | | | |
| 40 | Leaf curl | *Cotton leaf curl virus (CLCuV)* | Geminiviridae | | Yes | No | Harrison, *et, al,.*1997 |
| **Algea** | | | | | | | |
| 41 | Algal leaf and fruit spot/ red rust | *Cephaleuros virescens* Kuntze | Trentepohliaceae | Trentepohliales | No | Yes | USDA, 2005 |

| SN | Common Name | Scientific name | Family | Order | Presence in Bangladesh | Quarantine status | References |
|---|---|---|---|---|---|---|---|
| **Weed** | | | | | | | |
| **Grasses** | | | | | | | |
| 42 | Bermuda grass | *Cynodon dactylon* L. | Poaceae | Poales / Cyperales | Yes | No | Holm et al., 1979; CABI, 2013 |
| 43 | Egyptian crowfoot grass | *Dactyloctenium aegyptium* (L.) | Poaceae | Cyperales | Yes | No | Holm et al., 1979; CABI, 2016 |
| 44 | Cogon grass | *Imperata cylindrica* (L.) | Poaceae | Cyperales | Yes | No | Holm et al., 1979; Garrity et al., 1996; EPPO, 2014 |
| 45 | Quack grass | *Agropyron repens* (L.) | Poaceae | Cyperales | Yes | No | Holm et al., 1991; EPPO, 2014 |
| 46 | Indian goose grass | *Eleusine indica* (L.) | Poaceae | Cyperales | Yes | No | Holm et al., 1979; CABI, 2015 |
| 47 | Johnson grass | *Sorghum helepense* (L.) | Poaceae | Cyperales | Yes | No | Shukla, 1996; CABI, 2015 |
| **Broad leaf** | | | | | | | |
| 48 | Coat buttons | *Tridax procumbens* L. | Fabaceae | Asterales | Yes | No | Rahman et al., 2008 |
| 49 | Beggar-ticks | *Bidens pilosa* L. | Asteraceae | Asterales | Yes | No | Sudha et al., 1998 |
| 50 | Amaranth | *Amaranthus viridis* L. | Amaranthaceae | Caryophyllales | Yes | No | Holm et al., 1991 |
| 51 | Asthma herb | *Euphorbia hirta* L. | Euphorbiaceae | Euphorbiales | Yes | No | Holm et al., 1979 |
| 52 | Whitetop Weed | *Parthenium hysterophorus* L | Asteraceae | Asterales | Yes | No | Navie *et al.,* 1996a; EPPO, 2014 |
| 53 | Horse purslane | *Trianthema portulacastrum* L. | Aizoaceae | Caryophyllales | Yes | No | Mandal & Bishayee, 2015 |
| 54 | Common Purslane | *Portulaca oleracea* L | Portulacaceae | Caryophyllales | Yes | No | Holm et al., 1991 |
| 55 | *Parthenium weed* | *Parthenium hysterophorus* | Asteraceae | Asterales | No | Yes | |
| **Sedges** | | | | | | | |
| 56 | Purple nut sedge | *Cyperus rotundus* L. | Cyperaceae | Cyperales | Yes | No | Govaerts, 2014; Holm et al., 1979 |
| 57 | Flat sedge | *Cyperus iria* L. | Cyperaceae | Cyperales | Yes | No | Moody, 1989 |
| 58 | Yellow nutsedge: | *Cyperus esculentus* L. | Cyperaceae | Cyperales | Yes | No | Govaerts, 2014; Holm et al., 1979 |
| 59 | Small-floweed umbrella sedge | *Cyperus difformis* L. | Cyperaceae | Cyperales | Yes | No | Govaerts, 2014 |

## Table 7: Quarantine pests of guava for Bangladesh likely to be associated with guavaimported from flower exporting countries

| Sl. No | Common name | Scientific name | Distribution to flower exporting countries | Plant parts likely to carry the pest | References |
|---|---|---|---|---|---|
| **Arthropods** | | | | | |
| **Insect pests** | | | | | |
| 1 | Queensland fruit fly | *Bactrocera tryoni* | China, India, Japan, Nepal, Pakistan, Sri Lanka, Thailand, USA | Fruit, clothing/ footwear | EPPO, 2014; CABI/EPPO, 2013 |
| 2 | Mediterranean fruit fly | *Ceratitis capitata* | Afghanistan, China, India, Iran, Jordan, Soudi Arabia, Turkey, Egypt, USA, Brazil, France, Italy, Russian Federation, UK, | Fruit, Clothing/ footwear and possessions | CABI, 2007; Cayol & Causse, 1993; Kapoor, 1989 |
| 3 | Green scale | *Coccus viridis* | China, India, Philippines, Malaysia | Fruit, Clothing/ footwear and possessions | CABI, 2002 |
| 4 | Spiked mealybug | *Nipaecoccus nipae* | China, India, Iran, Jordan, Soudi Arabia, Turkey, Egypt, USA, Brazil, France | Fruit, leaves, possessions | APPPC, 1987; CABI/EPPO, 2005 |
| 5 | Long-tailed mealybug | *Pseudococcus longispinus* | China, India, Iran, Jordan, Soudi Arabia, Turkey, Egypt, USA, Brazil, France, Philippines, Malaysia | Fruit, leaves, possessions | CIE, 1984; AVA, 2001. |
| 6 | Tea mosquito bug: | *Helopeltis antonii* Signoret | India, Indonesia, Sri Lanka | Fruit, Clothing/ footwear and possessions | EPPO, 2014; CABI, 2017 |
| 7 | Guava aphid | *Aphis punicae* Passerini | India, Indonesia, Japan, Pakistan | Fruit, Clothing/ footwear and possessions | Bhagat, 2012; Blackman and Eastop, 2013; Öztürk et al., 2005; Sugimoto, 2011 |
| 8 | Redbanded thrips | *Selenothrips rubrocinctus* | China, Malaya, Philippine Islands, Taiwan, USA, Brazil | Fruit, Clothing/ footwear and possessions | H. A. Denmark and D. O. Wolfenbarger, 2012 |
| 9 | Anar /Pomegranate butterfly/ Guava blue butterfly | *Virachola isocrate* | Sri Lanka, China, India | Fruit, Clothing/ footwear and possessions | Kumawat K. C., S. S. Jheeba and A. K. Soni. (2001) |
| 10 | Guava stem borer | *Apriona* Sp. | India, Pakistan, Afghanistan | Fruit | Wikipedia, 2017 |

| | | | | | |
|---|---|---|---|---|---|
| **Disease causing organisms** | | | | | |
| **Fungi** | | | | | |
| 11 | Brown rot | *Monilinia fructigena* | China, India, Korea, Nepal, Taiwan, Turkey | Stem, Leaf, Fruit | CABI/EPPO, 2000; EPPO, 2014 |
| 12 | Guava rust | *Puccinia psidii* | China, India, Indonesia, Japan, Taiwan,South Africa, USA, Argentina, Brazil, Australia | Stem, Leaf, Fruit | EPPO, 2014; CABI/EPPO, 2014 |
| **Bacteria** | | | | | |
| 13 | Bacteriosis | *Erwinia psidii* | Brazil, Argentina, Uruguay | Flowers, bud, fruit, tender shoot | ARRIEL *et al.,* 2014 |
| **Algea** | | | | | |
| 14 | Algal leaf and fruit spot: | *Cephaleuros virescens* Kuntze | Thailand, USA | Leaf, Fruit | USDA, 2005 |
| **Weeds** | | | | | |
| 15 | *Parthenium weed* | *Parthenium hysterophorus* | Bangladesh (restricted areas), India, China, Bhutan, Japan, Pakistan, Australia, Brazil | Whole season of the crops | Shabbir 2006; Shabbir et al. 2011; Anwar et al. 2012 |

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# CHAPTER 7

## RISK ASSESSMENT

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 guava idenfied for Bangladesh has been analyzed details as follows:

**ARTHROPOD: INSECT PESTS**

## 7.1 Pest-1: Queensland fruit fly, *Bactrocera tryoni*

### 7.1.1 Hazard Identification

**Scientific name:** *Bactrocera tryoni* (Froggatt)

**Synonyms**: *Chaetodacus tryoni* (Froggatt)

*Dacus ferrugineus tryoni* (Froggatt)

*Dacus tryoni* (Froggatt)

*Strumeta tryoni* (Froggatt)

*Tephritis tryoni* Froggatt

**Common names**: Fruchtfliege,

Queensland

**Taxonomic tree**

Domain: *Bactrocera tryoni*

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

Order: Diptera

Family: Tephritidae

Genus: Bactrocera

EPPO Code: DACUTR. This pest has been included in EPPO A1 list: No. 235

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

### 7.1.2 Biology

Eggs are laid below the skin of the host fruit. These hatch within 1-3 days and the larvae feed for 10-31 days. Pupariation is in the soil under the host plant and adults emerge after 1-2 weeks (longer in cool conditions) and adults occur throughout the year (Christenson & Foote, 1960). *B. tryoni* would be unable to survive the winter in the EPPO region, except in the south. The adults are best able to survive low temperatures, *Bactrocera* spp. generally having a normal torpor threshold of 7°C, dropping as low as 2°C in winter. The ability of *B. tryoni* to survive repeated frosts has been studied by Meats & Fitt (1987). Sutherst & Maywald (1991) have used the CLIMEX model to describe the potential for population growth of *B. tryoni* in Australia, together with the climatic factors which limit its geographical distribution and abundance. A projection was also made of the behaviour of *B. tryoni* in North America following hypothetical introduction into Los Angeles County, California (USA).

### 7.1.3 Hosts

*B. tryoni* has a very wide host range on both cultivated and wild species (in 25 families). As shown by Fitt (1986), adults of *B. tryoni* exhibit no particular preference in the species of fruits on which they will lay. The main hosts are in practice mostly tree fruits: Annona, Averrhoa carambola, avocados (*Persea americana*), Citrus, Fortunella, **guavas (*Psidium guajava***), Malus, mangoes (*Mangifera indica*), passion fruits (*Passiflora edulis*), pawpaws (*Carica papaya*), peaches (*Prunus persica*), plums (*Prunus domestica*) and Pyrus. However, vegetables such as tomatoes (*Lycopersicon esculentum*) are also infested. Many tree fruit crops of the EPPO region are potential hosts.

### 7.1.4 Distribution

**EPPO region**: Absent.

**North America:** USA (found but not established in California).

**South America:** Chile (twice adventive in Easter Island, but eradicated; Bateman, 1982). **Oceania:** Australia (throughout eastern half of Queensland, eastern New South Wales, and extreme east of Victoria; recently found in Tasmania, where it is now under eradication; outbreaks repeatedly occur in South Australia, but are regularly eradicated (Maelzer, 1990); established in the Perth area of Western Australia in 1989 but now believed eradicated). A few males have been trapped in Papua New Guinea but *B. tryoni* is unlikely to be established there (Drew, 1989). Adventive in New Caledonia and French Polynesia (Austral Islands and many of the Society Islands). New Zealand (intercepted only). Doubtful records in Northern Mariana Islands, Vanuatu.

**EU:** Absent.

### 7.1.5 Hazard Identification Conclusion

Considering the facts that *B. tryoni* -

- is not known to be present in Bangladesh [CABI/EPPO, 1999; EPPO, 2014]
- potentially economic important to Bangladesh because it is an important pest of many cultivated plants including most characteristically fruits: Annona, Averrhoa carambola, avocados (*Persea americana*), Citrus, Fortunella, guavas (*Psidium guajava*), Malus, mangoes (*Mangifera indica*), passion fruits (*Passiflora edulis*), pawpaws (*Carica papaya*), peaches (*Prunus persica*), plums (*Prunus domestica*) and Pyrus. However, vegetables such as tomatoes (*Lycopersicon esculentum*) are also infested. Many tree fruit crops of the EPPO region are potential hosts.

- It is a serious pest of Australia from where a large amount of fruits are imported to Bangladesh.

- *B. tryoni,* the Queensland fruit fly, is the most costly horticultural pest in Australia and has invaded several countries in the surrounding region (White and Elson-Harris, 1994). It has the potential to spread too many places around the world because of its wide climatic and host range (Meats 1989b; Sutherst *et al.,*2000) and a tendency to be carried by human travellers at the larval stage inside infested fruit. *B. tryoni* is a very serious pest of a wide variety of fruits throughout its range. Damage levels can be anything up to 100% of unprotected fruit.

- The major risk is from the importation 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. An isolated catch of B. tryoni in a cue lure baited trap in California (Foote *et al.,* 1993) probably had an origin of this sort.

- It can establish in Bangladesh through imports of the fruits. It has capability to cause direct and indirect economic and ecological damage to many valuable cultivated crops and fruits.

- *B. tryoni* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.1.6 Determine Likelihood of Pest Establishing in Bangladesh 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><br>• This pest has been established in many Oceania and Europian countries including USA, Australia, New Zealand, Canada, Italy, Germany [CABI/EPPO, 1999; EPPO, 2014]. But it is not present in Asain countries.<br><br>**b. Posibility of survival of this pest during transport, storage and transfer? – Yes**<br><br>• The adult females of *B. tryoni* lay eggs below the skin of the host fruit. These hatch within 1-3 days and the larvae feed for 10-31 days (Christenson & Foote, 1960). This period of time taken for shipment through transportation pathways from the above mentioned exporting countries to Bangladesh is sufficient enough for survival of this pest. Secondly, fruit is packed in wrapping (wooden boxes) and stored in normal conditions. So the pests could survive during transporting process.<br><br>• On the other hand, the adults are best able to survive low temperatures. *Bactrocera* spp. generally having a normal torpor threshold of 7°C, dropping as low as 2°C in winter. The ability of *B. tryoni* to survive repeated frosts has been studied by Meats & Fitt (1987). Sutherst & Maywald (1991) have used the CLIMEX model to describe the potential for population growth of *B. tryoni* in Australia, together with the climatic factors which limit its | **Yes and High** |

<table>
<tr><td>
geographical distribution and abundance.<br><br>
c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,<br><br>
• Adult flight and the transport of infested fruits are the main means of movement and dispersal to previously uninfested areas. Many Bactrocera spp. can fly 50-100 km (Fletcher, 1989).<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>
• B. tryoni is the most serious insect pest of fruit and vegetable crops in Australia, and it infests all commercial fruit crops, other than pineapple (Drew, 1982). Most of the data given here are from the host catalogue of Hancock et al. (2000), much of which derives from host data gathered in a major survey in the Cairns area. That revised list recorded B. tryoni from 49 families of plants, represented by 234 species. In addition to the hosts listed, Garcinia dulcis, Diplocyclos palmatus, Flaacourtia inermis, Sandoricum indicum, Artocarpus odoratissima, Casimiroa tetrameria, Murraya exotica and Solanum muricatum are economically important hosts of B. tryoni. Other major wild hosts are Annona atemoya, Terminalia aridicola, T. muelleri, T. platyphylla, T. sericocarpa, T. subacroptera, Syzgium suborbiculare, S. tierneyanum and Nauclea orientalis. is highly polyphagous,<br><br>
• It is an important pest of many cultivated plants including most characteristically fruits: Annona, Averrhoa carambola, avocados (Persea americana), Citrus, Fortunella, guavas (Psidium guajava), Malus, mangoes (Mangifera indica), passion fruits (Passiflora edulis), pawpaws (Carica papaya), peaches (Prunus persica), plums (Prunus domestica) and Pyrus. However, vegetables such as tomatoes (Lycopersicon esculentum) are also infested; but seldom cucurbits.<br><br>
• B. tryoni would be unable to survive the winter in the EPPO region, except in the south. The adults are best able to survive low temperatures, Bactrocera spp. generally having a normal torpor threshold of 7°C, dropping as low as 2°C in winter. The ability of B. tryoni to survive repeated frosts has been studied by Meats & Fitt (1987). Sutherst & Maywald (1991) have used the CLIMEX model to describe the potential for population growth of B. tryoni in Australia, together with the climatic factors which limit its geographical distribution and abundance.<br><br>
• The climate of Bangladesh is not similar to places it is established.
</td><td></td></tr>
<tr><td>• Not as above or below</td><td>Moderate</td></tr>
<tr><td>
• This pest has not established in new countries in recent years, and<br>
• The pathway does not appears good for this pest to enter Bangladesh and establish, and<br>
• Its host(s) are not common in Bangladesh and climate is not similar to places it is established
</td><td>Low</td></tr>
</table>

### 7.1.7 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>• It is an important pest of many cultivated plants including most characteristically fruits: Annona, Averrhoa carambola, avocados (*Persea americana*), **Citrus**, Fortunella, **guavas** (*Psidium guajava*), Malus, **mangoes** (*Mangifera indica*), passion fruits (*Passiflora edulis*), **pawpaws** (*Carica papaya*), peaches (*Prunus persica*), plums (*Prunus domestica*) and Pyrus. However, vegetables such as **tomatoes** (*Lycopersicon esculentum*) are also infested. Therefore, it is a high risk, if fruits and plant material are imported from Australia there is possibility to establish the pest in Bangladesh.<br>• This is a fairly serious pest of several important fruits, vegetables and other crops for Bangladesh.<br>**b. Economic Impact and Yield Loss**<br>• There are about 4,500 species of tephritid flies (Diptera: Tephritidae). Approximately one third are frugivorous and around 250 are considered economic pests, with 23 of these known to be serious pests in Australia, Oceania and tropical Asia (White and Elson-Harris, 1994; Vijaysegaran, 1997). Adults of frugivorous Tephritidae lay their eggs beneath the skin of sound ripening fruit; the larvae feed within the fruit and cause direct damage and induce decay and premature fruit drop (Allwood and Leblanc, 1997).<br>• The percentage of produce lost has been estimated to be 10-50% in tropical Asia and Oceania and higher levels can occur in other parts of the world if control measures are not in place (Allwood and Leblanc, 1997).<br>• *B. tryoni* has a permanent presence in the eastern Australian states as well as the Northern Territory and the north of Western Australia (Meats *et al.,*2008; Cameron *et al.,*2010). Various statutory authorities have estimated economic losses in Australia due to *B. tryoni* to be between $28.5 million and $100 million per annum (Sutherst *et al.,* 2000).<br>**c. Environmental Impact**<br>• **Impact on Natural Habitats:** Impacts on natural habitats are unlikely because *B. tryoni* is a generalist and is mainly abundant in crops, villages and towns, and in natural habitats it would be only one of several fruit fly species present (Drew *et al.,* 1984; Raghu *et al.,* 2000).<br>• **Impact on Biodiversity:** Impacts on biodiversity are also unlikely for the same reasons as for impacts on natural habitats. However, as far as fruit flies are concerned an unequivocal answer to the question - whether there is an impact of a pest species on other species in a district - should be assessed only by experiment or by incubating field-sampled fruit individually in order to rear out and identify surviving adult insects (Gibbs, 1967; Fitt, 1986). Conversely, frugivorous birds and rodents can destroy a large percentage of wild fruit in some places that would be otherwise available to fruit flies or have fruit fly larvae already in them (Drew, 1987).<br>• **Impact on human health:** Adult fruit fly can be controlled with methyl eugenol traps (Lakshmanan *et al.* 1973), bait sprays, pheromone mating | **Yes and High** |

| | |
|---|---|
| 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 fruits would have a high risk potential for **environment and human health**. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.1.8 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**

### 7.1.9 Risk Management Measures

Consignments of fruits of *Annona, Averrhoa carambola, Carica papaya, Citrus, Fortunella, Malus, Mangifera indica, Passiflora edulis, Persea americana, Prunus domestica, Prunus persica, Psidium guajava and Pyrus* from countries where *B. tryoni* occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. EPPO recommends that such fruits should come from an area where B. tryoni does not occur, or from a place of production found free from the pest by regular inspection for 3 months before harvest. Fruits may also be treated in transit by cold treatment (e.g. 14, 18 or 20 days at 0.5, 1 or 1.5°C, respectively; USDA, 1994), by hot-water dip (Heard *et al.,* 1991; Jessup, 1991) or, for certain types of fruits, by vapour heat (e.g. keeping at 43°C for 4-6 h) (Heard *et al.,* 1992; USDA, 1994). Ethylene dibromide was previously widely used as a fumigant but is now generally withdrawn because of its carcinogenicity; methyl bromide is less satisfactory, damaging many fruits and reducing their shelf life, but treatment schedules are available (e.g. 32 g/m3 for 2 h at 21-26°C; USDA, 1994). Insecticides such as fenthion, dimethoate and omethoate can be applied as sprays during grading and packing of tomatoes and mangoes (Heather *et al.,* 1987). Irradiation is now being investigated as a treatment against *B. tryon*i (Jessup, 1990; Heather *et al.,* 1991; Lescano *et al.,* 1994). Plants of host species transported with roots from countries where *B. tryoni* occurs should be free from soil, or the soil should be treated against puparia. The plants should not carry fruits. Such plants may indeed be prohibited importation.

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## 7.2 Pest-2: Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann*)*

### 7.2.1 Hazard Identification

**Scientific name:** *Ceratitis capitata (Wiedemann)*

**Synonyms**: *Ceratitis citriperda* MacLeay

*Ceratitis hispanica* De Brême

*Pardalaspis asparagi* Bezzi

*Tephritis capitata* Wiedemann

**Common names**: Mediterranean fruit fly,

Medfly (English)

**Taxonomic tree**

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

Order: Diptera

Family: Tephritidae

Genus: Ceratitis

Species: *Ceratitis capitata*

EPPO Code: CERTCA. This pest has been included in EPPO A2 list: No. 105

**Bangladesh status:** Not present in Bangladesh [EPPO, 2014; CABI/EPPO, 2015]

### 7.2.2 Biology

Eggs of *C. capitata* are laid below the skin of the host fruit. They hatch within 2-4 days (up to 16-18 days in cool weather) and the larvae feed for another 6-11 days (at 13-28°C). Pupariation is in the soil under the host plant and adults emerge after 6-11 days (24-26°C; longer in cool conditions) and adults live for up to 2 months (field-caged) (Christenson & Foote, 1960). *C*. *capitata* will not in practice survive sub-zero winter temperatures; it is well named Mediterranean, for the area in which it survives in the EPPO region is precisely that (virtually coinciding with where Citrus is grown). Worner (1988) uses the climate-matching system to evaluate the areas of potential establishment of *C. capitata* in New Zealand.

### 7.2.3 Hosts

*C. capitata* is a highly polyphagous species whose larvae develop in a very wide range of unrelated fruits. On Hawaii (USA), 60 out of 196 fruit species examined over the years 1949-85 were at least once found as hosts of *C. capitata*; the two most important hosts were coffee (*Coffea arabica*) and *Solanum pseudocapsicum* (Liquido *et al.,* 1989). In the EPPO region, important hosts include **Cucumis (melons, cucuimbers, gerkins),** apples (*Malus pumila*), avocados (*Persea americana*), Citrus, figs (*Ficus carica*), kiwifruits (*Actinidia* *deliciosa*), mangoes (*Mangifera indica*), medlars (*Mespilus germanica*), ***Psidium guajava*** **(guava),** pears (*Pyrus communis*), *Prunus* spp. (especially peaches, *P. persica*), in fact practically all the tree fruit crops. It has also been recorded from wild hosts belonging to a large number of families.

### 7.2.4 Distribution

*C. capitata* originates in tropical Africa, from where it has spread to the Mediterranean area and to parts of Central and South America.

**EPPO region**: Southern part of the EPPO region, i.e. Albania, Algeria, Croatia (Kovacevic, 1965), Cyprus, Egypt, **France** (very limited distribution in south only; Cayol & Causse, 1993), Greece (including Crete), Hungary (found but not established), Israel, Italy, Lebanon, Libya, Malta, Morocco, Portugal (including Azores and Madeira), Russia (southern, found but not established), Slovenia, Spain (including Balearic and Canary Islands), Switzerland (limited distribution), Syria, Tunisia, Turkey, Ukraine (outbreaks in the south eradicated). Records in northern or central Europe (Austria, Belgium, Bulgaria, Czech Republic, **Germany**, Hungary, Luxemburg, **Netherland**, Sweden, UK) refer to interceptions or short-lived adventive populations only (Karpati, 1983; Fischer-Colbrie & Busch-Petersen, 1989).

**Asia**: Afghanistan (unconfirmed), Cyprus, **India** (single interception, Kapoor, 1989), Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, Yemen.

**Africa**: Algeria, Angola, Benin, Burkina Faso, Burundi, Botswana, Cameroon, Cape Verde Islands, Congo, Côte d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Libya, Madagascar (also the related species C. malgassa), Malawi, Mali, Mauritius, Morocco, Mozambique, Niger, Nigeria, Réunion, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, St. Helena, Sudan, Tanzania, Togo, Tunisia, Uganda, Zaire, Zimbabwe. Karpati (1983) lists some other African countries but does not give the source of his data.

**North America**: Bermuda (eradicated). **USA** (only Hawaii); introduced and eradicated several times in California during 1980s and 1990s; introduced, eradicated and still absent in Florida and Texas (Cunningham, 1989b; Lorraine & Chambers, 1989). Eradicated from Mexico.

**Central America and Caribbean**: Belize (eradicated), Costa Rica, El Salvador, Guatemala, Honduras, Jamaica, Netherlands Antilles, Nicaragua, and Panama. The related species C. malgassa, from Madagascar, was at one time established in Puerto Rico (Steyskal, 1982).

**South America**: Argentina (locally), Bolivia, **Brazil** (Espirito Santo, Goias, Minas Gerais, Paraná, Rio Grande do Sul, São Paulo), **Chile** (extreme north only, declared eradicated in 1996), Colombia, Ecuador, Paraguay, Peru, Suriname, Uruguay, Venezuela.

**Oceania**: Australia (found but not established in New South Wales, limited distribution in Western Australia), Northern Mariana Islands.

**EU**: Present.

### 7.2.5 Hazard Identification Conclusion

Considering the facts that *B. cabitata* -

- is not known to be present in Bangladesh [EPPO, 2014; CABI/EPPO, 2015]
- *C. capitata* is a highly polyphagous species whose larvae develop in a very wide range of unrelated fruits. On Hawaii (USA), 60 out of 196 fruit species examined over the years 1949-85 were at least once found as hosts of *C. capitata*; the two most important hosts were coffee (*Coffea arabica*) and *Solanum pseudocapsicum* (Liquido

*et al.,* 1989). In the EPPO region, important hosts include Cucumis (melons, cucuimbers, gerkins), apples (*Malus pumila*), avocados (*Persea americana*), Citrus, figs (*Ficus carica*), kiwifruits (*Actinidia deliciosa*), mangoes (*Mangifera indica*), medlars (*Mespilus germanica*), *Psidium guajava* (guava), pears (*Pyrus communis*), *Prunus* spp. (especially peaches, *P. persica*), in fact practically all the tree fruit crops.

- *C. capitata* is an EPPO A2 quarantine pest (OEPP/EPPO, 1981), and is also of quarantine significance throughout the world (CPPC, NAPPO, APPPC and especially for Japan and the USA. In the EPPO region, *C. capitata* has reached the limits of its natural distribution and does not appear likely to establish in any major new areas (but possibly around the Black Sea). However, its presence even as temporary adventives populations could lead to severe additional constraints for export of fruits to uninfested areas in other continents.
- *C. capitata* is a highly invasive species. It has a high dispersive ability, a very large host range and a tolerance of both natural and cultivated habitats over a comparatively wide temperature range. It has a high economic impact, affecting production, control costs and market access. It has successfully established in many parts of the world, often as a result of multiple introductions (Malacrida *et al.,* 2007). Frequent incursions into North America require expensive eradication treatments and many countries maintain extensive monitoring networks.
- *C. capitata* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.2.6 Determine Likelihood of Pest Establishing in Bangladesh via this Pathway

Table 3.1 – 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 Asain, American, Oceania and Europian countries including **India** (single interception), USA, **Australia**, Russia, Saudi Arabia, Turkey, Canada, Italy, Germany, Brazil, Chile [CABI/EPPO, 1999; EPPO, 2014].<br>**b. Posibility of survival during transport, storage and transfer?—Yes**<br>• Eggs of *C. capitata* are laid below the skin of the host fruit. They hatch within 2-4 days (up to 16-18 days in cool weather) and the larvae feed for another 6-11 days (at 13-28°C). Therefore, this pest can survive during transport, storage and transfer of infested fruits from exporting countries into Bangladesh.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Adult flight and the transport of infested fruits are the major means of movement and dispersal to previously uninfested areas. There is evidence that *C. capitata* can fly at least 20 km (Fletcher, 1989). Some host fruits are only infested when ripe, and this has been the basis for an "infestation-free quarantine procedure" for avocados exported from Hawaii to mainland USA, which was recently called into question when fruits still on the tree were found to be infested (Liquido *et al.,* 1995). But this insect is not present in South Asian countries. | **Yes and High** |

| | |
|---|---|
| **d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• *C. capitata* is a highly polyphagous species whose larvae develop in a very wide range of unrelated fruits. In the EPPO region, important hosts include Cucumis (melons, cucumbers, gerkins), apples (*Malus pumila*), avocados (*Persea americana*), Citrus, figs (*Ficus carica*), kiwifruits (*Actinidia deliciosa*), mangoes (*Mangifera indica*), *Psidium guajava* (guava), medlars (*Mespilus germanica*), pears (*Pyrus communis*), *Prunus* spp. (especially peaches, *P. persica*), in fact practically all the tree fruit crops. Among these host plants, the cucumbers, citrus, mangoes are common in Bangladesh.<br>• Eggs of *C. capitata* hatch within 2-4 days (up to 16-18 days in cool weather) and the larvae feed for another 6-11 days (at 13-28°C). Pupariation is in the soil under the host plant and adults emerge after 6-11 days (24-26°C; longer in cool conditions) and adults live for up to 2 months (field-caged) (Christenson & Foote, 1960).<br>• Therefore, the climatic requirements of this insect pest are more or less similar to Bangladesh to establish it. | |
| • 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 |

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

Table 3.2 – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *C. capitata* is a highly invasive species. It has a high dispersive ability, a very large host range and a tolerance of both natural and cultivated habitats over a comparatively wide temperature range. It has a high economic impact, affecting production, control costs and market access. It has successfully established in many parts of the world, often as a result of multiple introductions (Malacrida *et al.,* 2007). Frequent incursions into North America require expensive eradication treatments and many countries maintain extensive monitoring networks.<br>• This is a fairly serious pest of several important fruits, vegetables and other crops for Bangladesh.<br>**b. Economic Impact and Yield Loss**<br>• *C. capitata* is an important pest in Africa and has spread to almost every other continent to become the single most important pest species in the family. It is highly polyphagous and causes damage to a very wide range of unrelated fruit crops.<br>• In Mediterranean countries, it is particularly damaging on citrus and peaches. It also transmits fruit-rotting fungi (Cayol *et al.,* 1994).<br>• It has a high economic impact, affecting production, control costs and market access.<br>• The quarantine importance of this pest restricts the international trades of the cucurbit fruits. | **Yes and High** |

| c. Environmental Impact and Health Hazards | |
|---|---|
| • Adult fruit fly 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 fruits would have a high risk potential for **environment and human health**. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in your country. | Low |

### 7.2.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

**Establishment Potential X Consequence Potential = Risk**

Table 3.3 – Calculating risk

| 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**

### 7.2.9 Risk Management Measures

- Consignments of fruits from countries where *C. capitata* occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. EPPO recommends (OEPP/EPPO, 1990) that fruits of Citrus or Prunus should have been treated by an appropriate method, e.g. in transit by cold treatment (e.g. 10, 11, 12, 14, 15 days at 0.0, 0.6, 1.1, 1.7 or 2.2°C, respectively,) or, for certain types of fruits, by vapour heat (e.g. keeping at 44°C for 8 h) (USDA, 1994), forced hot-air (Armstrong *et al.,* 1995) or hot water treatment (Sharp & Picho-Martinez, 1989).

- Ethylene dibromide was previously widely used as a fumigant but is now generally withdrawn because of its carcinogenicity; methyl bromide is less satisfactory, damaging many fruits and reducing their shelf-life, although treatment schedules are available for specific cases (e.g. 32 g/m3 for 2-4 h; USDA, 1994). Irradiation has been proposed as disinfestation method (Ohta *et al.,* 1989). A combination of methyl bromide fumigation and cold treatment is also recommended against *C. capitata*.

- Wrapping fruits in shrinkwrap film has been investigated as a possible method of disinfesting fruits (Jang, 1990).

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## 7.3 Pest-3: Green Scale, *Coccus viridis*

### 7.3.1 Hazard Identification

**Scientific name:** *Coccus viridis*

**Synonyms**: *Lecanium viride*

**Common names**: Green scale

**Taxonomic tree**

Kingdom: Animalia

Phylum: Arthropoda

Subphylum: Hexapoda

Class: Insecta

Order: Hemiptera

Suborder: Sternorrhyncha

Family: Coccidae

Genus: Coccus

Species: *Coccus viridis*

EPPO Code: COCCVI.

**Bangladesh status:** Not present in Bangladesh [CABI, 2002]

### 7.3.2 Biology

Males have not been recorded for this species so the populations are composed entirely of females. A mature female lays whitish oval eggs and keeps them underneath her body to protect them. She usually chooses the underside of a leaf and adult scales may often be seen in a line on both sides of the midrib and beside the lateral veins. Eggs hatch in anything between a few minutes and a few hours. The newly hatched crawlers wander off to find somewhere suitable to settle on a leaf or near the tip of a green shoot. Both nymphs and adults suck sap from the phloem of the host plant. When a large number of scale insects are present, their collective feeding causes a yellowing of the leaves which may later fall, a loss of plant vigour and a reduction in crop yield. The scale insects excrete honeydew on which bees, wasps, ants and other insects feed. Sooty mould fungus often grows on the honeydew and this decreases the area of leaf available for photosynthesis, spoils the appearance of the plant and reduces the marketability of fruit. It is especially damaging to young trees after transplanting.

### 7.3.3 Hosts

***Coccus viridis*** **(Green)**has a broad host range (CABI, 2002). Primary hosts are *Citrus* spp. (Rutaceae), *Coffea arabica* (Rubiaceae), *Artocarpus* sp. (Moraceae), *Camellia sinensis* (Theaceae), *Manihot esculenta* (Euphorbiaceae), *Mangifera indica* (Anacardiaceae), ***Psidium guajava***(Myrtaceae), and *Theobroma cacao* (Sterculiaceae) (CABI, 2002). Other hosts include *Alpinia purpurata* (Zingiberaceae), *Chrysanthemum* sp. (Asteraceae), *Manilkara zapota* (Sapotaceae), *Nerium oleander* (Apocynaceae) (CABI, 2002), and *Dimocarpus longan* (Sapindaceae) (ScaleNet, 2004).

### 7.3.4 Distribution

***Coccus viridis*** **(Green)** is pantropical in distribution. It has been reported from India through Indo-China, Malaysia to the Philippines and Indonesia, throughout much of Oceania and sub-Saharan Africa south to South Africa (CABI, 2002). In the New World, it is present in Florida, and ranges from Central America to the northern part of South America and throughout the Caribbean. Its reported distribution corresponds to Agro Ecological Zones (AEZ) of Bangladesh. It is estimated that this species could become established in areas of Bangladesh. Survival outside of these areas would be limited to greenhouse or other artificial situations.

### 7.3.5 Hazard Identification Conclusion

Considering the facts that *Coccus viridis* -

- is not known to be present in Bangladesh [EPPO, 2014; CABI/EPPO, 2015]
- ***Coccus viridis*** **(Green)** has a broad host range (CABI, 2002). Major hosts are ***Coccus viridis*** **(Green)** has a broad host range (CABI, 2002). Primary hosts are *Citrus* spp. (Rutaceae), *Coffea arabica* (Rubiaceae), *Artocarpus* sp. (Moraceae), *Camellia sinensis* (Theaceae), *Manihot esculenta* (Euphorbiaceae), *Mangifera indica* (Anacardiaceae), *Psidium guajava* (Myrtaceae), and *Theobroma cacao* (Sterculiaceae) (CABI, 2002). Most of them are major crops in Bangladesh.
- *C. viridis* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.3.6 Determine likelihood of pest establishing in Bangladesh via this pathway

Table 4.1 – 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>• It has been reported from India through Indo-China, Malaysia to the Philippines and Indonesia, throughout much of Oceania and sub-Saharan Africa south to South Africa (CABI, 2002). Most of the fruits, field crops and vegetables are imported into our country from those countries where the pest is already estabilished. | **Yes and High** |

| | |
|---|---|
| **b. Posibility of survival during transport, storage and transfer?—Yes**<br><br>• Males have not been recorded for this species so the populations are composed entirely of females. A mature female lays whitish oval eggs and keeps them underneath her body to protect them. She usually chooses the underside of a leaf and adult scales may often be seen in a line on both sides of the midrib and beside the lateral veins. Eggs hatch in anything between a few minutes and a few hours. The newly hatched crawlers wander off to find somewhere suitable to settle on a leaf or near the tip of a green shoot. So, the pest easily transport through fruits and other planting materials.<br>• The transport duration of guava from exporting countries to Bangladesh is about 20 days, so the duration is suitable for its survival. The storage condition is also favorable for its survival.<br><br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br><br>• *Coccus viridis* is parthenogenetic and oviparous (Dekle 1976b). Females may deposit up to 500 eggs (CABI 2002). There may be several generations per year (Kosztarab 1997). The rate of natural dispersal is inherently low (Tandon and Veeresh 1988); however, since 1985, *C. viridis* has been intercepted 10,658 times by agricultural specialists at U.S. ports of entry (PIN309 query September 30, 2004), which is strong evidence that this species can, and has, spread quickly and widely via the transport of infested plant materials. In light of this evidence, this organism was rated **High** for the Dispersal Potential risk element.<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>• ***Coccus viridis*** **(Green)**has a broad host range (CABI, 2002). Primary hosts are *Citrus* spp. (Rutaceae), *Coffea arabica* (Rubiaceae), *Artocarpus* sp. (Moraceae), *Camellia sinensis* (Theaceae), *Manihot esculenta* (Euphorbiaceae), *Mangifera indica* (Anacardiaceae), *Psidium guajava* (Myrtaceae), and *Theobroma cacao* (Sterculiaceae) (CABI, 2002). Most of the fruit crops are common in our country.<br><br>• Therefore, the climatic requirements of this insect pest are more or less similar to Bangladesh to establish it. | |
| • 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 |

### 7.3.7 Determine the Consequence Establishment of this Pest in Bangladesh

Table 4. 2 – Which of these descriptions best fit of this pest?

<table>
<tr><th>Description</th><th>Consequence potential</th></tr>
<tr><td>a. Is this a serious pest of Bangladesh? - Yes.<br>Coccus viridis (Green)has a broad host range (CABI, 2002). Primary hosts are Citrus spp. (Rutaceae), Coffea arabica (Rubiaceae), Artocarpus sp. (Moraceae), Camellia sinensis (Theaceae), Manihot esculenta (Euphorbiaceae), Mangifera indica (Anacardiaceae), Psidium guajava (Myrtaceae), and Theobroma cacao (Sterculiaceae) (CABI, 2002). So, it the pest enter into Bangladesh became a serious pest for our country.<br>b. Economic Impact and Yield Loss<br>• Although its economic impact is usually minor, it can be extremely devastating depending on location and crop (CABI 2002). Coccus viridis is a pest of coffee, citrus and other crops in several regions in the tropics, and it is reported as a major pest of citrus in Bolivia (Ben-Dov 1993). Coccus viridis is a major pest of coffee in Haiti (Aitken Soux 1985) and India (Narasimham 1987). In Brazil, infestations of 50 scales per plant caused significant damage to coffee seedlings, reducing leaf area and plant growth rate (Silva and Parra 1982). Of all the scale insects known on coffee in Papua New Guinea, C. viridis and one other scale species cause most of the yield loss Williams 1986). In India, citrus fruit quality was significantly lower on trees following C. viridis infestation and the sooty mold (Capnodium citri) contamination that accompanied it (Haleem 1984). Based on this evidence, the wider establishment in the Bangladesh of C. viridis would likely lead to lower yield of host crops, lower value of host crop commodities, and loss of foreign or domestic-markets. Consequently, C. viridis was rated High for the Economic Impact risk element.<br>c. Environmental Impact and Health Hazards<br>• The extreme polyphagy of C. viridis predisposes it to attack vulnerable native plants in the Bangladesh. The wider establishment of this species could have a negative impact on the fruits industry in all over areas of Bangladesh, and stimulate the initiation of chemical control programs. Therefore, the Environmental Impact risk element was rated High.</td><td>Yes and High</td></tr>
<tr><td>• Not as above or below</td><td>Moderate</td></tr>
<tr><td>• This is a not likely to be an important pest of common crops grown in your country.</td><td>Low</td></tr>
</table>

### 7.3.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

**Establishment Potential X Consequence Potential = Risk**

Table 4.3 – Calculating risk

| 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**

### 7.3.9 Risk Management Measures

- Avoid importation of guava and planting material from countries, where this pest is available.
- 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).

### 7.3.10 References


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## 7.4 Pest-4: Spiked Mealybug: *Nipaecoccus nipae* (Maskell, 1893)

### 7.4.1 Hazard Identification

**Scientific Name:** *Nipaecoccus nipae* (Maskell, 1893)

**Synonyms**:

*Ceroputo nipae (*Maskell), Lindinger, 1904

*Dactylopius dubia* Maxwell-Lefroy, 1903

*Dactylopius nipae* Maskell, 1893

**Common names**: Spiked mealybug, coconut mealybug,

**Taxonomic tree**

Domain: Eukaryota
Kingdom: Metazoa
Phylum: Arthropoda
Subphylum: Uniramia
Class: Insecta
Order: Hemiptera
Suborder: Sternorrhyncha
Superfamily: Coccoidea
Family: Pseudococcidae
Genus: Nipaecoccus
Species: *Nipaecoccus nipae*

**EPPO Code:** NIPANI.

**Bangladesh status:** Not present in Bangladesh [APPPC, 1987; CABI/EPPO, 2005]

### 7.4.2 Biology

*N. nipae* is sexually reproductive but its biology and ecology are poorly known. Males and females cannot be readily distinguished from each other during the first two instars, but the third instar female begins to resemble the adult. When present, immature males change within a pupal cocoon during the third instar prior to emerging as a winged adult

### 7.4.3 Hosts

*N. nipae* is polyphagous and attacks 80 genera of plants belonging to 43 families (Ben-Dov, 1994). It is recorded feeding on a wide range of economically important plants, mostly fruit crops and ornamentals, including avocados, bananas, citrus, cocoa, coconuts, custard apples (*Annona reticulata*), edible figs, **guavas**, mangoes, oil palm, orchids, pawpaws, pineapples, seaside grapes and soursop (*Annona muricata*). *N. nipae* seems to prefer palms, such as species of Areca, Cocos, Kentia, Kentiopsis and Sabal. In temperate regions in Europe and North America, *N. nipae* often attacks ornamental palms grown under glass.

**(a) Major host:***Annona squamosa* (sugar apple), *Artocarpus altilis* (breadfruit), *Cajanus cajan* (pigeon pea), *Cocos nucifera* (coconut), *Ficus carica* (fig), *Ficus elastica* (rubber plant), *Ipomoea batatas* (sweet potato), *Mangifera indica* (mango), Musa (banana), ***Psidium guajava* (guava)**

### 7.4.4 Distribution

*N. nipae* is found in Europe, Asia, Africa, North, Central and South America and Oceania (Ben-Dov, 1994; CABI/EPPO, 2005).

**Asia:** China (Ben-Dov, 1994), India (Josephrajkumar *et al.,* 2012), Indonesia (CABI/EPPO, 2005), Korea, Republic of (CABI/EPPO, 2005), Philippines (Caasi-Lit *et al.,* 2012), Turkey (CABI/EPPO, 2005)

**Africa:** Morocco (CABI/EPPO, 2005), South Africa (CABI/EPPO, 2005)

**North America:** Mexico and USA (CABI/EPPO, 2005)

**South Amrica**: Brazil, Chile, Argentina, Peru, Colombia (Ben-Dov, 1994; CABI/EPPO, 2005)

**Europe:** Belgium, Italy, Portugal, Russian federation, Spain, UK (Ben-Dov, 1994; CABI/EPPO, 2005)

**Ocenia:** Fiji (Hodgson & Agowska, 2011)

### 7.4.5 Hazard Identification Conclusion

Considering the facts that *N. nipae* -

- is not known to be present in Bangladesh [APPPC, 1987; CABI/EPPO, 2005];
- will be potentially economic important to Bangladesh because it is a major pest of several crops, fruits and ornamental plants like avocados, bananas, citrus, cocoa, coconuts, custard apples, edible figs, guavas, mangoes, oil palm, orchids, pawpaws, pineapples, seaside grapes etc which are also important crops in our country.
- The degree of polyphagy of *P. solenopsis* its numerous economically important host-plants, and the rapid escalation of international trade in fresh plant material and produce, mean that this species presents a high risk of introduction.
- *P. solenopsis* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.4.6 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>• In recent years *N. nipae* been established in different country especially in Asian countries like China, India, Indonesia, Korea, Republic of, Philippines, Turkey. Guav and other fruits are mainly imported from thesre countries.<br>**b. Possibility of survival during transport, storage and transfer? No**<br>• Due to lack of information about their biology, we can't predict about their survival during transport, storage and transfer.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establishment and spread? - Yes,**<br>• The pathway appear good for this pest to enter into Bangladesh and establishment because the adults, eggs, nymphs and pupae may transport through flowers, inflorescence, fruits, leaves, roots and stems. Different type of vegetables, fruits, crops, seeds, flowers, plant parts are | **YES and Moderate** |

| | |
|---|---|
| imported in our country from different country in where the pest is already established. So, this insect can enter in our country through any of this imported material.<br>• Immature and adult female *N. nipae* are readily carried on plants and plant produce and may be injurious when introduced to new geographical areas where they have no natural enemies.<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• *N. nipae* is polyphagous and attacks 80 genera of plants belonging to 43 families (Ben-Dov, 1994). It is recorded feeding on a wide range of economically important plants, mostly fruit crops and ornamentals, including bananas, citrus, cocoa, coconuts, custard apples (*Annona reticulata*), edible figs, guavas, mangoes, oil palm, orchids, pawpaws, pineapples, most of them are important plants in our country<br>• These climatic conditions of these countries where this pest has already estabilished 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 Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | Low |

### 7.3.4.7. 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>• Because it is a major pest of several economically important plants, mostly fruit crops and ornamentals, including bananas, citrus, cocoa, coconuts, custard apples (Annona reticulata), edible figs, guavas, mangoes, oil palm, orchids, pawpaws, pineapples etc which are also important crops in our country.<br>**b. Economic impact and yield loss**<br>• *N. nipae* is generally of little economic importance, but it has become a pest of avocados and guavas in Hawaii, Bermuda and Puerto Rico (see Ben-Dov, 1994 for further references). Ant-attended infestations of *N. nipae* have been recorded causing damage to coconut plantations in Guyana, together with the coconut scale Aspidiotus destructor (Raj, 1977). *N. nipae* is also a pest of ornamental palms. The damage caused by *N. nipae* may result in ornamental plants, fruit, cut flowers and foliage losing their market value.<br>**c. Environmental Impact**<br>• The grower is required to implement chemical applications to save the crop, resulting in increased expenses in production as well as the potential of chemical contamination of soil and water.<br>• The excessive use of toxic chemical insecticides have a negative impact to our environment, natural life, wild life, even aquatic life and disrupting the natural control system in the field. | **Yes and Moderate** |
| • Not as above or below | **Moderate** |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.4.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 5.3 – Calculation of 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 – Moderate**

### 7.4.9 Risk Management Measures

- Avoid importation of guava and other fruits from countries, where this pest is available.
- In countries where *N. nipae* not already present, the enforcement of strict phytosanitary regulations as required for *N. nipae* may help to reduce the risk of this mealybug 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 *N. nipae* present.

### 7.4.10 References


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## 7.5 Pest-5: Long-tailed mealybug: *Pseudococcus longispinus* Targioni Tozzetti

### 7.5.1 Hazard identification

**Scientific Name:** *Pseudococcus longispinus* Targioni Tozzetti

**Synonyms**:

*Boisduvalia lauri (*Boisduval) Signoret

*Coccus adonidum* various authors (not Linnaeus)

*Coccus laurinus* Boisduval

*Dactylopius adonidum (*Linnaeus)

*Dactylopius longifilis* Comstock

**Common names**: long-tailed mealybug

**Taxonomic tree**

- Domain: Eukaryota
- Kingdom: Metazoa
  - Phylum: Arthropoda
    - Subphylum: Uniramia
      - Class: Insecta
        - Order: Hemiptera
          - Suborder: Sternorrhyncha
            - Superfamily: Coccoidea
              - Family: Pseudococcidae
                - Genus: Pseudococcus
                  - Species: *Pseudococcus longispinus*

**EPPO Code:** PSECAD.

**Bangladesh status:** Not present in Bangladesh [CABI, 2017]

### 7.5.2 Biology

The female lays 75-200 eggs (dependent on the host plant) and a generation is completed in about six weeks at 26ºC. Third-stage nymphs may also be inseminated, but oviposit only after having molted to females. Pest numbers peak in early summer, declining in autumn and winter. First instar nymphs may disperse by becoming wind-borne. Large populations are often attended by ants, which do not seem to affect the numbers of *P. longispinus* but hinder its natural enemies.

### 7.5.3 Hosts

The longtailed mealybug has a relatively wide host range that includes many economically important crops, such as avocado, citrus, grapes, pear, persimmon, and pineapple (Faber *et al*. 2007, Furness 1976, Dentener *et al*. 1997, Williams and Watson 1988). Valuable ornamental plants, especially those adapted to tropical and subtropical environments are also hosts. These include species of cycads (Culbert 1995) and orchids (Kot *et al*. 2015, Ray and Hoy 2014). Plants kept inside homes or in greenhouses seem to be especially at risk for mealybug infestation, due to the relatively stable temperature and humidity of these environments (Blumberg and Van Driesche 2001).

**(a) Major host:***Albizia julibrissin* (silk tree), Citrus, *Colocasia esculenta* (taro), *Diospyros kaki* (persimmon), *Persea americana* (avocado),***Psidium guajava* (guava**), *Pyrus communis* (European pear), *Solanum melongena* (aubergine), *Vitis vinifera* (grapevine)

**(b) Minor host:***Alpinia purpurata* (red ginger), *Ananas comosus* (pineapple), *Cocos nucifera* (coconut), Coffea (coffee), *Malus domestica* (apple), *Manihot esculenta* (cassava),*Prunus domestica* (plum), *Solanum tuberosum* (potato) etc.

### 7.5.4 Distribution

Longtailed mealybug is widespread throughout the world. It is found outdoors in the warmer parts of America, Europe, and Africa. In northern latitudes it occurs in greenhouses (McKenzie 1967). First collected in Hawaii before 1900, it is present on the six major Islands (Zimmerman 1948, Hawaiian Terrestrial Arthropod Chlecklist 1992).

- **Asia:** China (CIE, 1984), India (Ben-Dov, 1994), Indonesia (Ben-Dov, 1994), Iran (CIE, 1984), Japan (Ben-Dov, 1994), Malaysia (CIE, 1984), Philippines (Lit & Calilung, 1994), Singapore (AVA, 2001), Sri Lanka (CIE, 1984), Taiwan (CIE, 1984), Turkey (CIE, 1984), Vietnam (CIE, 1984)
- **Africa:** Egypt (CIE, 1984), Cameron (CIE, 1984), Ghana (CIE, 1984), Zimbabwe (CIE, 1984)
- **North America:** Canada (CIE, 1984), Mexico (Ben-Dov, 1994) and USA (CIE, 1984)
- **South Amrica**: Brazil (Culik *et al.,* 2009), Chile (CIE, 1984), Argentina (CIE, 1984), Uruguay (CIE, 1984)
- **Europe:** Netherlands, Belgium, Denmark, Finland, France, Sweden, UK, Germany, Greece, Italy (CIE, 1984), Russian Federation (Ben-Dov, 1994)
- **Ocenia:** Australia (CIE, 1984), Fiji (CIE, 1984), New Zealand (CIE, 1984)

### 7.5.5 Hazard Identification Conclusion

Considering the facts that *P. longispinus* -

- is not known to be present in Bangladesh [CABI,2017];

- The longtailed mealybug has a relatively wide host range that includes many economically important fruits, such as guava, avocado, citrus, grapes, pear, persimmon, and pineapple.
- Valuable ornamental plants, especially those adapted to tropical and subtropical environments are also hosts. These include species of cycads and orchids. Plants kept inside homes or in greenhouses seem to be especially at risk for mealybug infestation, due to the relatively stable temperature and humidity of these environments
- will be potentially economic important to Bangladesh because it is a major pest of several crops like okra, cotton, sunflower, china-rose, tobacco, sesame, tomato, aubergine etc which are also important crops in our country.
- The degree of polyphagy of *P. longispinus* its numerous economically important host-plants, and the rapid escalation of international trade in fresh plant material and produce, mean that this species presents a high risk of introduction.
- *P. longispinus* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.5.6 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>• Longtailed mealybug is widespread throughout the world. It is found outdoors in the warmer parts of America, Europe, Asia and Africa.<br>• In recent years *P. longispinus* been established in different country especially in Asian countries like China, India, Sri-Lanka, Japan, Malaysia, Philippines, Singapore, Vietnam and Turkey. This mealybug species has the ability to increase rapidly in population size and spread to cover vast areas where host plants occur, in a relatively short period of time.<br><br>**b. Possibility of survival during transport, storage and transfer? Yes**<br>• The female lays 75-200 eggs (dependent on the host plant) and a generation is completed in about six weeks at 26ºC. The transport, storage and transfer duration from exporting countries to our country is about 20 days, so the duration is favorable for its survival and the storage environment is also favorable for its survival.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establishment and spread? - Yes,**<br><br>• The pathway appear good for this pest to enter into Bangladesh and establishment because pest or symptoms not visible to the naked eye but usually visible under light microscope so it is very difficult to detect them. The adults, eggs, nymphs and pupae may transport through fruits, leaves, roots and stems. Different type of vegetables, fruits, crops, seeds, flowers, plant parts are imported in our country from different country in where the pest is already established. So, this insect can enter in our country through any of this imported material...<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>• *P. longispinus* is a major pest of several fruit crops like Avocado, citrus, | **YES and High** |

| | |
|---|---|
| guava, grapevine, European pear, aubergine, silk tree, taro, persimmon etc, most of the crops are cultivated in our country. Besides this, they also imported from different countries.<br>• *P. longispinus* is a minor pest of red ginger, pineapple, coconut, coffee, apple, cassava, plum, potato etc. Most of which are common in our country, | |
| • 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 Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | Low |

### 7.5.7 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>• Because it is a major pest of several fruit crops like Avocado, citrus, guava, grapevine, European pear, aubergine, silk tree, taro, persimmon etc. Most of fruits are common in our county, beside the cultivation the fruits are also imported from countries where the pest is already established. So, if the pest enter into our country became a serious pest.<br>**b. Economic impact and yield loss**<br>• Mealybugs and other insects with piercing-sucking mouthparts, like aphids, feed directly from the host plant vascular system. This food source is plentiful but somewhat dilute, meaning the insect must take in an abundance of plant sap to get adequate nutrition.<br>• Honeydew, a sugary substance periodically excreted from the insect's body, is a waste product of this feeding behavior. Honeydew itself is not harmful to the plant, but can coat the leaves and nearby objects and encourage growth of a fungus known as sooty mold. Sooty mold, like honeydew, is not directly injurious to the plant, but it is unsightly, hard to remove, and can diminish the plant's photosynthetic capabilities. It also reduces or eliminates the economic value of fruits grown for fresh consumption and plants grown for ornamental value.<br>• Sometimes honeydew-producing insects are first noticed because of the presence of another insect species taking advantage of their sugary excretions. Colonies of longtailed mealybug have been observed being tended by white-footed ants, *Technomyrmex difficilis* Forel (Warner *et al.* 2002).<br>• In addition to typical feeding damage*, Pseudococcus longispinus,* as well as several related mealybug species, is an efficient vector of Grapevine leafroll-associated virus 3 (GLRaV-3), a major causal agent of Grapevine leafroll disease (Douglas and Krüger 2008). The causal agents of Grapevine leafroll disease are distributed worldwide and this disease reduces yield and quality of grapes used for juice, wine, and table consumption (Maree *et al.* 2013).<br>**c. Environmental Impact**<br>• The grower is required to implement chemical applications to save the crop, resulting in increased expenses in production as well as the potential of chemical contamination of soil and water. | **Yes**<br>**and**<br>**High** |

| | |
|---|---|
| • The extreme use of harmful chemical insecticides may harm to natural environment, disrupting the natural control system in our crop field and may causes resistance, resurgence and upset. | |
| • Not as above or below | **Moderate** |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.5.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 6.3 – Calculation of 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 – Moderate**

### 7.5.9 Risk Management Measures

- Avoid importation of infested material from countries, where this pest is available.
- In countries where *Phenacoccus solenopsis* not already present, the enforcement of strict phytosanitary regulations as required for *P. solenopsis* may help to reduce the risk of this mealybug 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 *P. solenopsis* present.

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## 7.6 Pest-6: Tea mosquito bug: *Helopeltis antonii* Signoret, 1858

### 7.6.1 Hazard identification

**Scientific Name:** *Helopeltis antonii* Signoret, 1858

**Common names**: Tea bug

**Taxonomic tree**

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

Order: Hemiptera

Family: Miridae

Genus: *Helopeltis*

Species: *Helopeltis antonii*

**EPPO Code:** HELOAN

**Bangladesh status:** Not present in Bangladesh (CABI, 2017; EPPO, 2014)

### 7.6.2 Biology

The total developmental period of a closely related species *H. antonii* reared under constant temperature of 19 to 35 °C on cashew flushing shoots was 231.37 h (Srikumar and Bhat, 2011). The mean incubation period of eggs was 10.5 ± 1.29 (9-12) d with 60.53% survivals. Mean longevity of adult females was 22.6 ± 3.29 d with a range of 19-25 d.

### 7.6.3 Hosts

Besides guava, the insect, *H.antonii,* also infest cashew nut, neem tree, tea, Jamaica Cherry, avocado, black pepper, pomegranate, cocoa and grapevine plants.

### 7.6.4 Distribution

**Asia:** India, Indonesia and Sri Lanka (EPPO, 2014; Siswanto, *et al.,*2008; Stonedahl, 1991). This insect was first of all discovered by Antoine Dohrn in Sri Lanka and Signoret (1858) named the species as Helopeltis antonii. This pest is widely distributed in Indonesia, Vietnam, Sri Lanka and India. In India it is more commonly found in Southern parts. The common name “Tea mosquito bug” is applied for both the species *H. antonii* and *H. theivora*.

### 7.6.5 Hazard Identification Conclusion

Considering the facts that *H.antonii* -

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

- is potentially economic important to Bangladesh because it is an important pest of guava in India, Indonesia and Sri Lanka [EPPO, 2014; Siswanto, *et al.,* 2008; Stonedahl, 1991] from where guava are imported to Bangladesh.
- *H.antonii* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.6.6 Determine Likelihood of Pest Establishing in Bangladesh via this Pathway

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

| Description | Establish ment Potential |
|---|---|
| **a. Has this pest been established in several new countries in recent years-Yes**,<br>• In recent years *H.antonii* has been established in different parts of India and Indonesia and become a serious pest ot these countries.<br>• H. antonii is perhaps the most serious single pest of commercially grown cashews in India, with crop losses sometimes reaching 30-40% (Devasahayam and Nair, 1986). Sathiamma (1977) found that inflorescence panicles (48.5%) and fruits (32%) sustained higher levels of attack than young shoots (14%).<br>**b. Posibility of survival during transport, storage and transfer? Yes**<br>• Depending upon the season, hatching of eggs takes 5-27 days. The wingless nymphs are red in colour and owing to their elongated delicate legs they look like an ant or a spider. The nymph feed upon the sap of the host plant. The nymphal period lasts for 12-15 days in summer and 53-58 days in winter.The transport duration of guava and planting materials from exporting countries to our country is about 20 days. So, the insect can easily survive within this time. Besides this, the storage environment is also favorable for its survival. So, *H.antonii* can survive during transport, storage & transfer into the infested fruit.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - No,**<br>• The eggs are inserted into the tender parts of the host plants, more commonly in axis of the leaves or in inflorescence or buds, by the females. The eggs are elongated and sausage shaped. So, the egg can not enter into our country through seed and/or fruits. Besides this the adult and nymph suck the sap from the tender parts of the tea plant like leaves, young shoots, buds etc.So, there is less possibility to enter this pests through fruits or seeds.<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• Besides guava, the insect, *H.antonii,* also infest cashew nut, neem tree, tea, Jamaica Cherry, avocado, black pepper, pomegranate, cocoa and grapevine plants.<br>• Tea is one of the cash crop in our country and the pest causes severe damage in tea industries.<br>• These climatic requirements for growth and development of *H.antonii* is | **YES and Moderate** |

| | |
|---|---|
| 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 Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | Low |

### 7.6.7 Determine the Consequence Establishment of this Pest in Bangladesh

Table 7.2: Which of these descriptions best fit of this pest?

| **Description** | **Consequence potential** |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *H.antonii* is highly polyphagous with several hosts. This pest is a serious pest of guava, tea, Jamaica Cherry, avocado, black pepper, pomegranate, cocoa and grapevine plants.<br>• If the pest enter into our country, became a serious problem in tea industries.<br>**b. Economic impact and yield loss**<br>• Estimates of crop loss attributed to damage by Helopeltis spp. are variable and depend on factors such as agricultural practices, control methods, locality, climate, and the plant and insect species involved. H. antonii is perhaps the most serious single pest of commercially grown cashews in India, with crop losses sometimes reaching 30-40% (Devasahayam and Nair, 1986). Sathiamma (1977) found that inflorescence panicles (48.5%) and fruits (32%) sustained higher levels of attack than young shoots (14%). Nymphs caged on young shoots made an average of 114 feeding lesions per day (range 78-235), while females made an average of 97 (16-238) and males 25 (11-59).<br>**c. Environmental Impact**<br>• Due to estabilishment of this pest different types of chemical insecticides are used to control it causes a great negarive effect in the environment like distruction of natural control system, development of resistence, resurgence and secondary pest outbreak. | **Yes and High** |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.6.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 7.3 – Calculation of 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**

### 7.6.9 Risk Management Measures

- Avoid importation of bulbs and seeds from countries, where this pest is available.
- In countries where *H.antonii* is not already present, the enforcement of strict phytosanitary regulations as required for *H.antonii*, may help to reduce the risk of this leek moth 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 *H.antonii* are present.

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## 7.7 Pest-7: Guava aphid: *Aphis punicae* Passerini

### 7.7.1 Hazard Identification

**Scientific Name:** *Aphis punicae* Passerini

**Common names**: Guava aphid

**Taxonomic tree**

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Class: Insecta

Order: Hemiptera

Family: Aphididae

Genus: *Aphis*

Species: *Aphis punicae*

**EPPO Code:** APHIPU

**Bangladesh status:** Not present in Bangladesh

### 7.7.2 Biology

The body of the apterous female is light green, including the cauda and siphunculi, length of the female body is 1.0-2.0 mm. The head and thorax of alate females are dark, as are the siphunculi, whereas the abdomen and cauda are greenish and body length is 1.4-1.9 mm. Aphid reproduces by viviparous parthenogenesis throughout the year (autoecious cycle). The females deposit their eggs in the leaf axils. The aphids that emerge in the following spring reproduce by viviparous parthenogenesis till autumn. The pest has spring and autumn population peaks (Mescheloff and Rosen, 1990). On the evergreen Duranta repens Linnaeus (golden dewdrop) the aphid reproduces by viviparous parthenogenesis throughout the year (autoecious cycle). On the deciduous pomegranate sexual forms occur in winter, mate and the females (the "amphigones") deposit their eggs in the leaf axils. The aphids that emerge in the following spring reproduce by viviparous parthenogenesis till autumn. The pest has spring and autumn population peaks. The optimal conditions for the aphid, when reared on pomegranate, are between 22.5-25ºC, at which temperatures each female produces aboud 30 progeny. The threshold for development was calculated to be at 11.8ºC.

### 7.7.3 Hosts

Besides guava, the insect, *A. punicae,* also infest pomegranate and various ornamentals.

### 7.7.4 Distribution

Around the Mediterranean to Switzerland, Southern Russia to India.

### 7.7.5 Hazard Identification Conclusion

Considering the facts that *A. punicae* -

- is not known to be present in Bangladesh;
- is potentially economic important to Bangladesh because it is an important pest of guava in India from where guava are imported to Bangladesh.
- *A. punicae* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.7.6 Determine Likelihood of pest establishing in Bangladesh via this Pathway

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

| **Description** | **Establish ment Potential** |
|---|---|
| **a. Has this pest been established in several new countries in recent years- Yes**,<br>• In recent years *A. punicae* has been established in different parts of India.<br>**b. Posibility of survival during transport, storage and transfer? Yes**<br>• The transport duration of guava and planting materialsfrom exporting countries to our country is about 20 days. So, the pest can easily survive within this duration. Besides this, the pest has spring and autumn population peaks. The optimal conditions for the aphid, when reared on pomegranate, are between 22.5-25ºC, at which temperatures each female produces aboud 30 progeny. The threshold for development was calculated to be at 11.8ºC (Bayhan *et al.,*2005). So, the storage environment is also suitable for its growth, survival and development.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Pest or symptoms not visible to the naked eye but usually visible under light microscope. Besides this the adult and nymph can easily enter into our country through fruits, propagating materials.<br>• Long distance dispersal is by wind. Aerial sampling may be suitable for predicting future aphid abundance, but was not suitable for predicting existing populations (Parajulee *et al.,*2003). *A. punicae* was collected at 150 m in India, and it was concluded that this dispersal of *A. punicae* was over tens or hundreds of kilometres (Reynolds *et al.,* 1999).<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• Host range of *A. punicae* are available in Bangladesh.<br>• These climatic requirements for growth and development of *A. punicae* is more or less similar with the climatic condition of **Bangladesh**. | **YES and HIGH** |
| • 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 Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | |

### 7.7.7 Determine the Consequence Establishment of this Pest in Bangladesh

Table 8.2: Which of these descriptions best fit of this pest?

| **Description** | **Consequence potential** |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *A. punicae* is highly polyphagous with several hosts and most of the hosts are very common in our country. If the pest enter into our country became a serious problem for our fruit industries.<br>**b. Economic impact and yield loss**<br>• The feeding of *A. punicae* causes leaf drop, reductions in pomegranate fruit quality and stunts tree growth. The pest's honeydew and ensuing sootymold enhance these injuries.<br>• Besides this it also reduce the market value of the affected fruirs.<br>**c. Environmental Impact**<br>• Control of this pest is very difficult. After estabilishment of this pests farmers use different type of chemical insecticides, which has a great negative effect to our environment. | **Yes and High** |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.7.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 8.3 – Calculation of 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**

### 7.7.9 Risk Management Measures

- Avoid importation of guava and propagating materials from countries, where this pest is available.
- In countries where *A. punicae* is not already present, the enforcement of strict phytosanitary regulations as required for *A. punicae*, may help to reduce the risk of this leek moth 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 *A. punicae* are present.

### 7.7.10 References


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## 7.8 Pest-8: Red banded thrips: *Selenothrips rubrocinctus* (Giard)

### 7.8.1 Hazard identification

**Scientific Name:** *Selenothrips rubrocinctus* (Giard)

**Synonymy:** *Heliothrips rubrocinctus* Giard

*Physopus rubrocinctus* Giard (1901)

*Heliothrips (Selenothrips) decolor* Karny

*Heliothrips (Selenothrips) mendex* Schmutz

*Brachyurothrips indicus* Bagnall

**Common names**: Redbanded thrips

**Taxonomic tree**

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Class: Insecta

Order: Thysanoptera

Family: Thripidae

Genus: Selenothrips

Species: *Selenothrips rubrocinctus*

**EPPO Code:** SLENRU

**Bangladesh status:** Not present in Bangladesh (UFIFAS, 2012)

### 7.8.2 Biology

Eggs are inserted into the leaf tissue. They are white, kidney-shaped and about 0.25 mm long (Hill, 1975). The first and second nymphal stages are yellow with a bright red b around the base of the abdomen. When fully grown, the second instar is about 1 mm long. The tip of the nymph's abdomen is turned up and carries a drop of excreta on anal setae (Hill, 1975). The pre-pseudo pupa is yellowish with red eyes, with a red band across the first three abdominal segments. The pseudo-pupa has an almost similar appearance as the pre-pseudo pupa with larger wing knobs (Hill, 1975). The adult female is dark brown and just over 1 mm long. Males are smaller and rare (Hill, 1975). Reproduction by the red-banded thrips is parthenogenetically (Avidov and Harpaz, 1969). Females live about 7 weeks and lay an average of 25 eggs. Eggs hatch in 12 - 18 days (Hill, 1975). The nymphal stage lasts 6 - 10 days and the pre-pseudo pupa; the pseudo pupal stage together 3 - 6 days.

### 7.8.3 Hosts

The redbanded thrips is a pest of many plants. The locality and its flora usually determine the more prevalent hosts. In the West Indies, it has been a serious pest of cacao and mango. The species of tropical fruit trees, ornamentals and shade trees that it attacks are too numerous to list here. The favorite tropical fruit hosts in Florida are mango, guava and avocado. It has also a problem in sweetgum trees in central Florida.

### 7.8.4 Distribution

The redbanded thrips is a tropical-subtropical species thought to have originated in northern South America (Chin and Brown 2008) and is found in the following areas:

- **Asia** — China, Malaya, Philippine Islands, Taiwan;
- **Africa** — Bioko, Ghana, Ivory Coast, Nigeria, Principe Island, Sierra Leone, Tanzania, Uganda, Zaire;
- **Australasia and Pacific Islands** — Hawaiian Islands, Mariana Islands, New Caledonia, New Guinea, Papua, and Solomon Islands;
- **North America —** United States (Florida), Mexico;
- **Central America** — Costa Rica, Honduras, Panama;West Indies;
- **South America** — Brazil, Ecuador, Guiana, Peru, Suriname, and Venezuela.

### 7.8.5 Hazard Identification Conclusion

Considering the facts that *S. rubrocinctus* -

- is not known to be present in Bangladesh;
- is potentially economic important to Bangladesh because it is an important pest of guava in China, Philippines and Taiwan from where guava are imported to Bangladesh.
- *S. rubrocinctus* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.8.6 Determine Likelihood of Pest Establishing in Bangladesh via this Pathway

Table 9.1 – 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>• In recent years *A. punicae* has been established in different parts of the world like Asia, Africa, Australasia, North America and South America from where different types of fruits are imported in our country especially guava and mango.<br>**b. Posibility of survival during transport, storage and transfer? Yes**<br>• The transport duration of guava and planting materials from exporting countries to our country is about 20 days. So, the pest can easily survive within this duration. Because females live about 7 weeks and lay an average of 25 eggs. Eggs hatch in 12 - 18 days (Hill, 1975). The nymphal stage lasts 6 - 10 days and the pre-pseudo pupa; the pseudo pupal stage together 3 - 6 days. On the other hand, the storage condition is more or less common for its survival.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Pest or symptoms not visible to the naked eye but usually visible under light microscope. Besides this the adult and nymph can easily enter into our country through fruits, propagating materials.<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• Host range of *S. rubrocinctus* are available in Bangladesh.<br>• These climatic requirements for growth and development of *S. rubrocinctus* is more or less similar with the climatic condition 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 Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | Low |

### 7.8.7 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>• The redbanded thrips is a pest of many plants. The locality and its flora usually determine the more prevalent hosts. In the West Indies, it has been a serious pest of cacao and mango. The species of tropical fruit trees, ornamentals and shade trees that it attacks are too numerous to list here. The favorite tropical fruit hosts in Florida are mango, guava and avocado. It has also a problem in sweetgum trees in central Florida. So, if the pest enter into our country became a serious pest for our country.<br>**b. Economic impact and yield loss**<br>• The larvae and adults feed on the foliage and the fruit by piercing the epidermis with their mouthparts. Redbanded thrips prefer young foliage and their feeding causes leaf silvering, distortion, leaf drop. The thrips destroys the cells on which it feeds, causes injury to the fruit, and leaves unsightly dark colored droplets or blotches of excrement on the leaf surface. A more serious injury is leaf drop, which may denude trees. Honeydew excretory products from red-banded thrips and other insect infestations fall to leaves, fruits or objects beneath, giving rise to the objectionable fruit-degrading, black sooty mold.<br>**c. Environmental Impact**<br>• Control of this pest is very difficult. After estabilishment of this pests farmers use different type of chemical insecticides, which has a great negative effect to our environment. | **Yes and High** |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.3.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 9.3 – Calculation of 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**

### 7.8.9 Risk Management Measures

- Avoid importation of guava and propagating materials from countries, where this pest is available.
- In countries where *S. rubrocinctus* is not already present, the enforcement of strict phytosanitary regulations as required for *S. rubrocinctus* may help to reduce the risk of this leek moth 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 *S. rubrocinctus* are present.

### 7.8.10 References


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## 7.9 Pest-9: Anar butterfly: *Virachola isocrate*

### 7.9.1 Hazard identification

**Scientific Name:** *Virachola isocrate*

**Common names**: Anar butterfly, Pomegranate fruit borer or pomegranate butterfly

**Taxonomic tree**

Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

Order: Lepidoptera

Family: Lycaenidae

Genus:*Virachola*

Species: *Virachola isocrate*

**EPPO Code:** VIRAG.

**Bangladesh status:** Not present in Bangladesh [Bhakare, 2017]

### 7.9.2 Biology

Eggs are laid singly on tender leaves, stalks and flower buds. Incubation period lasts for 8-10 days with average period of 8.8 days. Larval period lasts for 17-46 days with mean duration of 31.4 days. Pupation occurs either inside the damaged fruits or on the stalk holding it. Pupal period lasts for 7-33 days with mean duration of 16 days. Total life cycle is completed within 30 to 60 days with average duration of 46.5 days. Adult longevity ranged from 4-7 days with average 5.7 days (Khan, 2016).

### 7.9.3 Hosts

*V. isocrate* is a polyphagous pest attacking a wide range of host plants, including guava, pomegranate, anola, apple, ber, citrus, litchi, peach, pear, sapota and tamarind (Atwal, 1976).

### 7.9.4 Distribution

**Asia:** India (Maharashtra, Kerala, Karnataka, Telangana, Paschimbanga, Madhya Pradesh, Tamil Nadu, Manipur, Odisha) (Bhakare, 2017).

### 7.9.5 Hazard Identification Conclusion

Considering the facts that *V. isocrate* -

- is not known to be present in Bangladesh [Bhakare, 2017];
- is potentially economic important to Bangladesh because it is an important pest of guava in India including Maharashtra, Kerala, Karnataka, Telangana, Paschimbanga, Madhya Pradesh, Tamil Nadu, Manipur and Odisha [Bhakare, 2017] from where guava are imported to Bangladesh.
- *V. isocrate* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.9.6 Determine Likelihood of Pest Establishing in Bangladesh 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><br>• In recent years *V. isocrate* has been established in different parts of India and became a serious pest for fruit industries because Infestation from flowering to button stage causing loss up to 50 per cent of the fruit.<br><br>**b. Posibility of survival during transport, storage and transfer? Yes**<br><br>• A lot of fruits, field crops and vegetables are transported into our country from India via land port. The duration of transport take more than 10 days. The duration is favourable for survival for this pest. Besides this the storage condition is also favourable for its survival, growth and development. | **YES and HIGH** |

| | |
|---|---|
| **c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• The adult female lays egg on the fruit skin, lower surface of leaves. After hatching the larvae make a hole and enter into the fruit. So, the eggs and larvae are easily entered into our country through fruits and other planting materials. The climatic condition of India and Bangladesh are more or less similar. So, the climatic conditions are also favourable for its estabilishment.<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• Host range of *V. isocrate* are available in Bangladesh.<br>• These climatic requirements for growth and development of*V. isocrate* is 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 Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | Low |

**7.3.9.7. 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>• Pomegranate fruit borer or pomegranate butterfly is the most widespread, polyphagous and destructive pest distributed all over India and common in Asia. If more than one larva found in fruit so it will be possible for a founder population to occur. So, if the pest enters into our country became a serious pest.<br>**b. Economic impact and yield loss**<br>• The larvae bore into the pomegranate fruits soon after hatching. Once inside the fruit, larvae (approx 2cm length) feed on the flesh and seeds. The bored hole is plugged by the last abdominal segment of the larva. When fully grown, the larva comes out by boring through the hard shell and spins a web, which ties the fruit, stalk to the main branch.<br>• Offensive smell and excreta of caterpillars coming out of the entry holes with excreta stuck around the holes.The fruits rot and drop off. The holes ultimately expose the rest of the fruit to disease, and typically rot off the tree.<br>• V. isocrate has been established in different parts of India and became a serious pest for fruit industries because Infestation from flowering to button stage causing loss up to 50 per cent of the fruit.<br>**c. Environmental Impact**<br>• Due to establishment of this pest, causes great economic losses. So, farmers use different type of insecticides in the field to control this pest. Use | **Yes**<br>**and**<br>**High** |

| | |
|---|---|
| of excess chemical insecticide has a great negative effect on our environment like destruction of natural control system, development of resistence, resurgence and secondary pest outbreak. Besides this its also have negative effect on wild life and aquatic life. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.9.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 10.3 – Calculation of 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**

### 7.9.9 Risk Management Measures

- Avoid importation of bulbs and seeds from countries, where this pest is available.
- In countries where *V. isocrate*is not already present, the enforcement of strict phytosanitary regulations as required for *V. isocrate*, may help to reduce the risk of this leek moth 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 *V. isocrate*are present.

### 7.9.10 References

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Khan, M. M. H. 2016. Biology and management of fruit borer, *virachola isocrates*(fab.) Infesting guava. *Bangladesh J. Agril. Res*. **41**(1): 41-51.

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## 7.10 Pest-10: Brown rot: *Virachola Isocrate*

### 7.10.1 Hazard Identification

**Scientific Name:** *Monilinia fructigena* Honey ex Whetzel 1945

**Other Scientific names:** *Acrosporium fructigenum* (Pers.) Pers. 1822

*Monilia fructigena* Pers.: Fr. 1801 [anamorph] Pers.: Fr. 1801

*Oidium fructigenum* Kunze & J. C. Schmidt 1817

*Oidium wallrothii* Thüm. 1875

*Oospora candida* Wallr. 1833

*Oospora fructigena* (Pers.: Fr.) Wallr. 1833

*Sclerotinia fructigena* Aderh. & Ruhland 1905

*Sclerotinia fructigena* (Pers.: Fr.) J. Schröt. 1893

*Torula fructigena* Pers. 1796

**Common names**: Brown rot, blossom blight [teleomorph]; blossom blight of fruit trees; blossom wilt; fruit canker; spur blight; spur canker; twig blight; twig canker; wither tip.

**Taxonomic tree**

Domain: Eukaryota

Kingdom: Fungi

Phylum: Ascomycota

Subphylum: Pezizomycotina

Class: Leotiomycetes

Subclass: Leotiomycetidae

Order: Helotiales

Family: Sclerotiniaceae

Genus: Monilinia

Species: *Monilinia fructigena*

**EPPO Code:** MONIFG.

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

### 7.10.2 Biology

The conidia of *M. fructigena* are “dry air” spores (Hirst, 1953) that are not actively discharged, but are set free by air currents and wind. Although short and unspecialized, the conidiophores elevate the spore chains above the infected tissues and thus provide better exposure to air currents. Except when mummified fruit have fallen to the ground, infected fruits and peduncles are in positions on the tree that are suitable for efficient take-off and aerial dispersal of spores (Byrde and Willetts, 1977). Shock waves produced ahead of the drops will also lead to the liberation of dry spores (Jarvis, 1962). Aerial dispersal results in the spread of spores over a wide area, whereas water splash dispersal brings about only short-range dissemination, mainly to other parts of the same tree or, in some instances, between adjacent trees. Roberts and Dunegan (1932) considered that transport by air was the most important way that spores of *M. fructigena* reach their hosts, but transport by water escapes the extreme environmental conditions to which wind-borne inocula are often subjected. Animals are important vectors of this fungus, either incidentally or because of complex adaptations (Lack, 1989). Almost any insect attracted to rotting flowers or fruit has the potential to pick up and carry spores from sporulating mycelium to healthy, susceptible tissues, but those that create new wounds provide the necessary sites of infection for *M. fructigena* (Xu and Robinson, 2000; Xu *et al.,* 2001b; 2007). The most important animal vectors are birds, wasps (Vespula spp.), beetles, especially the nitidulid beetles (Carpophilus spp.), flies (Diptera) including Drosophila spp., and Lepidoptera (Byrde and Willetts, 1977). The brown rot fungi overwinter mainly in or on diseased mummified fruit either attached to the tree or on the ground. Other infected tissues on trees, such as twigs, peduncles and cankers on twigs or branches, can also serve as sources of primary inoculum. In the spring or early summer, when temperatures, day-length and relative humidities are suitable, tufts of conidiophores form sporodochia on the surface of the mummified fruit and infected tissues, and bear chains of conidia. Conidia are transported by wind, water or insects to young fruit. Initial infection is via wounds (Rekhviashvili, 1975; Xu and Robinson, 2000; Xu *et al.,* 2001b; 2007), often scab lesions or sites of insect damage. Subsequent spread by contact between adjacent fruit is a minor cause of infection (Xu and Robinson 2000; Holb and Scherm, 2008). Growth cracks may also be infection courts on apple (Xu and Robinson, 2000; Holb and Scherm, 2008). Free moisture on the plant surface is not essential for the rapid germination and infection by conidia (Xu and Robinson, 2000).

There are only a few records of the development of the sexual form of *M. fructigena* (Ibragimov and Abbasov, 1976; Batra, 1979; Batra and Harada, 1986). Apothecia may be produced in spring on mummified fruit that have overwintered on the ground. Mummified fruits that remain on the tree do not produce apothecia (Byrde and Willetts, 1977). Batra (1991) described apothecia observed from an unusual introduction to North America. The apothecia described in Japan (Batra and Harada, 1986), although not obviously different, may be the sexual state of the Japanese anamorphic species, Monilia polystroma.

*M. fructigena* is a pathogen of moist conditions, favoured by rain, fog and other factors that increase humidity, especially at the beginning of the host growth period; brown rot is rare in arid climates. Conidia are generally formed on mummified fruit and blighted twigs at temperatures of >5°C. Germination and germ tube growth are partially inhibited by light, but sporulation is enhanced. Conidia provide the inocula for most primary infections. Xu et al. (2001a) found 97% RH and temperatures of 3-25°C optimum for germination of conidia in the UK.

### 7.10.3 Hosts

Under suitable environmental conditions, *M. fructigena* will infect not only all cultivated drupaceous and pomaceous species, but also many other members of the Rosaceae. The extensive cultivation of fruit trees in temperate regions and their long lifespan ensure that hosts are readily available. The main commercial crops that are hosts to *M. fructigena* include apple [*Malus domestica*], ***Psidium guajava* (guava)**, pear [*Pyrus communis*], quince [*Cydonia oblonga*], plum [*Prunus domestica*], and sweet cherry [*Prunus*]. Sour cherry [*Prunus*] is a less important host than peach [*Prunus persica*], nectarine [*Prunus persica*], and apricot [*Prunus armeniaca*]. There are many records of the brown rot fungi attacking other plants (Byrde and Willetts, 1977; Tzavella-Klonari, 1985; Sharma and Kaul, 1989a; Faivre-Amiot and Geoffrion, 1996). Wild hosts may be sources of inoculum if located near orchards (Zehr, 1982).

### 7.10.4 Distribution

*M. fructigena* is found throughout western and southern Europe and extends into the Scandinavian countries, Eastern Europe, the former Soviet Union, the Middle East, India, and North Africa (CABI/EPPO, 2000; USDA/SMML, 2005). Recent identification of the common brown rot fungus in Japan, previously considered to be *M. fructigena*, as a separate anamorphic species, *Monilia polystroma*, may suggest reconsideration of other reports of *M. fructigena* from eastern Asia (Van Leeuwen *et al.,* 2002). The new species has also been isolated in Hungary, within the known range of *M. fructigena* (Petróczy and Palkovics, 2009).

UK CAB International (1976) includes a record for presence in Brazil. EMBRAPA have since notified CABI that this record was a misidentification and that *M. fructigena* is not present in Brazil. Earlier reports of the species from Chile and Uruguay (UK CAB International, 1976) are also due to misidentification of other species of *Monilinia* (Malvárez et al., 2004; USDA/SMML, 2005).

In the USA, *M. fructigena* was reported from a pear [*Pyrus communis*] orchard in Maryland (Batra, 1979), but this minor outbreak was eradicated (Batra and Harada, 1986; Ogawa and English, 1991). It has also been erroneously reported from Florida (Florida Department of Agriculture and Consumer Services, USA, correspondence, 2000).

- **Asia:** Afghanistan**,** China (restricted distribution), India (restricted distribution), Japan, Korea, Nepal, Taiwan, Turkey (CABI/EPPO, 2000; EPPO, 2014)
- **Africa:** Egypt, Morocco (CABI/EPPO, 2000; EPPO, 2014)
- **North America:** Absent (CABI/EPPO, 2000; EPPO, 2014)
- **South America:** Absent (EPPO, 2014)
- **Europe:** Belgium, France, Germany, Italy, Netherlands, Russia, Sweden, UK (CABI/EPPO, 2000; EPPO, 2014).

### 7.10.5 Hazard Identification Conclusion

Considering the facts that *M. fructigena* -

- 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 guava in India, china, Nepal, Germany, Italy from where guava are imported to Bangladesh.
- *M. fructigena* causes significant losses both before and after harvest, it is not easy to assess the overall losses it causes in a country or on a worldwide scale (Batra, 1991)
- *M. fructigena* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.10.6 Determine Likelihood of Pest Establishing in Bangladesh via this Pathway

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

| **Description** | **Establish ment Potential** |
|---|---|
| **a. Has this pest been established in several new countries in recent years- Yes**,<br>• In recent years *M. fructigena* has been established in different parts of world espacilly in Asia and Europe country including India, Japan, China, Nepal, Italy, and Germany from where most of the fruit espacilly guava are imported in our country. | |
| **b. Posibility of survival during transport, storage and transfer? Yes**<br>• Pest or symptoms not visible to the naked eye but usually visible under light microscope. Moreover, hypae and spores are transmitted via fruits, leaves, stems, flowers etc.<br>• *M. fructigena* is a pathogen of moist conditions, favoured by rain, fog and other factors that increase humidity, especially at the beginning of the host growth period; brown rot is rare in arid climates. Conidia are generally formed on mummified fruit and blighted twigs at temperatures of >5°C. Germination and germ tube growth are partially inhibited by light, but sporulation is enhanced. Conidia provide the inocula for most primary infections. Xu *et al.* (2001a) found 97% RH and temperatures of 3-25°C optimum for germination of conidia in the UK.<br>• The transport duration of fruits espacilly guava from exporting countries to our country is about 20 days. So, the transport duration is favourable for this pathogen to survive. On the other hand, the storage condition is also suitable for this pathogen to survive, growth and reproduction. | **YES and HIGH** |
| **c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• Pest or symptoms not visible to the naked eye but usually visible under light microscope. Moreover, hypae and spores are transmitted via fruits, leaves, stems, flowers etc. So, the pathogen can enter easily.<br>• **Natural Dispersal:** Conidia of the *Monilia* anamorph are dispersed by wind and rain-splash, and, where apothecia are formed, ascospores will be wind-disseminated (Batra, 1991).<br>• **Vector Transmission:** Various types of insects, including wasps, beetles, flies and butterflies have been identified as vectors of *Monilinia* species (Byrde and Willetts, 1977). According to Lack (1989), any insect that visits both infected and uninfected fruit could serve as a vector; he specifically observed bees, wasps, fruit flies and syrphid flies on apple [*Malus domestica*] fruit infected with *M. fructigena*. Birds may also be vectors (Byrde and Willetts, 1977). Holb and Scherm (2008) and Xu et al. (2001b) report birds as wound agents in fruit orchards affected by *M. fructigena*.<br>• **Accidental Introduction:** The Australian phytosanitary authority has intercepted infected fruit (Mackie et al., 2005), as has occurred in the | |

| | |
|---|---|
| USA (USDA/SMML, 2005). The probable source of *M. fructigena* found on pear [*Pyrus communis*] trees at Beltsville, Maryland, USA, was not identified by Batra (1979), but only one variety growing at the experimental orchard at the agricultural station was infected.<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• Host range of *M. fructigena* are available in Bangladesh.<br>• These climatic requirements for growth and development of*M. fructigena* is 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 Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | Low |

### 7.10.7 Determine the Consequence 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>• Pomegranate fruit borer or pomegranate butterfly is the most widespread, polyphagous and destructive pest distributed all over India and common in Asia and Europe and became a serious pest of fruit industries. The pathogen has the capacity to disperse easily via wind, animal, vector and agricultural equipments. So, eradication of this pathogen is quite impossible, so, if the pathogen enters into our country became a serious pests.<br>**b. Economic impact and yield loss**<br>• Although *M. fructigena* causes significant losses both before and after harvest, it is not easy to assess the overall losses it causes in a country or on a worldwide scale (Batra, 1991). Losses are highly visible to the grower, but are rarely worth the implementation of specific control measures in their own right. Early-maturing cultivars are most affected, but the majority of diseased fruits are those that would in any case be rejected for other reasons such as bruising or bird and insect damage (Smith *et al.,* 1992). *M. fructigena* is less damaging than *Monilinia fructicola* or *Monilinia laxa*, although it occasionally causes economically important losses of apple [*Malus domestica*] and plum [*Prunus domestica*] fruits in Europe, particularly in hot and humid summers (Smith *et al.,* 1992).<br>• In 1972, Burchill and Edney reported 35.8% fruit infection in an English apple orchard. Ciferri reported 7.3% infection of apples in Italy. Preece reported mean losses of 0.2-1.5% in samples of Cox's Orange Pippin apples taken from refrigerated stores in England between 1961 and 1965, with a range of 0.1-4.5% for individual orchards. In a survey carried out in a typical English commercial store, Evans stated that brown rot and other rots due to Botrytis cinerea and Penicillium spp. usually accounted for less than 5% loss in storage. See Byrde and Willetts (1977) for further details of these references. | **Yes**<br>**and**<br>**High** |

| | |
|---|---|
| • According to Berrie (1993), average commercial losses due to fungal rots in apples have been maintained at <2% under UK conditions by the routine use of postharvest fungicide dips or drenches. In surveys of markets, stores and canning centres in Himachal Pradesh, India, the cumulative incidence of brown rot in harvested apples was 5.0-15.2%; the occurrence of *M. fructigena* varied from 2.1 to 14.2% (mean 6.72%), being more frequent under low-temperature conditions (Sharma and Kaul, 1989c). In central Europe, pre-harvest losses of apples due to brown rot are usually less than 10%, but losses of up to 46% have been reported (Holb and Scherm, 2007).<br><br>**c. Environmental Impact**<br><br>• Due to establishment of this pathogen, causes great economic losses. So, farmers use different type of fungicides in the field to control this pest. Use of excess chemical fungicide has a great negative effect on our environment like destruction of natural control system, development of resistence, resurgence and secondary pest outbreak. Besides this its also have negative effect on wild life and aquatic life. | |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.10.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 11.3 – Calculation of 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**

### 7.10.9 Risk Management Measures

- Avoid importation of fruits from countries, where this pest is available.
- In countries where *M. fructigena* is not already present, the enforcement of strict phytosanitary regulations as required for *M. fructigena*, may help to reduce the risk of this leek moth 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 *M. fructigena* are present.

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## 7.11 Pest-11: Algal Leaf and Fruit Spot: *Cephaleuros Virescens*

### 7.11.1 Hazard Identification

**Scientific Name:** *Cephaleuros virescens*

**Common names**: Algal leaf and fruit spot

**Taxonomic tree**

Domain: Eukaryota

Kingdom: Plantae

Division: Chlorophyta

Class: Ulvophyceae

Order: Trentepohliales

Family: Trentepohliaceae

Genus:*Cephaleuros*

Species: *Cephaleuros virescens*

**EPPO Code:**

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

### 7.11.2 Biology

Cephaleuros species consist of branched filaments that comprise a thallus in the form of irregular discs. The thallus grows below the cuticle or sometimes below the epidermis of the host plant. This pigmented thallus (orange to red-brown) consists of a prostrate portion that is branched irregularly with irregular cells and an erect portion of unbranched hairs, with cylindrical cells, sterile or fertile, protruding through the cuticle. Haustorial cells are sometimes present inside the plant host's tissue. Sporangiophores bear one or more head cells subtending sporangiate-laterals. Gametangia are terminal or intercalary on the prostrate cell filaments.

### 7.11.3 Hosts

Species of *Cephaleuros* are very common on the leaves of such economically important tropical trees and shrubs as tea (*Camellia sinensis*), kava (*Piper methysticum*), pepper (*Piper nigrum*), magnolia (*Magnolia grandiflora*), coffee (*Coffea arabica*), oil palm (*Elaeis guineensis*), avocado (*Persea americana*), vanilla (*Vanilla planifolia*), mango (*Mangifera indica*), breadfruit (*Artocarpus altilis*), guava, coconut (*Cocos nucifera*), cacao (*Theobroma cacao*), as well some citrus (*Citrus spp*.) cultivars. *Cephaleuros* species do not affect certain key subsistence crops in the Pacific, such as banana (*Musa spp*.) and taro (*Colocasia esculenta*), although coconut and breadfruit are hosts for leaf spots.

### 7.11.4 Distribution

- ***Europe*****:** Belgium (Sarma 1986).
- ***Atlantic Islands***: Azores (Sarma 1986).
- ***North America*****:** Louisiana (Nelsen *et al.* 2011), Mexico (Sarma 1986), United States of America (Sarma 1986).
- ***Central America*****:** Costa Rica (Sarma 1986), Guatemala (Sarma 1986).
- ***Caribbean Islands*****:** Jamaica (Sarma 1986), Puerto Rico (Sarma 1986), Trinidad & Tobago (Sarma 1986).
- ***South America*****:** Argentina (Tell 1985, Sarma 1986), Brazil (Sarma 1986), Colombia (Sarma 1986), Ecuador (Sarma 1986), French Guiana (Rindi & López-Bautista, 2008), Peru (Sarma 1986).
- ***Africa*****:** Cameroon (Sarma 1986), Ghana (Sarma 1986), Kenya (Sarma 1986), Mauritius (Sarma 1986), South Africa (Nelsen et al. 2011), Sudan (Sarma 1986), Tanzania (incl. Zanzibar) (Sarma 1986), Zaire (Sarma 1986).
- ***South-west Asia*****:** India (Sarma 1986, Gupta 2012, Suto et al. 2014, Suto et al. 2014), Sri Lanka (Sarma 1986).
- ***Asia*****:** China (Sarma 1986, Hu & Wei 2006), Japan (Suto & Ohtani 2009), Taiwan (Shao 2003-2014, Nelsen et al. 2011).
- ***South-east Asia***: Indonesia (Sarma 1986), Malawi (Sarma 1986), Malaysia (Sarma 1986).
- ***Australia and New Zealand*****:** New Zealand (Broady *et al.* 2012), Queensland (Sarma 1986, Day *et al.* 1995).
- ***Pacific Islands*****:** New Caledonia (Sarma 1986).

### 7.11.5 Hazard Identification Conclusion

Considering the facts that *C. virescens* -

- is not known to be present in Bangladesh [CABI, 2015];
- is potentially economic important to Bangladesh because it is an important pest of guava in Asia including India, Japan and Turkey [CABI, 2015] from where guavas are imported to Bangladesh.
- *C. virescens* is a **quarantine pest** for Bangladesh and considered to be a **potential hazard organism** in this risk analysis.

### 7.11.6 Determine Likelihood of Pest Establishing in Bangladesh via this Pathway

Table 12.1 – Which of these descriptions best fit of this pest?

| **Description** | **Establish ment Potential** |
|---|---|
| **a. Has this pest been established in several new countries in recent years- No**,<br>• The pathogen had estabilished more than 50 countries before 2000 and there is no record of this pathogen to estabilished new countries after 2001.<br>**b. Posibility of survival during transport, storage and transfer? Yes**<br>• The transport duration and storage condition is favorable for this pathogen to survive, growth and development.<br>**c. Does the pathway appear good for this pest to enter Bangladesh and establish? - Yes,**<br>• *C. virescens* can enter into Bangladesh, cause neighboring countries and other Asian countries from where Bangladesh import guava fruit and guava plants are contaminated with *C. virescens.*<br>**d. Are the host(s) of this fairly common in Bangladesh and the climate is similar to places it is established?– Yes**<br>• Host range of *C. virescens* are available in Bangladesh.<br>• These climatic requirements for growth and development of*C. virescens* is more or less similar with the climatic condition of Bangladesh. | **YES and Moderate** |
| • NOT AS ABOVE OR BELOW | Moderate |
| • This pest has not established in new countries in recent years, **Yes**<br>• The pathway does not appears good for this pest to enter Bangladesh and establish, and<br>• Its hosts are not common in Bangladesh and climate is not similar to places it is established. | Low |

### 7.11.7 Determine the Consequence Establishment of this Pest in Bangladesh

**Table 12.2:** Which of these descriptions best fit of this pest?

| **Description** | **Consequence potential** |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br>• *P. cervinus* is highly polyphagous with several hosts.<br>**b. Economic impact and yield loss**<br>• There is no information about the economic impact of this pathogen.<br>**c. Environmental Impact**<br>• There is no information about the environmental impact of this pathogen. | **Low** |
| • Not as above or below | Moderate |
| • This is a **not** likely to be an important pest of common crops grown in Bangladesh. | Low |

### 7.11.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

Establishment Potential X Consequence Potential = Risk

Table 12.3 – Calculation of 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 – Low**

### 7.11.9 Risk Management Measures

- Avoid importation of fruits from countries, where this pest is available.
- In countries where *C. virescens* is not already present, the enforcement of strict phytosanitary regulations as required for *C. virescens* may help to reduce the risk of this leek moth 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 *C. virescens* are present.

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## 7.12 Pest-12: Parthenium weed: Parthenium Hysterophorus

### 7.12.1 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

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.

### 7.12.2 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).

### 7.12.3 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).

### 7.12.4 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.

### 7.12.5 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 fruits, 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.

### 7.12.6 Determine Likelihood of Pest Establishing in Bangladesh via this Pathway

Table 13.1. – 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 | **YES**<br>**and**<br>**HIGH** |

| | |
|---|---|
| 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><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).<br><br>• **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><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><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><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><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><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><br>• The pathway does not appears good for this pest to enter your country | Low |

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

### 7.12.7 Determine the Consequence Establishment of this Pest in Bangladesh

**Table 13.2** – Which of these descriptions best fit of this pest?

| Description | Consequence potential |
|---|---|
| **a. Is this a serious pest of Bangladesh? - Yes.**<br><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><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><br>• This is a **fairly serious pest** of several important crops and human health rather than flowers for Bangladesh.<br><br>**b. Economic impact and yield loss**<br><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><br>• Parthenium weed lacks predators, and cattle and livestock usually do not | **Yes**<br><br>**and**<br><br>**High** |

| | |
|---|---|
| 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 |

### 7.12.8 Calculating the Risk of this Pest via this Pathway for Bangladesh

**Establishment Potential X Consequence Potential = Risk**

Table 13.3 – 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**

### 7.12.9 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.

### 7.12.10 References


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### 7.13 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 guava pathway to Bangladesh from India, Thailand, Mayanmar, China and other exporting countries, out 15 potential hazard organisms, 10 hazard organisms were identified with high risk potential, 1 identified with moderate risk potential,1 is low and due to lack of detail information other 3 quarantine organisms have been identified as uncertainity.

The overall pest risk potential ratings of 12 quarantine pests of guava for Bangladesh have been included in the following table:

**Table 8: The Overall Pest Risk Potential Rating**

| Sl. No. | Potential Hazard Organism | Common name | Family | Order | Pest Risk Potential |
|---|---|---|---|---|---|
| **Insect pests** | | | | | |
| 1 | Queensland fruit fly | *Bactrocera tryoni* | Tephritidae | Diptera | High |
| 2 | Mediterranean fruit fly | *Ceratitis capitata* | Tephritidae | Diptera | High |
| 3 | Green scale | *Coccus viridis* | Coccidae | Hemiptera | High |
| 4 | Coconut mealybug | *Nipaecoccus nipae* | Pseudococcidae | Hemiptera | Moderate |
| 5 | Long-tailed mealybug | *Pseudococcus longispinus* | Pseudococcidae | Hemiptera | High |
| 6 | Tea mosquito bug: | *Helopeltis antonii* Signoret | Miridae | Hemiptera | High |
| 7 | Guava aphid | *Aphis punicae* Passerini | Aphididae | Hemiptera | High |
| 8 | Redbanded Thrips | *Selenothrips rubrocinctus* | Thripidae | Thysanoptera | High |
| 9 | Anar butterfly | *Virachola isocrate* | Lycaenidae | Lepidoptera | High |

| Sl. No. | Potential Hazard Organism | Common name | Family | Order | Pest Risk Potential |
|---|---|---|---|---|---|
| **Insect pests** | | | | | |
| 1 | Queensland fruit fly | *Bactrocera tryoni* | Tephritidae | Diptera | High |
| 2 | Mediterranean fruit fly | *Ceratitis capitata* | Tephritidae | Diptera | High |
| 3 | Green scale | *Coccus viridis* | Coccidae | Hemiptera | High |
| 4 | Coconut mealybug | *Nipaecoccus nipae* | Pseudococcidae | Hemiptera | Moderate |
| 5 | Long-tailed mealybug | *Pseudococcus longispinus* | Pseudococcidae | Hemiptera | High |
| 6 | Tea mosquito bug: | *Helopeltis antonii* Signoret | Miridae | Hemiptera | High |
| 7 | Guava aphid | *Aphis punicae* Passerini | Aphididae | Hemiptera | High |
| 8 | Redbanded Thrips | *Selenothrips rubrocinctus* | Thripidae | Thysanoptera | High |
| 9 | Anar butterfly | *Virachola isocrate* | Lycaenidae | Lepidoptera | High |
| **Fungus** | | | | | |
| 10 | Brown rot | *Monilinia fructigena* | Leotiomycetidae | Helotiales | High |
| **Algae** | | | | | |
| 11 | Algal leaf and fruit spot: | *Cephaleuros virescens* Kuntze | Trentepohliaceae | Trentepohliales | Low |
| **Weed** | | | | | |
| 12 | Parthenium weed | *Parthenium hysterophorus* | Asteraceae | Asterales | High |

**Uncertainity**

The quarentine pest species those remain uncertainitry as potential hazards due to lack of their detail information. Such uncertain species were guava stem borer (*Apriona* Sp.), guava rust (*Puccinia psidii*) and bacteriosis (*Erwinia psidii*). The taxonomic identities of these uncertain species are given in the table 9.

**Table 9:** Quarantine pest species for Bangladesh likely to be associated with host plants during importation from exporting countries, but remained as uncertain hazards due to lack of detail information

| Sl. No. | Common name | Scientific name | Family | Order |
|---|---|---|---|---|
| 01. | Guava stem borer | *Apriona* Sp. | Cerambycidae | Coleoptera |
| 02. | Guava rust | *Puccinia psidii* | Pucciniaceae | Pucciniales |
| 03. | Bacteriosis | *Erwinia psidii* | Enterobacteriaceae | Enterobacteriales |

# CHAPTER 8

## RISK MANAGEMENT

### 8.1 Risk Management Optionsand 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 guavafrom India, Thailand, Myanmar, China or any other countries of guavaexport (i.e. produced under standard cultivation, harvesting and packing activities). Plant Quarantine Wing of Bangladesh will consider the risk management measures proposed below is commensurate with the identified risks.

#### 8.1.1 Pre-harvest Management Options

i. **Use of pest resistant varieties**: The use of resistant varieties is a common and effective component in reducing pest risk.

ii. **Chemical spray program**: Pre-harvest chemical sprays may be used to control pests within production fields, for example, the use of nematicides to control the root knot nematode.

iii. **Crop rotation**: Certain guava diseases can survive from season to season in the field. Depending on the type of pathogen, it may survive in the resting form either in the soil or in guava plant debris, or in a living form in surviving fallen fruit. On occasion, diseased fruitsare the sources of contamination for the current season crops. Therefore, acrop rotation to minimize soil disease problems is recommended.

iv. **Control of Insects**: Sucking and chewing insects like aphid, whitefly, scale insect, mealybugs etc may transmit many diseases. For example the *cotton leaf curl virus* disease was found to be transmitted by the aphids (EPPO, 1997). The control of these insects and the rouging of infected parts of plants as early as possible may prevent spread of diseases in the field.

v. **Irrigation practices and soil type**: A well drained soil is recommended for planting of guava as this make conditions less favourable to disease infection (Johnson, 1969). Over irrigation and a poorly drained soil increases the susceptibility to diseases such as powdery mildew, scab etc. The type of irrigation system may also aid in the transmission of some diseases.

vi. **Pre-harvest Inspection**: The relevant officers and inspectors from the importing country should inspect and verify the cleaning and disinfecting of equipment and storage used in guava production. Laboratory testing should be done periodically. Quarantine restrictions may be used to limit spread of diseases detected.

#### 8.1.2 Post-harvest Management Options

**i.** **Sanitization of equipment and material**: All machinery, transport and storage surfaces that the guavaseed will contact should be cleaned and disinfected prior to receiving new guava seeds. Since most disinfectants are inactivated by soil and plant debris, it is essential that this material be removed by thoroughly cleaning the equipment and storage with a pressure washer or steam cleaner before the disinfectant is applied.

**ii.** **Disposal of infected fruits**: All infected fruits should be discarded away from production site (Rowe *et. al*).

iii. **Seed and fruit grading**: The class and variety of guava fruits and seeds must be kept separate through harvesting, grading and storage. Grading must be done according to class, variety and disease tolerance. The class of guava must clearly identifiable and labeled.

### 8.1.3 Phytosanitary Measures

i. **Pest free areas**: As a sole mitigation measure, the establishment of pest-free areas or pest-free places of production may be completely effective in satisfying an importing country's appropriate level of phytosanitary protection (IPPC, 1996b, 1999).Establishment and maintenance of pest-free areas or production sites should be in compliance with international standards (*e.g.*, IPPC, 1996b, 1999, 2006).

ii. **Stipulated commercial grade for guava fruits**: This ensures a certain level of quality and cleanliness which results from commercial handling. This is a significant measure for pests that affect quality or associated with contaminants (eg. soil). Bangladesh should therefore make request for a certain grade of guava that reflects the acceptable tolerance level of the country.

iii. **Accept only certified guava seeds and seedling for crop production**: This measure is highly effective in mitigating pest risk, because it ensures the absence of specific pests, particularly pathogens, or a defined low prevalence of pests at planting. The main components of seed certification include: sampling and testing of production areas to ensure free from viruses; approval of land and seed to be multiplied; inspection of crops for variety purity and crop health; inspection of guava fruit samples; and sealing and labeling of certified seed. Guava seeds to be imported from the exporting countries should be sourced from an officially recognized seed certification system.

iv. **Shipments traceable to place of origin in exporting countries**: A requirement that guava seeds and fruits be packed in containers with identification labels indicating the place of origin, variety and grade is necessary to ensure traceability to each production site.

v. **Pre export inspection and treatment:** The NPPOs of exporting countries will inspect all consignments in accordance with official procedures in order to confirm those consignments are satisfied with import requirements on phytosanitary of Bangladesh.If quarantine fruit flies with high risk potential are found during inspection, the phytosanitary procedures should maintained:

- Consignments of fruits from countries where these pests occur should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. EPPO recommends (OEPP/EPPO, 1990) that such fruits should come from an area where fruit fliesdo not occur and where routine intensive control measures are applied.
- Fruits may also be treated in transit by cold treatment (e.g. 13 or 14 days at 0.0 or 0.6°C,, respectively) or, for certain types of fruits, by vapour heat (e.g. keeping at 43-44°C for 6-9 h, according to commodity) (FAO, 1983) or hot water treatment.

vi. **Requirement of phytosanitary certification from country of origin:** The phytopathological service of the country of origin should ensure the guava seeds and fruits from which the consignment is derived was not grown in the vicinity of unhealthy guava crops and was inspected by a duly authorized official/phytopathological service and the guavaseeds have been produced in areas within the country free from all pests and diseases.

vii. **Port-of-entry inspection and treatment**: Upon arrival in Bangladesh, each consignment of guava should be inspected to detect pests, with export phytosanitary certificate and seed certificate. Sampling of guava seeds and fruits consignments at port-of-entry in Bangladesh should combine visual inspection and laboratory testing. Visual inspection is useful to verify that certain phytosanitary certification requirements have been met and consignment is generally free of contaminants. The efficacy of this measure depends on the statistical level of sampling and the ability to detect the pests or article of concern (eg. soil). Laboratory testing requires that a portion of each sample taken for inspection be subjected to laboratory analysis for the detection of pathogens.

The consignment could re-export or destroy if quarantine pests or regulated articles with high risk potential are found during an inspection.

## 8.2 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.

**Appendix 1ঃ পেয়ারা চাষীদের জন্যে জরিপ প্রশ্নাবলী**

## গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

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বাংলাদেশ ফাইটোসেনেটারী শক্তিশালীকরণ প্রকল্প

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ফোনঃ ৯১০৩৭৭৪।

## Pest Risk Analysis (PRA) of Guava in Bangladesh

***Prepared by:***

**ইউসুফ এ্যান্ড এসোসিয়েটস্**

**৭ গুলশান এভিনিউ টাওয়ার (লেভেল-৪, ব্লক-এ), গুলশান, ঢাকা**

## সেট-১: পেয়ারা চাষীদের জন্যে জরিপ প্রশ্নাবলী

| **কোডঃ** | | | | | **মোবাইল ফোন** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**1.0 পেয়ারা চাষীর ব্যক্তিগত তথ্যাদিঃ**

1.1 উত্তরদাতার নাম: --------------------------------------------------------------------------------------------------------------------------

1.2 গ্রাম --------------------------------------------------------------- 1.3 কৃষি ব্লক: --------------------------------------------

1.4 উপজেলা: --------------------------------------------------------- 1.5 জেলা: ---------------------------------------------

1.6 শিক্ষাগত যোগ্যতাঃ -------------------------------------- 1.7 বয়সঃ --------------------------------------- ।

1.8 পেশাগত:[কোডঃ ১=ক্ষুদ্র পেয়ারা চাষী, ২=মাঝারী পেয়ারা চাষী, ৩=বড় পেয়ারাচাষী] ☐ 1.9 লিঙ্গঃ (কোডঃ ১=পুরুষ, ২=মহিলা) ☐

**2.0 পেয়ারা আবাদ ও পি.আর.এ সংক্রান্ত তথ্যাবলিঃ**

**2.1 উত্তরদাতার ব্যবহৃত জমির ধরণ/প্রকৃতিঃ**

| **পেয়ারা চাষে ব্যবহৃত জমির ধরণ** | **জমির পরিমাণ (শতাংশ)** |
|---|---|
| ১. এ বছর পেয়ারা চাষ করেছেন এমন জমির পরিমাণ বলুন? | |
| ২. অন্য ফসলের তুলনায় এবছর পেয়ারা চাষে নিয়োজিত জমির আনুমানিক শতকরা পরিমান (%) বলুন | |
| ৩. কত বৎসর যাবৎ পেয়ারা চাষ করেন? | |

**2.2 আপনি এবছর কোন কোন প্রকারের পেয়ারা চাষ করেছেন, দয়া করে বলবেন কি?**

| **চাষকৃত/ব্যবহৃত পেয়ারার প্রকারভেদ/জাত** | **বিভিন্ন প্রকারের পেয়ারার চাষকৃত জমির পরিমাণ (শতাংশ)** | **অর্জিত আয় (হাজার টাকা/ একর*)** |
|---|---|---|
| ১. কাজী পেয়ারা | | |
| ২. বারি পেয়ারা | | |
| ৩. থাই পেয়ারা | | |
| ৪. মুকুন্দপূরী | | |
| ৫.স্বরূপকাঠী | | |
| ৬.লতা | | |
| ৭. পূর্ণমন্ডলী (লাল) | | |
| ৮. আমদানীকৃত হাইব্রিড জাত | | |
| ৯. স্থানীয় জাত | | |

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|---|---|---|
| ১০. অন্য কোন জাত---------- (যদি থাকে) | | |

* ১ একর = ১০০ শতক

### 2.3 পেয়ারার বিভিন্ন জাতে ক্ষতিকর পোকামাকড়, রোগ-বালাই এবং আগাছার কোনটি বেশী আক্রমণ করে?

| নং | পেয়ারার বিভিন্ন জাতের নাম | যার প্রতি সংবেদনশীল | শূন্যস্থানে কোড নাম্বার লিখুন। |
|---|---|---|---|
| ১. | কাজী পেয়ারা | (কোড: ১=পোকামাকড়, ২=রোগ-বালাই, ৩=আগাছা, ৪=কোনটাই আক্রমণ করে না) | |
| ২. | বারি পেয়ারা | | |
| ৩. | থাই পেয়ারা | | |
| ৪. | মুকুন্দপূরী | | |
| ৫. | স্বরূপকাঠী | | |
| ৬. | লতা | | |
| ৭. | পূর্ণমন্ডলী (লাল) | | |
| ৮. | আমদানীকৃত হাইব্রিড জাত | | |
| ৯. | স্থানীয় জাত | | |
| ১০. | অন্য কোন জাত----------(যদি থাকে) | | |

### 2.4 পেয়ারা চাষের জন্যে সাধারণত: কোন কোন উৎস থেকে বীজ/চারা ক্রয়/সংগ্রহ করেন?

| উৎসসমূহ | উত্তরের ধরণ (কোড: হ্যাঁ=১, না=২)। | উৎস অনুযায়ী চারার গুনগত মান কেমন? [কোড: ১=ভালো, ২=মাধ্যম, ৩=ভালো নয়] |
|---|---|---|
| ১. নিজের তৈরী চারা/বীজ | | |
| ২. প্রতিবেশী কৃষকের কাছ থেকে সংগৃহীত | | |
| ৩. বিএডিসি-এর চারা/বীজ | | |
| ৪. অন্য কোন কোম্পানীর বীজ | | |
| ৫. স্থানীয় নার্সারী হতে সংগৃহীত চারা/বীজ | | |
| ৬. আমদানীকারকের নিকট হতে সংগৃহীত চারা/বীজ | | |
| ৭. কৃষি গবেষণা প্রতিষ্ঠান হতে সংগৃহীত চারা/বীজ | | |
| ৮. এনজিও হতে সংগৃহীত চারা/বীজ | | |
| ৯. অন্যান্য কোন উৎস -------------(যদি থাকে) | | |

## 3.0. পেয়ারা গাছে ক্ষতিকর পোকা-মাকড়ের আক্রমন সংক্রান্ত তথ্যাদি

### 3.1 মাঠপর্যায়ে পেয়ারার ক্ষতিকর পোকামাকড়ের উপস্থিতি এবং উপদ্রবের ধরণ/ অবস্থা কেমন? (দয়া করে খালী ঘরে সংখ্যা লিখুন)

| ইং | পোকার নাম | আক্রমণ হয়? [১=হ্যাঁ, ২=না] | আক্রমনের অবস্থা? (১=মূখ্য পোকা, ২=গৌণ পোকা) | আক্রমনের পর্যায় (১=চারা, ২=বাড়ন্ত গাছ, ৩=ফলজ গাছ) | কোন অংশ আক্রান্ত হয় [১=পাতা, ২=কান্ড, ৩=ফল, ৪=শিকড়] | আক্রমনের তীব্রতা? (কোড: ১=বেশী, ২=মধ্যম, ৩=কম) |
|---|---|---|---|---|---|---|
| ১ | Spiraling Whitefly | | | | | |
| ২ | Mealy bug | | | | | |
| ৩ | Thrips | | | | | |
| ৪ | Guava Blue – Butterflies | | | | | |
| ৫ | Guava fruit fly | | | | | |
| ৬ | Yellow scale | | | | | |
| ৭ | Black Scale | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| ৮ | Leaf miner | | | | | |
| ৯ | Stem borer | | | | | |
| ১০ | Vertebrate Pests | | | | | |
| ১১ | অন্যান্য----------(যদি থাকে) | | | | | |

**3.2. ক. আপনার এলাকায় পেয়ারা ক্ষেতে এমন কোন বাহক পোকা-মাকড় দেখেছেন কি যা পেয়ারা গাছে ভাইরাস বা অন্য রোগ ছড়ায়?**
(কোড: হ্যাঁ=১, না=২)
**খ. যদি উত্তর হ্যাঁ হয়, তাহলে বাহক বা ভেক্টর পোকা-মাকড়সমূহের নাম উল্লেখ করুন:**

**১। ----------------------------------, ২। ---------------------------------, ৩। -------------------------------------- ।**

**3.3. ক. আপনার এলাকায় পেয়ারা ক্ষেতে বর্তমানে এমন নতুন কোন পোকা দেখা যাচ্ছে কি, যা পূর্ববর্তী ৫ বৎসর সময়ে ছিল না?**
(কোড: হ্যাঁ=১, না=২)।
**খ. যদি উত্তর হ্যাঁ হয়, তাহলে পোকা মাকড়গুলো কি কি? নাম উল্লেখ করুন:**

**১। ----------------------------------, ২। ---------------------------------, ৩। -------------------------------------- ।**

**3.4. পেয়ারা ক্ষেতে আগের তুলনায় বর্তমানে অধিকতর ক্ষতি করে এমন কতগুলো অনিষ্টকারী পোকার নাম বলুন?**

**১। ----------------------------------, ২। ---------------------------------, ৩। -------------------------------------- ।**

**3.5. আপনার জানামতে পেয়ারার এমন কোন ক্ষতিকর পোকা আছে কি, যেগুলো পার্শ্ববর্তী কোন দেশ থেকে আমাদের দেশে প্রবেশ করেছে, যা আমাদের দেশে পূর্বে ছিল না?** (কোড: হ্যাঁ=১, না=২)।
**ক. যদি উত্তর হ্যাঁ হয়, তাহলে সে সব পোকার নাম বলুন?**

**১। ----------------------------------, ২। ---------------------------------, ৩। -------------------------------------- ।**

**3.6. আপনি সাধারণত কিভাবে পেয়ারার ক্ষতিকর পোকামাকড়ের আক্রমণ দমন করেন? নিচের খালিঘরে কোড নাম্বার লিখুনঃ**

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|---|---|---|---|---|---|---|---|---|---|---|
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(কোডঃ ১= গাছে কীটনাশক স্প্রে করে, ২=ব্যাগ বা পলিথিন দিয়ে ফল মুড়িয়ে দেয়া, ৩=ফ্রুট ফ্লাই দমনের জন্য ফেরোমন ফাঁদ ব্যবহার করে, ৪= সমন্বিত বালাই পদ্ধতি (আই.পি.এম.), ৫=চারা/বীজ লাগানোর সময় কীটনাশক দিয়ে চারা/বীজ শোধন করে, ৬= সেচ প্রদান করে, ৭= ক্ষতিকর পোকাসমূহ হাত দিয়ে সংগ্রহ করে মেরে ফেলা, ৮= সুষম সার ব্যবহার করে, ৯= অন্যান্য --------------------(দয়া করে উল্লেখ করুন) ]

**4.0. পেয়ারা গাছে রোগ-বালাই-এর আক্রমণ সংক্রান্ত তথ্যাদি**

**4.1. মাঠপর্যায়ে পেয়ারা ফসলের রোগসমূহের উপস্থিতি এবং আক্রমনের ধরণ/অবস্থা কেমন? (দয়া করে খালী ঘরে সংখ্যা লিখুন)**

| নং | রোগ সমূহের নাম | রোগের আক্রমণ হয়? [১=হ্যাঁ, ২=না] | আক্রমণের অবস্থা? (কোড: ১=মূখ্য, ২=গৌণ রোগ) | আক্রমণের পর্যায় (১=চারা, ২=বাড়ন্ত গাছ, ৩=ফলজ গাছ) | কোন অংশ আক্রান্ত হয় [১=পাতা, ২=কান্ড, ৩=ফল, ৪=শিকড়] | আক্রমণের তীব্রতা? (কোড: ১=বেশী, ২=মধ্যম, ৩=কম) |
|---|---|---|---|---|---|---|
| ১ | Grey Leaf Spot | | | | | |
| ২ | Anthracnose | | | | | |
| ৩ | Leaf spot | | | | | |
| ৪ | Root Knot Nematode | | | | | |
| ৫ | Rust | | | | | |
| ৬ | Kanker of stem | | | | | |
| ৭ | Dieback | | | | | |
| ৮ | Red rust | | | | | |
| ৯ | Scab | | | | | |
| ১০ | Sooti mould | | | | | |
| ১১ | Wilt | | | | | |
| ১২ | Fruit rot | | | | | |
| ১৩ | অন্যান্য------------ | | | | | |

**4.2. ক. আপনার এলাকায় পেয়ারা ক্ষেতে ভেক্টর বাহিত কোন ভাইরাস বা অন্য কোন রোগ আছে কি?** (কোড: হ্যাঁ=১, না=২)।
**খ. যদি উত্তর হ্যাঁ হয়, তাহলে বাহক বা ভেক্টর বাহিত রোগসমূহের নাম উল্লেখ করুন:**

**১। ----------------------------------, ২। ---------------------------------, ৩। -------------------------------------- ।**

4.3. **ক. আপনার এলাকায় পেয়ারা ক্ষেতে বর্তমানে এমন কোন নতুন রোগের আক্রমন দেখা যাচ্ছে কি, যা পূর্ববর্তী সময়ে ছিল না?**
(কোড: হ্যাঁ=১, না=২)।
**খ. যদি উত্তর হ্যাঁ হয়, তাহলে রোগসমূহ কি কি? নাম উল্লেখ করুন:**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

4.4. **আপনার এলাকায় পেয়ারা ক্ষেতে আগের তুলনায় বর্তমানে বেশী ক্ষতি করে এমন কতগুলো রোগের নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। ---------------------------------।

4.5. **ক. আপনার জানামতে পেয়ারা ফসলে এমন রোগ আছে কি, যেগুলো পার্শ্ববর্তী কোন দেশ থেকে আমাদের দেশে প্রবেশ করেছে, যা আমাদের দেশে পূর্বে ছিল না? (কোড: হ্যাঁ=১, না=২)।**
**খ. যদি উত্তর হ্যাঁ হয়, তাহলে এ সকল রোগের নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

4.6. **পেয়ারা ক্ষেতে আপনি কিভাবে রোগ-বালাই দমন করে থাকেন? নিচের খালিঘরে কোড নাম্বার লিখুনঃ**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

[কোডঃ ১= মাটিতে বীজ বপন/চারা রোপনের পূর্বে ছত্রাকনাশক দিয়ে বীজ/চারা শোধন করে, ২= পেয়ারার বীজ বপন/চারা রোপন করার সময় নালাতে কীটনাশক মিশিয়ে, ৩=গাছে ছত্রাকনাশক স্প্রে করে, ৪=সেচ দেয়ার সময় কীটনাশক মিশিয়ে, ৫= বাহক দমনের জন্য কীটনাশক স্প্রে করা, ৬= জমিতে জৈব-সার প্রয়োগ করে, ৭= জমিতে সেচ প্রদান করে, ৮= জমি থেকে রোগাক্রান্ত গাছসমূহ তুলে ধ্বংস করা, ৯= জমিতে থেকে আগাছা পরিস্কার করে পোকার আবাসস্থল নষ্ট করা, ১০= সমন্বিত বালাই পদ্ধতি (আই.পি.এম.), ১১= সুষম সার ব্যবহারের মাধ্যমে, ১২= অন্যান্য ---------------------------(দয়া করে উল্লেখ করুন)]

5.0. **পেয়ারা বাগানে আগাছার আক্রমন সংক্রান্ত তথ্যাদি**

5.1. **মাঠপর্যায়ে পেয়ারা বাগানে আগাছার আক্রমণ, বাগানের পর্যায়, আক্রমণের অবস্থা এবং ক্ষতির তীব্রতা কেমন? (খালী ঘরে সংখ্যা লিখুন)**

| নং | নাম | আগাছার আক্রমণ হয়? [১=হ্যাঁ, ২=না] | আক্রমনের অবস্থা? (কোড: ১=মূখ্য আগাছা, ২=গৌণ আগাছা) | গাছের কোন পর্যায় আক্রমন করে? [১=চারা, ২=বাড়ন্ত, ৩=ফলজ] | আক্রমনের তীব্রতা? (কোড: ১=বেশী, ২=মধ্যম, ৩=কম) |
|---|---|---|---|---|---|
| ১ | দূর্বা ঘাস | | | | |
| ২ | মুথা | | | | |
| ৩ | বথূয়া | | | | |
| ৪ | চাপড়া | | | | |
| ৫. | স্বর্ণলতা | | | | |
| ৬. | পার্থেনিয়াম | | | | |
| ৭ | অন্যান্য | | | | |

5.2. **ক. আপনার এলাকায় পেয়ারা ক্ষেতে বর্তমানে নতুন এমন কোন আগাছা দেখা যাচ্ছে কি, যা পূর্ববর্তী সময়ে ছিল না?**

(কোড: হ্যাঁ=১, না=২)।

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে আগাছাসমূহ কি কি? নাম উল্লেখ করুন:**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

5.3. **আপনার এলাকায় পেয়ারা ক্ষেতে আগের তুলনায় বর্তমানে বেশী ক্ষতি করে এমন কতগুলো আগাছার নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

5.4. **ক. আপনার জানামতে পেয়ারার এমন আগাছা আছে কি, যেগুলো পার্শ্ববর্তী কোন দেশ থেকে আমাদের দেশে প্রবেশ করেছে, যা আমাদের দেশে পূর্বে ছিল না?** (কোড: হ্যাঁ=১, না=২)।

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে এ সকল আগাছাগুলোর নাম বলুন?**

১। ---------------------------------, ২। ---------------------------------, ৩। ----------------------------------

**5.5. পেয়ারা ক্ষেতে সাধারণতঃ কিভাবে আগাছা দমন করে থাকেন? নিচের খালিঘরে কোড নাম্বার লিখুনঃ**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

[কোডঃ ১= ক্ষেত থেকে আগাছা উঠিয়ে, ২= ক্ষেতে দানাদার আগাছানাশক ছিটিয়ে, ৩= জমি তৈরীর সময় আগাছা উঠিয়ে, ৪= মালচিং করে, ৫= গাছের গোড়ায়/আইলে মাটি উঠিয়ে, ৬= সেচ দিয়ে, ৭= অন্যান্য (উল্লেখ করুন) ]

তথ্য সংগ্রহকারীর নাম ঃ স্বাক্ষর ও তারিখ ঃ

ফিল্ড সুপারভাইজারের নাম ঃ স্বাক্ষর ও তারিখ ঃ

## Appendix 2ঃ মাঠ পর্যায়ের কৃষি কর্মকর্তার জন্যে জরিপ প্রশ্নাবলী

কৃষি সম্প্রসারণ অধিদপ্তর
বাংলাদেশ ফাইটোসেনেটারী শক্তিশালীকরণ প্রকল্প
উদ্ভিদ সংরক্ষণ উইং, খামারবাড়ী, ফার্মগেট, ঢাকা।
ফোনঃ ৯১০৩৭৭৪।

# Pest Risk Analysis (PRA) of Guava in Bangladesh

**ইউসুফ এ্যান্ড এসোসিয়েটস্**
**৭ গুলশান এভিনিউ টাওয়ার (লেভেল-৪, ব্লক-এ),গুলশান, ঢাকা**

## সেট-২: মাঠ পর্যায়ের কৃষি কর্মকর্তার জন্যে জরিপ প্রশ্নাবলী

| কোডঃ | | | | | মোবাইল ফোন | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**1.0** অংশগ্রহনকারীর পেশাগত **তথ্যাদিঃ**

**1.1.** উত্তর দাতার নাম: -----------------------------------------------------------------------------------------------------------------------

**1.2.** পদবীঃ [1=UAO, 2=AEO, 3=AAEO/JAEO, 4=SAPPO, 5=SAAO, 6=Other -------------(Specify)] ☐

**1.3.** কৃষি ব্লক: --------------------------------------------- **1.4.** উপজেলা: ------------------------------------------------

**1.5.** জেলা: ----------------------------------------------- **1.6.** লিঙ্গঃ (কোডঃ ১=পুরুষ, ২=মহিলা)

**1.7.** আপনি কত বছর যাবৎ আপনার পেশায় নিয়োজিত আছেন? --------------------------------------------- বছর।

**2.0** পেয়ারার **আবাদ সংক্রান্ত তথ্যাদি**

**2.1 পেয়ারার বিভিন্ন জাতের প্রতি ক্ষতিকর পোকামাকড়, রোগ-বালাই এবং আগাছার কোনটি বেশী আক্রমন করে?**

| **নং** | **পেয়ারার বিভিন্ন জাতের নাম** | **যার প্রতি সংবেদনশীল** | শূন্যস্থানে কোড নাম্বার লিখুন। |
|---|---|---|---|
| ১. | কাজী পেয়ারা | (কোডঃ ১=পোকামাকড়, ২=রোগ-বালাই, ৩=আগাছা, ৪=কোনটাই আক্রমন করে না) | |
| ২. | বারি পেয়ারা | | |
| ৩. | থাই পেয়ারা | | |
| ৪. | মুকুন্দপূরী | | |
| ৫. | স্বরূপকাঠী | | |
| ৬. | লতা | | |
| ৭. | পূর্ণমন্ডলী (লাল) | | |
| ৮. | আমদানীকৃত হাইব্রিড জাত | | |
| ৯. | স্থানীয় জাত | | |
| ১০. | অন্যান্য ------------- (যদি থাকে) | | |

**2.2 পেয়ারা চাষের জন্যে সাধারণত: কোন কোন উৎস থেকে বীজ/চারা ক্রয়/সংগ্রহ করা হয়?**

| **উৎসসমূহ** | **উত্তরের ধরণ (কোডঃ হ্যাঁ=১, না=২)।** | উৎস অনুযায়ী চারার গুনগত মান কেমন? [কোডঃ ১=ভালো, ২=মাধ্যম, ৩=ভালো নয়] |
|---|---|---|
| ১. নিজের তৈরী চারা/বীজ | | |
| ২. প্রতিবেশী কৃষকের কাছ থেকে সংগৃহীত | | |
| ৩. বিএডিসি-এর চারা/বীজ | | |
| ৪. অন্য কোন কোম্পানীর বীজ | | |
| ৫. স্থানীয় নার্সারী হতে সংগৃহীত চারা/বীজ | | |
| ৬. আমদানীকারকের নিকট হতে সংগৃহীত চারা/বীজ | | |
| ৭. কৃষি গবেষনা প্রতিষ্ঠান হতে সংগৃহীত চারা/বীজ | | |

| | | | |
|---|---|---|---|
| ৮. | এনজিও হতে সংগৃহীত চারা/বীজ | | |
| ৯. | অন্যান্য কোন উৎস -------------(যদি থাকে) | | |

**3.0. পেয়ারা গাছে ক্ষতিকর পোকা-মাকড়ের আক্রমন সংক্রান্ত তথ্যাদি**

**3.1 মাঠপর্যায়ে পেয়ারার ক্ষতিকর পোকামাকড়ের উপস্থিতি এবং উপদ্রবের ধরণ/ অবস্থা কেমন? (দয়া করে খালী ঘরে সংখ্যা লিখুন)**

| ইং | পোকার নাম | পোকার আক্রমণ হয়? [১=হ্যাঁ, ২=না] | গাছের কোন পর্যায় আক্রমন করে? [১=পাতা, ২=কান্ড, ৩=ফল, ৪=শিকড়] | পোকার আক্রমনের অবস্থা? (কোড: ১=মূখ্য পোকা, ২=গৌণ পোকা) | আক্রমনের তীব্রতা? (কোড: ১=বেশী, ২=মধ্যম, ৩=কম) |
|---|---|---|---|---|---|
| ১ | Spiraling Whitefly | | | | |
| ২ | Mealy bug | | | | |
| ৩ | Thrips | | | | |
| ৪ | Guava Blue – Butterflies | | | | |
| ৫ | Guava fruit fly | | | | |
| ৬ | Yellow scale | | | | |
| ৭ | Black Scale | | | | |
| ৮ | Leaf miner | | | | |
| ৯ | Stem borer | | | | |
| ১০ | Vertebrate Pests | | | | |
| ১১ | অন্যান্য----------(যদি থাকে) | | | | |

3.2. **ক. আপনার এলাকায় পেয়ারা ক্ষেতে এমন কোন বাহক পোকা-মাকড় দেখেছেন কি যা পেয়ারা গাছে ভাইরাস বা অন্য রোগ ছড়ায়?** (কোড: হ্যাঁ=১, না=২)। ☐

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে বাহক বা ভেক্টর পোকা-মাকড়সমূহের নাম উল্লেখ করুন:**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

3.3. **ক. আপনার এলাকায় পেয়ারা ক্ষেতে বর্তমানে এমন নতুন কোন পোকা দেখা যাচ্ছে কি, যা পূর্ববর্তী সময়ে ছিল না?** (কোড: হ্যাঁ=১, না=২)। ☐

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে পোকা মাকড়গুলো কি কি? নাম উল্লেখ করুন:**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

3.4. **পেয়ারা ক্ষেতে আগের তুলনায় বর্তমানে অধিকতর ক্ষতি করে এমন কতগুলো অনিষ্টকারী পোকার নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

3.5. **আপনার জানামতে পেয়ারার এমন কোন ক্ষতিকর পোকা আছে কি, যেগুলো পার্শ্ববর্তী কোন দেশ থেকে আমাদের দেশে প্রবেশ করেছে, যা আমাদের দেশে পূর্বে ছিল না?** (কোড: হ্যাঁ=১, না=২)। ☐

**ক. যদি উত্তর হ্যাঁ হয়, তাহলে সে সব পোকার নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

3.6. **সাধারণত কিভাবে পেয়ারার ক্ষতিকর পোকামাকড়ের আক্রমণ দমন করা হয়? নিচের খালিঘরে কোড নাম্বার লিখুনঃ**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

(কোডঃ ১= গাছে কীটনাশক স্প্রে করে, ২=ব্যাগ বা পলিথিন দিয়ে ফল মুড়িয়ে দেয়া, ৩=ফ্রুট ফ্লাই দমনের জন্য ফেরোমন ফাঁদ ব্যবহার করে, ৪= সমন্বিত বালাই পদ্ধতি (আই.পি.এম.), ৫=চারা/বীজ লাগানোর সময় কীটনাশক দিয়ে চারা/বীজ শোধন করে, ৬= সেচ প্রদান করে, ৭= ক্ষতিকর পোকাসমূহ হাত দিয়ে সংগ্রহ করে মেরে ফেলা, ৮= সুষম সার ব্যবহার করে, ৯= অন্যান্য -------------------- (দয়া করে উল্লেখ করুন) ]

## 4.0. পয়ারা গাছে রোগ-বালাই-এর আক্রমন সংক্রান্ত তথ্যাদি

**4.1. মাঠপর্যায়ে পেয়ারা ফসলের রোগসমূহের উপস্থিতি এবং আক্রমনের ধরণ/অবস্থা কেমন? (দয়া করে খালী ঘরে সংখ্যা লিখুন)**

| নং | রোগ সমূহের নাম | রোগের আক্রমণ হয়? [১=হ্যাঁ, ২=না] | আক্রমনের অবস্থা? (কোড: ১=মূখ্য, ২=গৌণ রোগ) | আক্রমনের পর্যায় (১=চারা, ২=বাড়ন্ত গাছ, ৩=ফলজ গাছ) | কোন অংশ আক্রান্ত হয় [১=পাতা, ২=কান্ড, ৩=ফল, ৪=শিকড়] | আক্রমনের তীব্রতা? (কোড: ১=বেশী, ২=মধ্যম, ৩=কম) |
|---|---|---|---|---|---|---|
| ১ | Grey Leaf Spot | | | | | |
| ২ | Anthracnose | | | | | |
| ৩ | Leaf spot | | | | | |
| ৪ | Root Knot Nematode | | | | | |
| ৫ | Rust | | | | | |
| ৬ | Kanker of stem | | | | | |
| ৭ | Dieback | | | | | |
| ৮ | Red rust | | | | | |
| ৯ | Scab | | | | | |
| ১০ | Sooti mould | | | | | |
| ১১ | Wilt | | | | | |
| ১২ | Fruit rot | | | | | |
| ১৩ | অন্যান্য-----(উল্লেখ করুন) | | | | | |

**4.2. ক. আপনার এলাকায় পেয়ারা বাগানে ভেক্টর বাহিত কোন ভাইরাস বা অন্য কোন রোগ আছে কি??** (কোডঃ হ্যাঁ=১, না=২)। ☐

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে বাহক বা ভেক্টর বাহিত রোগসমূহের নাম উল্লেখ করুনঃ**

১। ----------------------------------, ২। ---------------------------------, ৩। ---------------------------------------।

**4.3. ক. আপনার এলাকায় পেয়ারা বাগানে বর্তমানে এমন কোন নতুন রোগের আক্রমন দেখা যাচ্ছে কি, যা পূর্ববর্তী সময়ে ছিল না?** (কোডঃ হ্যাঁ=১, না=২)। ☐

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে রোগসমূহ কি কি? নাম উল্লেখ করুনঃ**

১। ----------------------------------, ২। ---------------------------------, ৩। ---------------------------------------।

**4.4. আপনার এলাকায় পেয়ারা বাগানে আগের তুলনায় বর্তমানে বেশী ক্ষতি করে এমন কতগুলো রোগের নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। ---------------------------------------।

**4.5. ক. আপনার জানামতে পেয়ারা গাছে এমন রোগ আছে কি, যেগুলো পার্শ্ববর্তী কোন দেশ থেকে আমাদের দেশে প্রবেশ করেছে, যা আমাদের দেশে পূর্বে ছিল না? (কোডঃ হ্যাঁ=১, না=২)।** ☐

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে এ সকল রোগের নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। ---------------------------------------।

**4.6. পেয়ারা গাছের রোগ-বালাই সাধারণত কিভাবে দমন করা হয়? নিচের খালিঘরে কোড নাম্বার লিখুনঃ**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

[কোডঃ ১= মাটিতে বীজ বপন/চারা রোপনের পূর্বে ছত্রাকনাশক দিয়ে বীজ/চারা শোধন করে, ২= পেয়ারার বীজ বপন/চারা রোপন করার সময় নালাতে কীটনাশক মিশিয়ে, ৩=গাছে ছত্রাকনাশক স্প্রে করে, ৪=সেচ দেয়ার সময় কীটনাশক মিশিয়ে, ৫= বাহক দমনের জন্য কীটনাশক স্প্রে করা, ৬= জমিতে জৈব-সার প্রয়োগ করে, ৭= জমিতে সেচ প্রদান করে, ৮= জমি থেকে রোগাক্রান্ত গাছসমূহ তুলে ধ্বংস করা, ৯= জমিতে থেকে আগাছা পরিস্কার করে পোকার আবাসস্থল নষ্ট করা, ১০= সমন্বিত বালাই পদ্ধতি (আই.পি.এম.), ১১= সুষম

সার ব্যবহারের মাধ্যমে, ১২= অন্যান্য ---------------------------(দয়া করে উল্লেখ করুন)]

**5.0. পেয়ারা বাগানে আগাছার আক্রমন সংক্রান্ত তথ্যাদি**

**5.1. আপনার এলাকায় পেয়ারা বাগানে আগাছার আক্রমন, বাগানের পর্যায়, আক্রমনের অবস্থা এবং ক্ষতির তীব্রতা কেমন?**

| নং | নাম | আগাছার আক্রমণ হয়? [১=হ্যাঁ, ২=না] | আক্রমনের অবস্থা? (কোড: ১=মূখ্য আগাছা, ২=গৌণ আগাছা) | গাছের কোন পর্যায় আক্রমন করে? [১=চারা, ২=বাড়ন্ত, ৩=ফলজ] | আক্রমনের তীব্রতা? (কোড: ১=বেশী, ২=মধ্যম, ৩=কম) |
|---|---|---|---|---|---|
| ১ | দূর্বা ঘাস | | | | |
| ২ | মুথা | | | | |
| ৩ | বথূয়া | | | | |
| ৪ | চাপড়া | | | | |
| ৫. | স্বর্ণলতা | | | | |
| ৬. | পার্থেনিয়াম | | | | |
| ৭ | অন্যান্য | | | | |

**5.2. ক. আপনার এলাকায় পেয়ারা বাগানে বর্তমানে নতুন এমন কোন আগাছা দেখা যাচ্ছে কি, যা পূর্ববর্তী সময়ে ছিল না?** (কোড: হ্যাঁ=১, না=২)।

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে আগাছাসমূহ কি কি? নাম উল্লেখ করুন:**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

**5.3. আপনার এলাকায় পেয়ারা বাগানে আগের তুলনায় বর্তমানে বেশী ক্ষতি করে এমন কতগুলো আগাছার নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

**5.4. ক. আপনার জানামতে পেয়ারার এমন আগাছা আছে কি, যেগুলো পার্শ্ববর্তী কোন দেশ থেকে আমাদের দেশে প্রবেশ করেছে, যা আমাদের দেশে পূর্বে ছিল না?** ([কোড: হ্যাঁ=১, না=২)।

**খ. যদি উত্তর হ্যাঁ হয়, তাহলে এ সকল আগাছাগুলোর নাম বলুন?**

১। ----------------------------------, ২। ---------------------------------, ৩। --------------------------------------।

**5.5. পেয়ারা বাগানে সাধারণত: কিভাবে আগাছা দমন করা হয়? নিচের খালিঘরে কোড নাম্বার লিখুনঃ**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

[কোডঃ ১= ক্ষেত থেকে আগাছা উঠিয়ে, ২= ক্ষেতে দানাদার আগাছানাশক ছিটিয়ে, ৩= জমি তৈরীর সময় আগাছা উঠিয়ে, ৪= মালচিং করে, ৫= গাছের গোড়ায়/আইলে মাটি উঠিয়ে, ৬= সেচ দিয়ে, ৭= অন্যান্য (উল্লেখ করুন) ]

তথ্য প্রদানকারীর নাম ও স্বাক্ষরঃ

তথ্য সংগ্রহকারীর নামঃ স্বাক্ষর ও তারিখঃ

ফিল্ড সুপারভাইজারের নামঃ স্বাক্ষর ও তারিখঃ

## Appendix 3ঃ KII Checklist for District Level DAE Official

**Government of the People's Republic of Bangladesh**

Department of Agricultural Extension

Strengthening Phytosanitary Capacity in Bangladesh,

Khamarbari, Farmgate, Dhaka

**Pest Risk Analysis (PRA) of Guava in Bangladesh**

***Prepared by:***

**ইউসুফ এ্যান্ড এসোসিয়েটস্**

৭ গুলশান এভিনিউ টাওয়ার (লেভেল-৪, ব্লক-এ),গুলশান, ঢাকা

## Set-3: KII Checklists for Additional DD (PP) at District Level DAE Office

Name of Key Informant…….. …………………………Designation ………………………..….

Organization:………………………..…………… Working area: …………………………

Mobile:………….………..…………………..…………

### 1.0 INFORMATION ABOUT INSECT PESTS OF GUAVA

1.1 What are the major insect pests that cause potential damage to guava in your area?

1.2 What are the minor insect pests that may harm to guava, if not to be controlled?

1.3 What are the insect pests of guava, which incidences are being seen in recent years, but not seen earlier in your area?

1.4 What is the damage potential of mealybug and whitefly on guava in your area? Are there any various species of mealy bug and whitefly present in guava, if yes please mention those species.

1.5 What are the quarantine insect pests of guava that might already be entered into Bangladesh through importation of guava seedlings/seeds from other countries or through cross boundary from neighboring countries that were not seen earlier?

1.6 What are the effective options to control the quarantine insect pests that are found in the guava field in your area?

1.7 Give your suggestions for the better management of the insect pests of guava in Bangladesh.

## 2.0 INFORMATION ABOUT DISEASES OF GUAVA

2.1 What are the major diseases that cause potential damage to guava in your area?

2.2 What are the minor diseases that may harm to guava, if not to be controlled?

2.3 What are the diseases of guava, which incidences are being seen in recent years, but not seen earlier in your area?

2.4 What are the quarantine diseases that might already be entered into Bangladesh through importation of guava saplings/seeds from other countries or through cross boundary from neighboring countries that were not seen earlier?

2.5 What are the possible ways of entry of newly introduced diseases of guava that were not seen earlier in the field in Bangladesh?

2.6 What are the effective options to control the quarantine diseases that are found Bangladesh?

2.7 Give your suggestions for the better management of the diseases of guava in Bangladesh.

## 3.0 INFORMATION ABOUT WEEDS OF GUAVA

3.1 What are the major weeds that cause potential damage to guava in your area?

3.2 What are the minor weeds that may harm to guava, if not to be controlled?

3.3 What are the weeds of guava, which incidences are being seen in recent years, but not seen earlier in your area?

3.4 What are the quarantine weeds of guava that might already be entered into Bangladesh through importation of guava saplings/seeds from other countries or through cross boundary from neighboring countries that were not seen earlier?

3.5 What are the effective options to control the quarantine weeds that are found in Bangladesh?

3.6 Give your suggestions for the better management of the weeds of guava in Bangladesh.

**Signature of the officer with Seal**
**Date:**

**Thank you for your kind cooperation**

## Appendix 4: KII Checklist for Quarantine Personnel at DAE HQ

**Government of the People's Republic of Bangladesh**

Department of Agricultural Extension

Strengthening Phytosanitary Capacity in Bangladesh,

Khamarbari, Farmgate, Dhaka

# Pest Risk Analysis (PRA) of Guava in Bangladesh

***Prepared by:***

**ইউসুফ এ্যান্ড এসোসিয়েটস্**

**৭ গুলশান এভিনিউ টাওয়ার (লেভেল-৪, ব্লক-এ),গুলশান, ঢাকা**

## Set-4: KII Checklists for Quarantine Personnel of DAE

## [DAE HQ, Quarantine Station/Port]

---

Name of Key Informant.…………………………………Designation ……………………….….

Organization:………………………..……………    Working area: …………………………

Mobile:…………………..…………………..…………

### 4.0 INFORMATION ABOUT INSECT PESTS OF GUAVA

4.1 What are the major insect pests that cause potential damage to guava in your area?

4.2 Is there any record, the consignment of guava saplings/seeds imported to Bangladesh that was intercepted and returned to exporting country, due to occurrence of **quarantine insect pests** in the consignment? If yes, which insect pests and from where? Please mention the name of intercepted insect pests and country of export.

4.3 Is there any record, the consignment of guava imported as planting materials to Bangladesh that was intercepted and returned to exporting country, due to occurrence of **non-quarantine regulated insect pests** in the consignment? If yes, which insect pests and from where? Please mention the name of intercepted insect pests and country of export.

4.4 What are the quarantine insect pests of guava that might already be entered into Bangladesh through importation of guava saplings/seeds from other countries or through cross boundary from neighboring countries that were not seen earlier?

4.5 What are the possible ways of entry of newly introduced quarantine insect pests of guava that were not seen earlier in the field in Bangladesh?

4.6 What are the effective ways to prevent the entry of quarantine insect pests of guava from guava exporting countries into Bangladesh?

4.7 What are the options to prevent the spread of quarantine insect pests of guava within Bangladesh?

4.8 What steps are being taken by the PQW of DAE to prevent the entry of quarantine insect pests of guava through imported guava saplings/seeds?

4.9 Give your suggestions for the better management of the insect pests of guava in Bangladesh.

**5.0 INFORMATION ABOUT DISEASES OF GUAVA**

5.1 What are the major diseases that cause potential damage to guava in your area?

5.2 Is there any record, the consignment of guava saplings/seeds imported to Bangladesh that was intercepted and returned to exporting country, due to occurrence of **quarantine diseases** in the consignment? If yes, which diseases and from where? Please mention the name of intercepted diseases and country of export.

5.3 Is there any record, the consignment of guava saplings/seeds imported as planting materials to Bangladesh that was intercepted and returned to exporting country, due to occurrence of **non-quarantine regulated diseases** in the consignment? If yes, which insect pests and from where? Please mention the name of intercepted diseases and country of export.

5.4 What are the quarantine diseases of guava that might already be entered into Bangladesh through importation of guava from other countries or through cross boundary from neighboring countries that were not seen earlier?

5.5 What are the possible ways of entry of newly introduced quarantine diseases of guava that were not seen earlier in the field in Bangladesh?

5.6 What are the effective ways to prevent the entry of quarantine diseases of guava from guava exporting countries into Bangladesh?

5.7 What are the options to prevent the spread of quarantine diseases of guava within Bangladesh?

5.8 What steps are being taken by the PQW of DAE to prevent the entry of quarantine diseases of guava through imported guava saplings/seeds?

5.9 Give your suggestions for the better management of the diseases of guava in Bangladesh.

**6.0 INFORMATION ABOUT WEEDS OF GUAVA**

6.1 What are the major weeds that cause potential damage to guava in your area?

6.2 Is there any record, the consignment of guava saplings/seeds imported to Bangladesh that was intercepted and returned to exporting country, due to occurrence of **quarantine weeds** in the consignment? If yes, which weeds and from where? Please mention the name of intercepted weeds and country of export.

6.3 Is there any record, the consignment of guava saplings/seeds imported as planting materials to Bangladesh that was intercepted and returned to exporting country, due to occurrence of **non-quarantine regulated weeds** in the consignment? If yes, which insect pests and from where? Please mention the name of intercepted weeds and country of export.

6.4 What are the quarantine weeds of guava that might already be entered into Bangladesh through importation of guava from other countries or through cross boundary from neighboring countries that were not seen earlier?

6.5 What are the possible ways of entry of newly introduced quarantine weeds of guava that were not seen earlier in the field in Bangladesh?

6.6 What are the effective ways to prevent the entry of quarantine weeds of guava from guava saplings/seeds exporting countries into Bangladesh?

6.7 What are the options to prevent the spread of quarantine weeds of guava within Bangladesh?

6.8 What steps are being taken by the PQW of DAE to prevent the entry of quarantine weeds of guava through imported guava saplings/seeds?

6.9 Give your suggestions for the better management of the weeds of guava in Bangladesh.

**Signature of the officer with Seal**
**Date:**

## Thank you for your kind cooperation

## **Appendix 5 ঃ KII Checklist for Researcher and Agricultural University Teachers**

**Government of the People's Republic of Bangladesh**
**Department of Agricultural Extension**
**Strengthening Phytosanitary Capacity in Bangladesh,**
**Khamarbari, Farmgate, Dhaka**

# Pest Risk Analysis (PRA) of Guava in Bangladesh

***Prepared by:***

**ইউসুফ এ্যান্ড এসোসিয়েটস্**
৭ গুলশান এভিনিউ টাওয়ার (লেভেল-৪, ব্লক-এ),গুলশান, ঢাকা

## Set-5: KII Checklists for Researchers & Agricultural University Teachers

## [Entomology, Plant Pathology and Agronomy/Horticulture]

## A. For Entomologist

Name of Key Informant…….. ……………………………Designation ………………………….

Organization:………………………..…………… Working area: …………………………

Mobile:…………………..…………………..…………

### 7.0 INFORMATION ABOUT INSECT PESTS OF GUAVA

7.1 What are the major insect pests that cause potential damage to guava in your area?

7.2 What are the minor insect pests that may harm to guava, if not to be controlled?

7.3 What are the insect pests of guava, which incidences are being seen in recent years, but not seen earlier in your area?

7.4 What is the damage potential of mealy bug and whitefly on guava in your area? Are there any various species of mealy bug and whitefly present in guava, if yes please mention those species.

7.5 What are the quarantine insect pests of guava that might already be entered into Bangladesh through importation of guava saplings/seeds from other countries or through cross boundary from neighboring countries that were not seen earlier?

7.6 What are the effective ways to prevent the entry of quarantine insect pests of guava from guava saplings/seeds exporting countries into Bangladesh?

7.7 What are the options to prevent the spread of quarantine insect pests of guava within Bangladesh?

7.8 What are the effective options to control the quarantine insect pests that are found in the guava field in your area?

7.9 Give your suggestions for the better management of the insect pests of guava in Bangladesh.

**Signature of the officer with Seal**
**Date:**

## B. For Plant Pathologist

Name of Key Informant…….. ……………………… Designation ……………………….…..

Organization:………………………..…………… Working area: …………………………

Mobile:…………………..…………….………..

**8.0 INFORMATION ABOUT DISEASES OF GUAVA**

8.1 What are the major diseases that cause potential damage to guava in your area?

8.2 What are the minor diseases that may harm to guava, if not to be controlled?

8.3 What are the diseases of guava, which incidences are being seen in recent years, but not seen earlier in your area?

8.4 What are the quarantine diseases that might already be entered into Bangladesh through importation of guava saplings/seeds from other countries or through cross boundary from neighboring countries that were not seen earlier?

8.5 What are the effective ways to prevent the entry of quarantine diseases of guava from guava saplings/seeds exporting countries into Bangladesh?

8.6 What are the options to prevent the spread of quarantine diseases of guava within Bangladesh?

8.7 What are the effective options to control the quarantine diseases that are found Bangladesh?

8.8 Give your suggestions for the better management of the diseases of guava in Bangladesh.

**Signature of the officer with Seal**
**Date:**

## C. For Agronomist/Horticulturist

Name of Key Informant…….. ………………………. Designation …………………………..….

Organization:……………………………..……     Working area: …………………………

Mobile:…………………..…………………..…………

**9.0 INFORMATION ABOUT WEEDS OF GUAVA**

9.1 What are the major weeds that cause potential damage to guava in your area?

9.2 What are the minor weeds that may harm to guava, if not to be controlled?

9.3 What are the weeds of guava, which incidences are being seen in recent years, but not seen earlier in your area?

9.4 What are the quarantine weeds of guava that might already be entered into Bangladesh through importation of guava saplings/seeds from other countries or through cross boundary from neighboring countries that were not seen earlier?

9.5 What are the effective ways to prevent the entry of quarantine weeds of guava from guava exporting countries into Bangladesh?

9.6 What are the options to prevent the spread of quarantine weeds of guava within Bangladesh?

9.7 What are the effective options to control the quarantine weeds that are found in Bangladesh?

9.8 Give your suggestions for the better management of the weeds of guava in Bangladesh.

**Signature of the officer with Seal**
**Date:**

## Appendix 6ঃ পেয়ারার চাষীদের জন্য এফ.জি.ডি. গাইডলাইন

### গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

কৃষি সম্প্রসারণ অধিদপ্তর

বাংলাদেশ ফাইটোসেনেটারী শক্তিশালীকরণ প্রকল্প

উদ্ভিদ সংরক্ষণ উইং, খামারবাড়ী, ফার্মগেট, ঢাকা।

ফোনঃ ৯১০৩৭৭৪।

### Pest Risk Analysis (PRA) of Guava in Bangladesh

***Prepared by:***

**ইউসুফ এ্যান্ড এসোসিয়েটস্**

**৭ গুলশান এভিনিউ টাওয়ার (লেভেল-৪, ব্লক-এ),গুলশান, ঢাকা**

# এফ.জি.ডি.-এর নির্দেশনাসমূহ

| কোডঃ | | | | |
|---|---|---|---|---|

**1.0 এফজিডি এর স্থানঃ** ------------------------------------------------------------------------------------------।

**1.2** গ্রাম ------------------------------------------------------------| **1.3** কৃষি ব্লক: -------------------------------------------|

**1.4** উপজেলা: -------------------------------------------------------| **1.5** জেলা: ----------------------------------------------|

**2.1 আপনাদের চাষকৃত পেয়ারারর মধ্যে সবচেয়ে জন প্রিয় পেয়ারার জাতগুলো কি কি?**

**2.2 আপনাদের এলাকায় সাধারণতঃ পেয়ারার চারা ব্যবহার করা হয়, তাদের উৎসসমূহ কি কি?**

**2.3 আপনার এলাকায় পেয়ারা গাছে সাধারণত কোন ধরনের ক্ষতিকর পোকামাকড়ের আক্রমন দেখা যায়? (নাম উল্লেখ করুন)**

ক. মুখ্য ক্ষতিকর পোকামাকড়ের নাম:

খ. গৌণ ক্ষতিকর পোকামাকড়ের নামঃ

**2.4 আপনাদের এলাকায় পেয়ারার গাছে সাধারণত কোন কোন রোগ আক্রমন করে? (রোগের নাম উল্লেখ করুন)**

ক. মুখ্য রোগঃ

খ. গৌণ রোগঃ

**2.5 আপনার এলাকায় পেয়ারা বাগানে সাধারণত কোন কোন আগাছার আক্রমন বেশী দেখা যায়? (নাম উল্লেখ করুন))**

ক. মুখ্য আগাছাঃ

খ. গৌণ আগাছাঃ

**2.6 ক. আপনার এলাকায় পেয়ারা বাগানে এমন কোন বাহক পোকা-মাকড় দেখেছেন কি যা পেয়ারা গাছে ভাইরাস বা অন্য কোন রোগ ছড়ায়? যদি উত্তর হ্যাঁ হয়, তাহলে বাহক বা ভেক্টর পোকা-মাকড়সমূহের নাম উল্লেখ করুন:**

**2.8 ক্ষতিকর পোকা-মাকড়, রোগ-বালাই ও আগাছাসমূহ সাধারণত পেয়ারা গাছের কোন কোন বৃদ্ধি পর্যায়/ধাপসমূহ বেশী আক্রান্ত হয়?**

ক. ক্ষতিকর পোকামাকড়:

খ. রোগ বালাই:

গ. আগাছা:

**2.9 ক্ষতিকর পোকা-মাকড় ও রোগ দ্বারা পেয়ারা গাছের কোন কোন অংশ বেশী আক্রান্ত হয়?**

ক. ক্ষতিকর পোকামাকড়:

খ. রোগ বালাই:

**2.10 ক্ষতিকর পোকা-মাকড়, রোগ-বালাই ও আগাছার দ্বারা পেয়ারা গাছে ক্ষতির তীব্রতা কেমন হয়?**

ক. ক্ষতিকর পোকামাকড়:

খ. রোগ বালাই:

গ. আগাছা:

**2.11 আপনার এলাকায় পেয়ারা বাগানে বর্তমানে এমন নতুন কোন পোকা-মাকড়, রোগ-বালাই ও আগাছা দেখা যাচ্ছে কি, যা পূর্ববর্তী সময়ে ছিল না? যদি থেকে থাকে, তাহলে সেগুলো কি কি? নাম উল্লেখ করুন:**

ক. ক্ষতিকর পোকামাকড়:

খ. রোগ বালাই:

গ. আগাছা:

**2.12 আপনার এলাকায় পেয়ারা বাগানে আগের তুলনায় বর্তমানে অনেক বেশী ক্ষতি করে এমন কতগুলো অনিষ্টকারী পোকা-মাকড়, রোগ-বালাই ও আগাছার নাম বলুন?**

ক. ক্ষতিকর পোকামাকড়:

খ. রোগ বালাই:

গ. আগাছা:

**2.13 আপনাদের এলাকার পেয়ারা বাগানে ক্ষতিকর পোকা-মাকড়, রোগ ও আগাছা দমনে কি কি কার্যকর ব্যবস্থা গ্রহন করা হয়?**

ক. ক্ষতিকর পোকামাকড় দমনে কার্যকর ব্যবস্থা:

খ. রোগ বালাই দমনে কার্যকর ব্যবস্থা:

গ. আগাছা দমনে কার্যকর ব্যবস্থা:

**2.14 আপনাদের জানামতে এমন পেয়ারার এমন কোন ক্ষতিকর পোকা-মাকড়, রোগ-বালাই ও আগাছা আছে কি, যেগুলো পার্শ্ববর্তী দেশ থেকে আমাদের দেশে প্রবেশ করেছে মনে হয়, অথচ সেগুলো পূর্বে আমাদের দেশে ছিল না? যদি থেকে থাকে, তাহলে তাদের নাম বলুন?**

ক. ক্ষতিকর পোকামাকড়:

খ. রোগ বালাই:

গ. আগাছাঃ

# ফোকাস গ্রুপ ডিসকাশন (এফ.জি.ডি.)-এ অংশগ্রহণকারীদের তালিকা

| ক্রমিক নং | নাম | পদবী | গ্রাম | ইউনিয়ন | উপজেলা | জেলা | স্বাক্ষর |
|---|---|---|---|---|---|---|---|
| ১ | | | | | | | |
| ২ | | | | | | | |
| ৩ | | | | | | | |
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| ১১ | | | | | | | |
| ১২ | | | | | | | |
| ১৩ | | | | | | | |
| ১৪ | | | | | | | |
| ১৫ | | | | | | | |

এফজিডি পরিচালনাকারীর নামঃ---------------------------------------------- ।

স্বাক্ষর ও তারিখ: ------------------------------------------------------------ ।

মোবাইল নম্বর:----------------------------------------------------------------- ।

## Appendix 7ঃ: Data Tables for Survey Findings on PRA of Guava in Bangladesh

**Table 1. Educational level of guava farmers**

| Sl. No. | Education level | Number of respondents [N=6700] | % response |
|---|---|---|---|
| 1 | Not literate | 754 | 11.25 |
| 2 | Upto primary | 1349 | 20.13 |
| 3 | Up to Class Eight | 1698 | 25.34 |
| 4 | SSC | 1328 | 19.82 |
| 5 | HSC | 948 | 14.15 |
| 6 | Bachelor degree | 331 | 4.94 |
| 7 | Masters or higher degree | 287 | 4.28 |
| 8 | PhD, MPhil | 5 | 0.07 |
| | **Total** | 6700 | 100.00 |

**Table 2. Age of guava farmers**

| Sl. No. | Age range | Number of respondents [N=6700] | % response |
|---|---|---|---|
| 1 | > 20 years | 307 | 4.58 |
| 2 | 21-30 years | 943 | 14.07 |
| 3 | 31-40 years | 1944 | 29.01 |
| 4 | 41-50 years | 2388 | 35.64 |
| 5 | 51-60 years | 898 | 13.40 |
| 6 | > 60 years | 220 | 3.28 |
| **Total** | | 6700 | 100.00 |

**Table 3.Categories of the guava farmers participated in the survey**

| Categories of guava growers | Number of respondents [N=6700] | % response |
|---|---|---|
| Small growers | 3976 | 59.34 |
| Medium growers | 2458 | 36.69 |
| Large growers | 266 | 3.97 |
| **Total** | 6700 | 100.0 |

**Table 4. Sex of the Guava growers**

| Sex | Number of respondents [N=6700] | % response |
|---|---|---|
| Male | 4382 | 65.40 |
| Female | 2318 | 34.60 |
| **Total** | 6700 | 100.00 |

**Table 5. Farmers' response on the land utilization pattern for Guava cultivation**

| Land utilization pattern | Farmers' response | |
|---|---|---|
| | Land size (Trimmed Mean) | |
| | Decimal | Hector |
| 1. Land area under Guava cultivation | 190 | |
| 2. Percent land uses under cucurbits cultivation | 52.3% | |
| 3. Duration (year) engaged in Guava cultivation | 9.56 Years | |

**Table 6. Farmers' response on the selection of Guava variety for cultivating in this year**

| Cultivated guava varieties | Farmers' response | | Land under guava cultivation (Decimal) | Income (Thousand/acre) |
|---|---|---|---|---|
| | No. of respondents | % Response | | |
| 1. Kazi payara | 4970 | 74.18 | 33.1 | 112492 |
| 2. BARI payara | 2218 | 33.10 | 16.8 | 39828 |
| 3. Thai payara | 5984 | 89.31 | 36.2 | 122322 |
| 4. Mukundopuri | 1987 | 29.66 | 15.4 | 33655 |
| 5. Sawrupkathi | 2893 | 43.18 | 15.1 | 62485 |
| 6. Lota | 1842 | 27.49 | 13.3 | 31692 |
| 7. Purnomondoli (Red) | 1625 | 24.25 | 15.7 | 29124 |
| 8. Imported Hybrid variety | 1355 | 20.22 | 16.8 | 23466 |
| 9. Local variety | 2534 | 37.82 | 16.2 | 41552 |
| **Multiple response** | | | | |

**Table 7. Susceptibility of different guava varieties to different categories of pests in Bangladesh**

| Sl. No. | Guava varities | Status of susceptibility to pests [N=6700] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Insect pests | | Diseases | | Weeds | | No infestation | |
| | | No. | % | No. | % | No. | % | No. | % |
| 11. | Kazi payara | 6154 | 91.85 | 5844 | 87.22 | 4673 | 69.75 | 425 | 6.34 |
| 12. | BARI payara | 4152 | 61.97 | 4012 | 59.88 | 3842 | 57.34 | 384 | 5.73 |
| 13. | Thai payara | 3844 | 57.37 | 3917 | 58.46 | 3577 | 53.39 | 334 | 4.99 |
| 14. | Mukundopuri | 3654 | 54.54 | 3488 | 52.06 | 2946 | 43.97 | 298 | 4.45 |
| 15. | Sawrupkathi | 3354 | 50.06 | 3243 | 48.40 | 2879 | 42.97 | 255 | 3.81 |
| 16. | Lota | 3152 | 47.04 | 3038 | 45.34 | 2637 | 39.36 | 194 | 2.90 |
| 17. | Purnomondoli (Red) | 3112 | 46.45 | 2854 | 42.60 | 2246 | 33.52 | 165 | 2.46 |
| 18. | Imported Hybrid variety | 4289 | 64.01 | 4083 | 60.94 | 3496 | 52.18 | 146 | 2.18 |
| 19. | Local variety | 3987 | 59.51 | 3884 | 57.97 | 2674 | 39.91 | 92 | 1.37 |
| **Multiple response** | | | | | | | | | |

**Table 8. Farmers' response on the selection of Guava variety for cultivation**

| SL No | Cultivated Guava varieties | Farmers' response | | | | seedling quality depending on the source | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of respondents | | % Response | | Good | | Medium | | Not good | |
| | | Yes | No | Yes | No | No | % | No | % | No | % |
| 1 | Farmer's own seed/seedling | 2884 | 3816 | 43.04 | 56.96 | 3318 | 49.52 | 2645 | 39.48 | 737 | 11.00 |
| 2 | From neighbors | 3347 | 3353 | 49.96 | 50.04 | 3464 | 51.70 | 2533 | 37.81 | 703 | 10.49 |
| 3 | BADC seed/ seedling | 2622 | 4078 | 39.13 | 60.87 | 3194 | 47.67 | 2218 | 33.10 | 1288 | 19.22 |
| 4 | Company seed | 3112 | 3588 | 46.45 | 53.55 | 3084 | 46.03 | 1933 | 28.85 | 1683 | 25.12 |
| 5 | Local nursery seed/seedling | 4218 | 2482 | 62.96 | 37.04 | 3246 | 48.45 | 1822 | 27.19 | 1632 | 24.36 |
| 6 | From importer | 3992 | 2708 | 59.58 | 40.42 | 2922 | 43.61 | 2173 | 32.43 | 1605 | 23.96 |
| 7 | From research institution | 4318 | 2382 | 64.45 | 35.55 | 3646 | 54.42 | 2298 | 34.30 | 756 | 11.28 |
| 8 | From NGO's | 3872 | 2828 | 57.79 | 42.21 | 3547 | 52.94 | 2347 | 35.03 | 806 | 12.03 |
| **Multiple response** | | | | | | | | | | | |

**Table 9. Incidence of harmful insect pest of guava**

| Sl. No. | Name of pests | Pest incidence | | | |
|---|---|---|---|---|---|
| | | Yes | | No | |
| | | Number | % response | Number | % response |
| 1 | Oriental fruit fly | 5866 | 87.55 | 834 | 12.45 |
| 2 | Peach fruit fly | 5927 | 88.46 | 773 | 11.54 |
| 3 | Spiraling white fly | 3347 | 49.96 | 3353 | 50.04 |
| 4 | Cottony cushion scale | 4122 | 61.52 | 2578 | 38.48 |
| 5 | Green cushion scale | 4892 | 73.01 | 1808 | 26.99 |
| 6 | Pineapple mealybug | 3672 | 54.81 | 3028 | 45.19 |
| 7 | Pink hibiscus mealybug | 3988 | 59.52 | 2712 | 40.48 |
| 8 | Guava mealybug | 4129 | 61.63 | 2571 | 38.37 |
| 9 | Castor capsule borer | 2348 | 35.04 | 4352 | 64.96 |
| 10 | Fruit borer | 2455 | 36.64 | 4245 | 63.36 |
| 11 | Red and black flat mite | 5341 | 79.72 | 1359 | 20.23 |
| 12 | False spider mite | 4763 | 71.10 | 1937 | 28.90 |
| 13 | Guava fruit fly | 4129 | 61.63 | 2571 | 38.37 |
| 14 | Queensland fruit fly | Not recorded in Bangladesh | | | |
| 15 | Mediterranean fruit fly | Not recorded in Bangladesh | | | |
| 16 | Green scale | Not recorded in Bangladesh | | | |
| 17 | Coconut mealybug | Not recorded in Bangladesh | | | |
| 18 | Long-tailed mealybug | Not recorded in Bangladesh | | | |
| 19 | Tea mosquito bug | Not recorded in Bangladesh | | | |
| 20 | Guava aphid | Not recorded in Bangladesh | | | |
| 21 | Redbanded thrips | Not recorded in Bangladesh | | | |
| 22 | Anar butterfly | Not recorded in Bangladesh | | | |

**Table.10- Farmers response on the insect infestation status and vulnerable stages of insect infestation**

| Sl. No. | Name of Insects pest | Pest status | | Vulnerable stage of plants | | |
|---|---|---|---|---|---|---|
| | | Major | Minor | Seedling | Vegetative | Fruiting |
| 1 | Oriental fruit fly | 84.5 | 15.5 | 0 | 0 | 100 |
| 2 | Peach fruit fly | 83.6 | 16.4 | 0 | 0 | 100 |
| 3 | Spiraling white fly | 76.1 | 23.9 | 36.9 | 34.8 | 28.3 |
| 4 | Cottony cushion scale | 46.7 | 53.3 | 39.7 | 43.5 | 16.8 |
| 5 | Green cushion scale | 42.3 | 57.7 | 41.1 | 38.4 | 16.9 |
| 6 | Pineapple mealybug | 28.4 | 71.6 | 32.4 | 22.8 | 44.8 |
| 7 | Pink hibiscus mealybug | 29.7 | 70.3 | 37.9 | 42.8 | 19.3 |
| 8 | Guava mealybug | 33.4 | 66.6 | 36.1 | 38.2 | 25.7 |
| 9 | Castor capsule borer | 48.1 | 51.9 | 40.2 | 41.8 | 18 |
| 10 | Fruit borer | 55.7 | 44.3 | 38.7 | 37.6 | 23.7 |
| 11 | Red and black flat mite | 34.3 | 65.7 | 18.3 | 62.7 | 19 |
| 12 | False spider mite | 28.6 | 71.4 | 15.7 | 73.4 | 10.9 |
| 13 | Guava fruit fly | 34.2 | 65.8 | 0 | 0 | 100 |
| 14 | Queensland fruit fly | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 15 | Mediterranean fruit fly | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 16 | Green scale | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 17 | Coconut mealybug | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 18 | Long-tailed mealybug | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 19 | Tea mosquito bug | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 20 | Guava aphid | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 21 | Redbanded Thrips | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 22 | Anar butterfly | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |

**Table: 11- Farmers response on the vulnerable parts and infestation severity of guava plants in field condition**

| Sl. No. | Name of Insects pest | Vulnerable plants parts | | | | Severity of infestation | | |
|---|---|---|---|---|---|---|---|---|
| | | Leaf | Stem | Fruit | Root | High | Medium | Low |
| 1 | Oriental fruit fly | 0 | 0 | 100 | 0 | 38.9 | 32.4 | 28.7 |
| 2 | Peach fruit fly | 0 | 0 | 100 | 0 | 34.1 | 35.1 | 30.8 |
| 3 | Spiraling white fly | 40.2 | 32.3 | 27.5 | 0 | 23.4 | 26.5 | 50.1 |
| 4 | Cottony cushion scale | 39.4 | 28.1 | 32.5 | 0 | 22.4 | 28.8 | 48.8 |
| 5 | Green cushion scale | 35.8 | 33.4 | 30.8 | 0 | 23.4 | 27.4 | 49.2 |
| 6 | Pineapple mealybug | 36.1 | 31.2 | 32.7 | 0 | 19.1 | 19.5 | 61.4 |
| 7 | Pink hibiscus mealybug | 22 | 38.2 | 39.8 | 0 | 19.9 | 28.4 | 51.7 |
| 8 | Guava mealybug | 43.2 | 26.4 | 30.4 | 0 | 20.8 | 23.1 | 56.1 |
| 9 | Castor capsule borer | 36.4 | 41.8 | 11.8 | 0 | 21.1 | 13.7 | 65.2 |
| 10 | Fruit borer | 21.8 | 22.8 | 55.4 | 0 | 18.3 | 59.2 | 22.5 |
| 11 | Red and black flat mite | 20.1 | 36.2 | 43.7 | 0 | 16.3 | 37.9 | 45.8 |
| 12 | False spider mite | 31.6 | 32.6 | 35.8 | 0 | 19.7 | 36.2 | 44.1 |
| 13 | Guava fruit fly | 0 | 0 | 100 | 0 | 21.7 | 26.4 | 51.9 |
| 14 | Queensland fruit fly | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 15 | Mediterranean fruit fly | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 16 | Green scale | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 17 | Coconut mealybug | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 18 | Long-tailed mealybug | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 19 | Tea mosquito bug | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 20 | Guava aphid | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 21 | Redbanded Thrips | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 22 | Anar butterfly | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |

**Table 12. Farmers' response on the vector insect pest that transfer virus or other diseases**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 3612 | 53.91 |
| No | 3088 | 46.09 |
| **Total** | 6700 | 100.00 |

**Table 13. Vector insect pest that transfer virus or other diseases**

| Sl. No. | Name of Insects pest | Frequency of response | % response |
|---|---|---|---|
| 1 | Cottony cushion scale | 3118 | 46.54 |
| 2 | Green cushion scale | 2843 | 42.43 |
| 3 | Pineapple mealybug | 2217 | 33.09 |
| 4 | Pink hibiscus mealybug | 1911 | 28.52 |
| 5 | Guava mealybug | 1128 | 16.84 |

**Table 14. New insect pests of guava currently seen in the field, those were not seen in last 5 years**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 2328 | 34.75 |
| No | 4372 | 65.25 |
| **Total** | 6700 | 100.00 |

**Table 15. Newly seen insect pests of guava, those were not seen in last 5 years**

| Sl. No. | Name of Insects pest | Frequency of response | % response |
|---|---|---|---|
| 1 | Cottony cushion scale | 2284 | 34.09 |
| 2 | Green cushion scale | 2047 | 30.55 |
| 3 | Pineapple mealybug | 1864 | 27.82 |
| 4 | Pink hibiscus mealybug | 1544 | 23.04 |
| 5 | Guava mealybug | 988 | 14.75 |

**Table 16. Currently more damaging insect pests of guava in field than previous infestation**

| Sl. No. | Name of Insects pest | Frequency of response | % response |
|---|---|---|---|
| 1 | Oriental fruit fly | 5843 | 87.21 |
| 2 | Peach fruit fly | 4925 | 73.51 |
| 3 | Spiraling white fly | 4282 | 63.91 |
| 4 | Castor capsule borer | 3754 | 56.03 |
| 5 | Fruit borer | 2817 | 42.04 |
| 6 | Red and black flat mite | 1497 | 22.34 |

**Table 17. Idea about insect pests of guava entered into Bangladesh from neighboring countries, those were not seen earlier**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 2184 | 32.60 |
| No | 4516 | 67.40 |
| **Total** | 6700 | 100.00 |

**Table 18. Newly entered insect pests of guava from neighboring countries, those were not seen earlier**

| Sl. No. | Name of insects pest | Frequency of response | % response |
|---|---|---|---|
| 1 | Oriental fruit fly | 1607 | 89.58 |
| 2 | Peach fruit fly | 1495 | 68.45 |
| 3 | Spiraling white fly | 1218 | 55.77 |
| 4 | Castor capsule borer | 1165 | 53.34 |
| 5 | Red and black flat mite | 919 | 42.08 |

**Table 19. Options for controlling insect pests of guava**

| Sl. No. | Control options | Number of respondents [N=6700] | % response |
|---|---|---|---|
| 1 | Spraying of insecticides | 6512 | 97.19 |
| 2. | Bagging of guava with bag or polyethylene | 4384 | 65.43 |
| 3. | Used of Pheromone Trap to control fruit fly | 2119 | 31.63 |
| 4. | IPM management | 5886 | 87.85 |
| 5. | Application of granular insecticide during seed sowing | 5917 | 88.31 |
| 6. | By irrigation | 4167 | 62.19 |
| 7. | Remove of harmful insect especially by hand picking | 3339 | 49.84 |
| 8. | Application of balanced fertilizer | 2389 | 35.66 |
| **Multiple response** | | | |

**Table 20. Incidence of harmful diseases of guava**

| Sl. No. | Name of diseases | Pest incidence | | | |
|---|---|---|---|---|---|
| | | Yes | | No | |
| | | Number | % response | Number | % response |
| 1 | Anthracnose | 3846 | 57.40 | 2854 | 42.60 |
| 2 | Basal rot | 1971 | 29.42 | 4729 | 70.58 |
| 3 | *Diplodia netalensis* | 2563 | 38.25 | 4137 | 61.75 |
| 4 | Fruit canker | 2812 | 41.97 | 3888 | 58.03 |
| 5 | Botryosphaeria rot | 1534 | 22.90 | 5166 | 77.10 |
| 6 | Mucor rot | 1285 | 19.18 | 5415 | 80.82 |
| 7 | Root Knot Nematode | 2989 | 44.61 | 3711 | 55.39 |
| 8 | Leaf curl | 2218 | 33.10 | 4482 | 66.90 |
| 9 | Brown rot | Not recorded in Bangladesh | | | |
| 10 | Bacteriosis | Not recorded in Bangladesh | | | |
| 11 | Algal leaf and fruit spot | Not recorded in Bangladesh | | | |

**Table 21. Farmers' response on the diseases infection status and vulnerable stages of infection**

| Sl. No. | Name of Diseases | Infection status | | Vulnerable stage of plants | | |
|---|---|---|---|---|---|---|
| | | Major | Minor | Seedling | Vegetative | Fruiting |
| 1 | Anthracnose | 56.5 | 43.5 | 39.4 | 38.4 | 22.2 |
| 2 | Basal rot | 45.7 | 54.3 | 33.1 | 38.7 | 28.2 |
| 3 | *Diplodia netalensis* | 33.3 | 66.7 | 35.7 | 37.9 | 26.4 |
| 4 | Fruit canker | 39.4 | 60.6 | 36.5 | 41.8 | 21.7 |
| 5 | Botryosphaeria rot | 38.8 | 61.2 | 38.7 | 39.9 | 21.4 |
| 6 | Mucor rot | 36.5 | 63.5 | 37.9 | 42.7 | 19.4 |
| 7 | Root Knot Nematode | 31.4 | 68.6 | 36.4 | 40.7 | 22.9 |
| 8 | Leaf curl | 30.8 | 69.2 | 42.7 | 36.9 | 20.4 |
| 9 | Brown rot | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 10 | Bacteriosis | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |
| 11 | Algal leaf and fruit spot | Not recorded in Bangladesh | | Not recorded in Bangladesh | | |

**Table 22. Farmers response on the vulnerable parts and infection severity of guava plants in field condition**

| Sl. No. | Name of diseases | Vulnerable plants parts | | | | Severity of infection | | |
|---|---|---|---|---|---|---|---|---|
| | | Leaf | Stem | Fruit | Root | High | Medium | Low |
| 1 | Anthracnose | 51.2 | 13.4 | 35.4 | 0 | 30.4 | 35.7 | 33.9 |
| 2 | Basal rot | 36.4 | 38.7 | 11.4 | 13.5 | 32.5 | 38.7 | 28.8 |
| 3 | *Diplodia netalensis* | 66.5 | 22.4 | 11 | 0 | 30.4 | 33.1 | 36.5 |
| 4 | Fruit canker | 8.4 | 51.9 | 3 | 36.7 | 20.1 | 27.5 | 52.4 |
| 5 | Botryosphaeria rot | 31.5 | 37.8 | 12.3 | 18.4 | 22.4 | 26.4 | 51.2 |
| 6 | Mucor rot | 9.1 | 59.7 | 7.1 | 24.1 | 23.1 | 24.8 | 52.1 |
| 7 | Root Knot Nematode | 29.8 | 27.2 | 8.8 | 34.2 | 22.1 | 25.9 | 52 |
| 8 | Leaf curl | 64.8 | 28.1 | 7.1 | 0 | 21.7 | 24.7 | 53.6 |
| 9 | Brown rot | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 10 | Bacteriosis | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |
| 11 | Algal leaf and fruit spot | Not recorded in Bangladesh | | | | Not recorded in Bangladesh | | |

**Table 23. Farmers response on the virus or other diseases which is transmitted by insect vector**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 2148 | 32.06 |
| No | 4552 | 67.94 |
| **Total** | 6700 | 100.00 |

**Table 24. Virus or diseases which are transmitted by insect Vector**

| Sl. No. | Name of diseases | Frequency of response | % response |
|---|---|---|---|
| 1 | Leaf curl | 1983 | 1983 |
| 2 | Fruit canker | 1798 | 1798 |

**Table 25. New diseases of guava currently seen in the field, those were not seen earlier**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 2918 | 43.55 |
| No | 3782 | 56.45 |
| **Total** | 6700 | 100.00 |

**Table 26. Newly seen diseases of guava, those were not seen earlier**

| Sl. No. | Name of diseases | Frequency of response | % response |
|---|---|---|---|
| 1 | Anthracnose | 2712 | 92.94 |
| 2 | Basal rot | 2386 | 109.25 |
| 3 | *Diplodia netalensis* | 1946 | 89.10 |
| 4 | Fruit canker | 1408 | 64.47 |
| 5 | Botryosphaeria rot | 1192 | 54.58 |

**Table 27. Currently more damaging diseases pests of guava in field than previous infection**

| Sl. No. | Name of diseases pest | Frequency of response | % response |
|---|---|---|---|
| 1 | Anthracnose | 4765 | 71.12 |
| 2 | Basal rot | 3751 | 55.99 |
| 3 | *Diplodia netalensis* | 3346 | 49.94 |
| 4 | Fruit canker | 2918 | 43.55 |
| 5 | Botryosphaeria rot | 2209 | 32.97 |
| 6 | Root Knot Nematode | 1988 | 29.67 |
| 7 | Leaf curl | 1125 | 16.79 |

**Table 28. Idea about diseases pests of guava entered into Bangladesh from neighboring countries, those were not seen earlier**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 1794 | 26.78 |
| No | 4906 | 73.22 |
| **Total** | 6700 | 100.00 |

**Table 29. Newly entered diseases pests of guava from neighboring countries, those were not seen earlier**

| Sl. No. | Name of diseases pest | Frequency of response | % response |
|---|---|---|---|
| 1 | Basal rot | 1987 | 90.98 |
| 2 | *Diplodia netalensis* | 1748 | 80.04 |
| 3 | Fruit canker | 1347 | 61.68 |
| 4 | Botryosphaeria rot | 1589 | 72.76 |

**Table 30. Options for controlling diseases pests of guava**

| Sl. No. | Control options | Number of respondents [N=6700] | % response |
|---|---|---|---|
| 1 | Spraying fungicide before seed/seedling sowing | 5917 | 88.31 |
| 2. | Spraying during seed sowing | 4265 | 63.66 |
| 3. | Spraying fungicide on plant | 6219 | 92.82 |
| 4. | Application of insecticide during irrigation | 2298 | 34.30 |
| 5. | Spraying insecticide to control vector pests | 2987 | 44.58 |
| 6. | Application of organic fertilizer | 4608 | 68.78 |
| 7. | By irrigation | 6259 | 93.42 |
| 8. | Removed affected plant from the field | 6544 | 97.67 |
| 9. | By weeding | 4994 | 74.54 |
| 10. | IPM management | 5007 | 74.73 |
| 11. | Application of balanced fertilizer | 4783 | 71.39 |

**Table 31. Incidence of harmful weed in guava field**

| Sl. No. | Name of weeds | weed incidence | | | |
|---|---|---|---|---|---|
| | | Yes | | No | |
| | | Number | % response | Number | % response |
| 1 | Bermuda grass (*Durba*) | 3925 | 58.58 | 2775 | 41.42 |
| 2 | Egyptian crowfoot grass | 3485 | 52.01 | 3215 | 47.99 |
| 3 | Cogon grass | 2894 | 43.19 | 3806 | 56.81 |
| 4 | Quack grass | 2517 | 37.57 | 4183 | 62.43 |
| 5 | Indian goose grass | 2372 | 35.40 | 4328 | 64.60 |
| 6 | Johnson grass | 1994 | 29.76 | 4706 | 70.24 |
| 7 | Coat buttons | 2487 | 37.12 | 4213 | 62.88 |
| 8 | Beggar-ticks | 2759 | 41.18 | 3941 | 58.82 |
| 9 | Amaranth | 2109 | 31.48 | 4591 | 68.52 |
| 10 | Asthma herb | 2367 | 35.33 | 4333 | 64.67 |
| 11 | Horse purslane | 2676 | 39.94 | 4024 | 60.06 |
| 12 | Common Purslane | 2467 | 36.82 | 4233 | 63.18 |
| 13 | Purple nut sedge | 2957 | 44.13 | 3743 | 55.87 |
| 14 | Flat sedge | 2293 | 34.22 | 4407 | 65.78 |
| 15 | Yellow nutsedge: | 2187 | 32.64 | 4513 | 67.36 |
| 16 | Small-floweed umbrella sedge | 2851 | 42.55 | 3849 | 57.45 |
| 17 | Parthenium weed | Restricted distribution | | | |

**Table 32. Farmers' response on the weed infestation status and vulnerable stages of weed infestation**

| Sl. No. | Name of weed | Pest status | | Vulnerable stage of plants | | |
|---|---|---|---|---|---|---|
| | | Major | Minor | Seedling | Vegetative | Fruiting |
| 1 | Bermuda grass | 43.4 | 56.6 | 43.1 | 39.1 | 17.8 |
| 2 | Egyptian crowfoot grass | 36.9 | 63.1 | 42.8 | 44.7 | 12.5 |
| 3 | Cogon grass | 33.1 | 66.9 | 39.1 | 48.8 | 12.1 |
| 4 | Quack grass | 29.4 | 70.6 | 38.9 | 36.7 | 24.4 |
| 5 | Indian goose grass | 25.8 | 74.2 | 33.1 | 28.9 | 38 |
| 6 | Johnson grass | 22.7 | 77.3 | 39.4 | 37.8 | 22.8 |
| 7 | Coat buttons | 26.7 | 73.3 | 43.6 | 31.2 | 25.2 |
| 8 | Beggar-ticks | 18.6 | 81.4 | 51.8 | 36.7 | 11.5 |
| 9 | Amaranth | 34.8 | 65.2 | 48.3 | 32.8 | 18.9 |
| 10 | Asthma herb | 29.7 | 70.3 | 36.7 | 34.2 | 29.1 |
| 11 | Horse purslane | 26.4 | 73.6 | 39.4 | 36.8 | 23.8 |
| 12 | Common Purslane | 41.4 | 58.6 | 41.6 | 37.9 | 20.5 |
| 13 | Purple nut sedge | 34.6 | 65.4 | 37.6 | 35.8 | 26.6 |
| 14 | Flat sedge | 28.3 | 71.7 | 43.2 | 39.6 | 17.2 |
| 15 | Yellow nutsedge | 32.6 | 67.4 | 42.7 | 35.8 | 21.5 |
| 16 | Small-floweed umbrella sedge | 33.8 | 66.2 | 36.3 | 34.9 | 28.8 |
| 17 | Parthenium weed | Restricted distribution | | Restricted distribution | | |

**Table 33. Farmers' response on the infestation severity of guava plants in field condition**

| Sl. No. | Name of weed | Severity of infestation | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| 1 | Bermuda grass (*Durba*) | 17.8 | 25.6 | 56.6 |
| 2 | Egyptian crowfoot grass | 18.4 | 21.7 | 59.9 |
| 3 | Cogon grass | 20.4 | 22.7 | 56.9 |
| 4 | Quack grass | 19.7 | 21.4 | 58.9 |
| 5 | Indian goose grass | 21.4 | 53.8 | 24.8 |
| 6 | Johnson grass | 17.9 | 21.1 | 61 |
| 7 | Coat buttons | 18.3 | 32.7 | 49 |
| 8 | Beggar-ticks | 23.6 | 37.8 | 38.6 |
| 9 | Amaranth | 21.9 | 32.6 | 45.5 |
| 10 | Asthma herb | 22.6 | 31.7 | 45.7 |
| 11 | Horse purslane | 16.7 | 29.2 | 54.1 |
| 12 | Common Purslane | 23.7 | 36.8 | 39.5 |
| 13 | Purple nut sedge | 22.3 | 36.9 | 40.8 |
| 14 | Flat sedge | 14.7 | 23.4 | 61.9 |
| 15 | Yellow nutsedge | 23.1 | 57.2 | 19.7 |
| 16 | Small-floweed umbrella sedge | 19.6 | 36.7 | 43.7 |
| 17 | Parthenium weed | Restricted distribution | | |

**Table 34. New weed of guava currently seen in the field, those were not seen earlier**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 2843 | 42.43 |
| No | 3857 | 57.57 |
| **Total** | 6700 | 100.00 |

**Table 35. Newly seen weed of guava, those were not seen earlier**

| Sl. No. | Name of weed | Frequency of response | % response |
|---|---|---|---|
| 1 | Egyptian crowfoot grass | 2644 | 93.00 |
| 2 | Cogon grass | 2279 | 104.35 |
| 3 | Quack grass | 2117 | 96.93 |
| 4 | Indian goose grass | 1876 | 85.90 |
| 5 | Johnson grass | 1547 | 70.83 |

**Table 36. Currently more damaging weed of guava in field than previous infestation**

| Sl. No. | Name of weed | Frequency of response | % response |
|---|---|---|---|
| 1 | Bermuda grass (*Durba*) | 5984 | 89.31 |
| 2 | Egyptian crowfoot grass | 5543 | 82.73 |
| 3 | Cogon grass | 4917 | 73.39 |
| 4 | Quack grass | 4669 | 69.69 |
| 5 | Indian goose grass | 3972 | 59.28 |

**Table 37. Idea about weed of guava entered into Bangladesh from neighboring countries, those were not seen earlier**

| Type of response | Number of respondents [N=6700] | % response |
|---|---|---|
| Yes | 2388 | 35.64 |
| No | 4312 | 64.36 |
| **Total** | 6700 | 100.00 |

**Table 38. Newly entered weed from neighboring countries, those were not seen earlier**

| Sl. No. | Name of weed | Frequency of response | % response |
|---|---|---|---|
| 1 | Parthenium | 1987 | 90.98 |

**Table 39. Options for controlling weed of guava**

| Sl. No. | Control options | Number of respondents [N=6700] | % response |
|---|---|---|---|
| 1 | Weeding from field | 6455 | 96.34 |
| 2. | Spraying granular herbicide | 5964 | 89.01 |
| 3. | Weeding during field preparation | 5282 | 78.84 |
| 4. | Mulching | 3318 | 49.52 |
| 5. | By earthen-up | 4678 | 69.82 |
| **Multiple response** | | | |