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SCIENTIFIC OPINION

# Commodity risk assessment of *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings from Guatemala

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**Abstract**

The European Commission requested the EFSA Panel on Plant Health to evaluate the probability of entry of pests (likelihood of pest freedom at entry), including both, regulated and non-regulated pests, associated with unrooted cuttings of the genera *Petunia* and *Calibrachoa* produced under physical isolation in Guatemala. The relevance of any pest for this opinion was based on evidence following defined criteria, based on the methodology used for high-risk plants adapted for the specificity of this assessment. Nineteen EU regulated pests (*Bemisia tabaci*, pepper golden mosaic virus, pepper huasteco yellow vein virus, tomato severe leaf curl virus, tomato yellow leaf curl virus, tomato spotted wilt virus, *Liriomyza huidobrensis*, *Liriomyza sativae*, *Liriomyza trifolii*, *Bactericera cockerelli*, *Eotetranychus lewisi*, *Epitrix subcrinita*, *Epitrix cucumeris*, *Helicoverpa zea*, *Chloridea virescens*, *Spodoptera ornithogalli*, *Ralstonia solanacearum*, *Ralstonia pseudosolanacearum*, *Xanthomonas vesicatoria*) and one EU non-regulated (*Phenacoccus solenopsis*) pest fulfilled all relevant criteria and were selected for further evaluation. For these pests, the risk mitigation measures proposed in the technical dossier from Guatemala were evaluated taking into account the possible limiting factors, and an expert judgement is given on the likelihood of pest freedom taking into consideration the risk mitigation measures acting on the pest, including uncertainties associated with the assessment. The limited and partially conflicting information provided in the dossier contributes to the wide estimates of pest freedom. The estimated degree of pest freedom varies among the pests evaluated, with *Ralstonia* spp. (*R. solanacearum* and *R. pseudosolanacearum*) being the pest most frequently expected on the imported cuttings. The expert knowledge elicitation indicated, with 95% certainty, that between 9916 and 10,000 bags containing unrooted cuttings per 10,000 would be free of *Ralstonia* spp.

**KEYWORDS**

European Union; Plant health; plant pest; Quarantine.

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# 1 | INTRODUCTION

## 1.1 | Background and Terms of Reference as provided by European Commission

### 1.1.1 | Background

The introduction of plants for planting of Solanaceae other than seeds into the European Union (EU) is prohibited from certain origins, including the countries that have requested this derogation, as they are listed in point 18 of Annex VI to Regulation (EU) 2019/2072. In August 2021, Germany sent a request for derogation to import unrooted cuttings of *Petunia* and *Calibrachoa* produced under physical isolation in Costa Rica, Kenya and Uganda, accompanied by an application describing the production methods and the pests associated with the plants in the different third countries. A similar request has also been received from Guatemala, accompanied by a technical dossier. In support of the request, the dossier prepared by Germany and Guatemala, with the identified pests and the details of the growing conditions are submitted.

### 1.1.2 | Terms of Reference

European Food Safety Authority (EFSA) is requested, pursuant to Article 29 of Regulation (EC) No 178/2002, to provide scientific opinion(s) on the field of plant health.

In particular, EFSA is requested to assess the probability of entry of pests (likelihood of pest freedom at entry), including both, regulated (Union quarantine pests, protected zone pests, and regulated non-quarantine pests (RNQPs)) and non-regulated pests, associated with unrooted cuttings of the genera *Petunia* and *Calibrachoa* produced under physical isolation in Costa Rica, Guatemala, Kenya and Uganda.

The assessment shall include all pests present in Costa Rica, Guatemala, Kenya and Uganda that could be associated with the unrooted cuttings of the genera *Petunia* and *Calibrachoa* produced under physical isolation and could have an impact if they are introduced into the EU.

In this assessment, EFSA shall take into account the available scientific information, and in particular the scientific and technical information provided in the dossiers by Germany and Guatemala. If necessary to complete its assessment, EFSA may ask additional scientific and technical information or clarifications (e.g. regarding pests status, pests control, production sites and systems, processing and shipping) on unrooted cuttings of the genera *Petunia* and *Calibrachoa* produced under physical isolation in Costa Rica, Guatemala, Kenya and Uganda. Such information can be requested by EFSA to the National Plant Protection Organisations (NPPO's) of Costa Rica, Guatemala, Kenya, Uganda or Germany as appropriate. Following the provision of such information, EFSA shall proceed with the assessment.

## 1.2 | Interpretation of the Terms of Reference

This opinion refers only to the Guatemala dossier. The EFSA Panel on Plant Health (hereafter referred to as 'the Panel') conducted a commodity risk assessment of *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings from Guatemala following the Guidance on commodity risk assessment for the evaluation of high-risk plant dossiers (EFSA PLH Panel, 2019), taking into account the available scientific information, including the technical information provided by Guatemala.

Following an exchange with European Commission (EC), the Panel was requested to broaden the scope of the assessment to Solanaceae host plants and to include RNQP species if they are relevant.

The EU quarantine pests that are regulated as a group in the Commission Implementing Regulation (EU) 2019/2072 were considered and evaluated separately at species level.

In its evaluation the Panel:

- Checked whether the information in the technical dossier (hereafter referred to as 'the Dossier') provided by the applicant (Department of Epidemiological Surveillance and Risk Analysis of the Plant Health Directorate, Vice Ministry of Agricultural Health and Regulations, Minsitry of Agriculture, Livestock, and Food, Republic of Guatemala) was sufficient to conduct a commodity risk assessment. When necessary, additional information was requested from the applicant.
- Considered the host status of *Petunia* and *Calibrachoa* as identical because they are very closely related genera.
- Selected the relevant Union quarantine pests (as specified in Commission Implementing Regulation (EU) 2019/2072,[1] hereafter referred to as 'EU quarantine pests'), and the Regulated Non-Quarantine Pests regulated for *Petunia*, *Calibrachoa* or for solanaceous crops and potentially associated with unrooted cuttings of the commodity species (*Petunia* and/or *Calibrachoa*), or to major solanaceous crops (tomato, pepper, potato and cultivated tobacco).

[1]Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019. OJ L 319, 10.12.2019, p. 1–279.

- Included in the assessment, pests with host plant records for *Petunia* and/or *Calibrachoa*, as well as polyphagous pests with major solanaceous crops (tomato, pepper, potato and cultivated tobacco) and that were considered based, on expert judgement, likely to use *Petunia* and/or *Calibrachoa* as a host plant.
- Assessed the effectiveness of the measures described in the dossier for the selected relevant pests.

The risk assessment and its conclusions are based on the information provided in the submitted technical dossier (specific place and procedure of production) and refer to the production sites described in the same document.

Risk management decisions are not within EFSA's remit. Therefore, the Panel provided a rating based on expert judgement regarding the likelihood of pest freedom for each relevant pest given the risk mitigation measures proposed by the NPPO of Guatemala.

# 2 | DATA AND METHODOLOGIES

## 2.1 | Data provided by the NPPO of Guatemala

The Panel considered all the data and information in the Dossier provided by the NPPO of Guatemala, received from the EC on 28 February 2022. Additional information was provided by NPPO of Guatemala upon requests from EFSA, on 3 October 2022, on 14 February 2023, on 27 July 2023 and on 30 November 2023. The Dossier is managed by EFSA.

The structure and overview of the Dossier is shown in Table 1. The number of the relevant section is indicated in the opinion when referring to a specific part of the Dossier.

**TABLE 1** Structure and overview of the Dossier.

| Dossier section | Overview of contents | Filename |
|---|---|---|
| 1.0 | Technical dossier on *Petunia* and *Calibrachoa* | EFSA_Dossier - Q-2022-00238_Guatemala_Petunia & Calibrachoa.docx |
| 2.0 | Answers to request of additional information on *Petunia* and *Calibrachoa* | Annex 1 Union Europea-ingles_october 2022.pdf |
| 3.0 | Table with status of *Petunia* and *Calibrachoa* pests in Guatemala | Listado de plagas requeridas de plagas para EFSA.pdf |
| 4.0 | Additional information on immunological tests and test performed for checking the presence of viruses | oficio jhd-723-2023_letter_July.pdf |
| 5.0 | Additional information on the propagation material, production cycle and on the status of specific pests | oficio jhd-1177-2023 english_001.pdf |

The data and supporting information provided by the NPPO of Guatemala formed the basis of the commodity risk assessment.

The databases shown in Table 2 and the resources and references listed below are the main sources used by the NPPO of Guatemala to compile the Dossier (details on literature searches can be found in the Dossier Section 4.0).

**TABLE 2** Database sources used in the literature searches by NPPO of Guatemala.

| Acronym/short title | Database name and service provider | URL of database | Justification for choosing database |
|---|---|---|---|
| CABI CPC | CABI Crop Protection Compendium | https://www.cabi.org/cpc/ | Internationally recognised database |
| EPPO GD | EPPO Global Database<br>Provider: European and Mediterranean Plant Protection Organization | https://gd.eppo.int/ | Internationally recognised database |

### Other resources used by the NPPO of Guatemala

Beck, H., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & & Wood, E. F. (2018, November 6). 'Present and future Köppen-Geiger climate classification maps at 1-km resolution'. Nature Scientific Data. doi: 10.1038/sdata.20181814.

Google Earth. (2018).

Peel, M. C., Mcmahon, T., & Finlayson, B. L. (2007, October 11). Update World map of the.

Köppen-Geiger Climate Classification. Hydrology and Earth System Sciences, 11, 1633–1644. doi: 10.5194/hess-11-1633-2007

Interviews and information provided by FIDES farm staff (ORANGE-DUMMEN) on the production areas.

Interviews and information provided by DANZINGER farm staff about the production areas.

## 2.2 | Literature searches performed by EFSA

Literature searches were undertaken by EFSA to complete a list of pests potentially associated with *Petunia* and *Calibrachoa*. Two searches were combined: (i) a general search to identify pests of *Petunia* and *Calibrachoa* in different databases and (ii) a tailored search to identify whether these pests are present or not in Guatemala and the EU. The searches were run between 30 May 2022 and 11 June 2022. No language, date or document type restrictions were applied in the search strategy. The Panel used the databases indicated in Table 3 to compile the list of pests associated with *Petunia* and *Calibrachoa*. As for Web of Science, the literature search was performed using a specific, ad hoc established search string (see Appendix B). The string was run in 'All Databases' with no range limits for time or language filters. This is further explained in Section 2.3.2 pest list from Benaki Phytopathological Institute (BPI).

**TABLE 3** Databases used by EFSA for the compilation of the pest list associated to the genus *Petunia* and *Calibrachoa*.

| Database | Platform/link |
|---|---|
| Aphids on World Plants | https://www.aphidsonworldsplants.info/C_HOSTS_AAIntro.htm |
| CABI Crop Protection Compendium | https://www.cabi.org/cpc/ |
| Database of Insects and their Food Plants | https://www.brc.ac.uk/dbif/hosts.aspx |
| Database of the World's Lepidopteran Hostplants | https://www.nhm.ac.uk/our-science/data/hostplants/search/index.dsml |
| EPPO Global Database | https://gd.eppo.int/ |
| Leaf-miners | https://www.leafmines.co.uk/html/plants.htm |
| Nemaplex | https://nemaplex.ucdavis.edu/Nemabase2010/PlantNematodeHostStatusDDQuery.aspx |
| Plant Viruses Online | https://bio-mirror.im.ac.cn/mirrors/pvo/vide/famindex.htm |
| International Committee on Taxonomy of Viruses (ICTV) - Master Species List 2021 (v3) | https://talk.ictvonline.org/files/master-species-lists/m/msl/9601 |
| Scalenet | https://scalenet.info/associates/ |
| Spider Mites Web | https://www1.montpellier.inra.fr/CBGP/spmweb/advanced.php |
| USDA ARS Fungi Database | https://nt.ars-grin.gov/fungaldatabases/fungushost/fungushost.cfm |
| Index Fungorum | https://www.indexfungorum.org/Names/Names.asp |
| Mycobank | https://www.mycobank.com |
| Web of Science: All Databases (Web of Science Core Collection, CABI: CAB Abstracts, BIOSIS Citation Index, Chinese Science Citation Database, Current Contents Connect, Data Citation Index<br>FSTA, KCI-Korean Journal Database, Russian Science Citation Index, MEDLINE<br>SciELO Citation Index, Zoological Record) | https://www.webofknowledge.com |
| World Agroforestry | https://www.worldagroforestry.org/treedb2/speciesprofile.php?Spid=1749 |
| Catalog of the Cecidomyiidae (Diptera) of the world | https://www.ars.usda.gov/ARSUserFiles/80420580/Gagne_2014_World_Cecidomyiidae_Catalog_3rd_Edition.pdf |
| Catalog of the Eriophoidea (Acarina: Prostigmata) of the world. | https://www.cabi.org/isc/abstract/19951100613 |
| Global Biodiversity Information Facility (GBIF) | https://www.gbif.org/ |

Additional searches, limited to retrieve documents, were run when developing the opinion. The available scientific information, including previous EFSA opinions on the relevant pests and diseases (see pest data sheets in Appendix A) and the relevant literature and legislation (e.g. Regulation (EU) 2016/2031; Commission Implementing Regulations (EU) 2018/2019; (EU) 2018/2018 and (EU) 2019/2072) were taken into account.

## 2.3 | Methodology

When developing the opinion, the Panel followed the EFSA Guidance on commodity risk assessment for the evaluation of high-risk plant dossiers (EFSA PLH Panel, 2019).

In the first step, pests potentially associated with the commodity in the country of origin (EU regulated pests and other pests) that may require risk mitigation measures were identified. The EU non-regulated pests not known to occur in the EU were selected based on evidence of their potential impact in the EU. After the first step, all the relevant pests that may need risk mitigation measures were identified.

In the second step, the proposed risk mitigation measures for each relevant pest were evaluated in terms of efficacy or compliance with EU requirements as explained in Section 1.2.

A conclusion on the likelihood of the commodity being free from each of the relevant pest was determined and uncertainties identified using expert judgements.

Pest freedom was assessed by estimating the number of bags containing infested/infected unrooted cuttings out of 10,000 exported bags. Each bag contains between 25 and 80 unrooted cuttings.

The information provided in some sections of the Opinion are the result of the Panel interpretation of the text of the applicant Dossier.

### 2.3.1 | Commodity data

Based on the information provided by the NPPO of Guatemala the characteristics of the commodity are summarised in Section 3.

### 2.3.2 | Identification of pests potentially associated with the commodity

To evaluate the pest risk associated with the importation of the commodity from Guatemala, a pest list was compiled. The pest list is a compilation of all identified plant pests reported to be associated with all species of *Petunia* and *Calibrachoa*, and the polyphagous pests associated to major Solanaceae crops based on information provided in the Dossier Sections 1.0, 2.0, 3.0 and on searches performed by the Panel. The search strategy and search syntax were adapted to each of the databases listed in Table 3, according to the options and functionalities of the different databases and CABI keyword thesaurus.

The pest list (see Microsoft Excel® file in Appendix D) is a document that includes pests that use the host plant at a genus level (*Petunia* and *Calibrachoa*) and at family level (Solanaceae), retrieved from EPPO Global Database, CABI Crop Protection Compendium, other databases and literature searches.

Plants of *Petunia* are widely used in plant virology as experimental hosts. Therefore, many if not most available data concerning host status for plant viruses refer to laboratory tests in which *Petunia* is reported either as local host where the virus is restricted to the inoculated leaf via cell to cell movement or systemic host, where the virus spreads from the inoculated leaf to other parts of the plant via systemic/phloem movement. In this assessment, viruses recorded to infect *Petunia* or *Calibrachoa* naturally were included for further evaluation. Viruses that are reported to infect *Petunia* or *Calibrachoa* experimentally were included for further evaluation if (i) they infect *Petunia* or *Calibrachoa* systemically or (ii) they infect *Petunia* or *Calibrachoa* locally, and their biology (e.g. highly contagious viruses) or transmission mode/epidemiology (e.g. spread via mechanical spread in the field) would allow *Petunia* to act as a virus source for further spread in the field.

The notifications of interceptions of EU member states were consulted for the years 2009 to 2023 (EUROPHYT, online, from 2009 to 2020 and TRACES-NT, online, from May 2020 to March 2023, Accessed: 27/5/2023). To check whether *Petunia* and *Calibrachoa* can act as a pathway, all notifications (all origins) for *Petunia* and *Calibrachoa* were evaluated. It should be noted that the import of *Petunia* and *Calibrachoa* from Guatemala is prohibited. For each selected pest it was checked if there were notification records for Guatemala (all commodities).

The evaluation of the compiled pest list was done in two steps: first, the relevance of the EU regulated pests was evaluated (Section 4.1); second, the relevance of any other plant pest was evaluated (Section 4.2).

Pests for which limited information was available on one or more criteria used to identify them as relevant for this Opinion, e.g. on potential impact, are listed in Appendix C (list of pests that can potentially cause an effect not further assessed).

The methodology used to establish pest presence depends in part on published literature. The limited number of publications from Guatemala can lead to an underestimation of the number of pests present, particularly for viruses. A limited number of pest specific surveys may increase the uncertainty of the pest status.

### 2.3.3 | Listing and evaluation of risk mitigation measures

The proposed risk mitigation measures were listed and evaluated. When evaluating the likelihood of pest freedom at origin, the following types of potential infection/infestation sources for *Petunia* and *Calibrachoa* in nurseries and relevant risk mitigation measures were considered (see also Figure 1):

- pest entry from surrounding areas,
- pest entry with new plants/seeds,
- pest spread within the nursery.

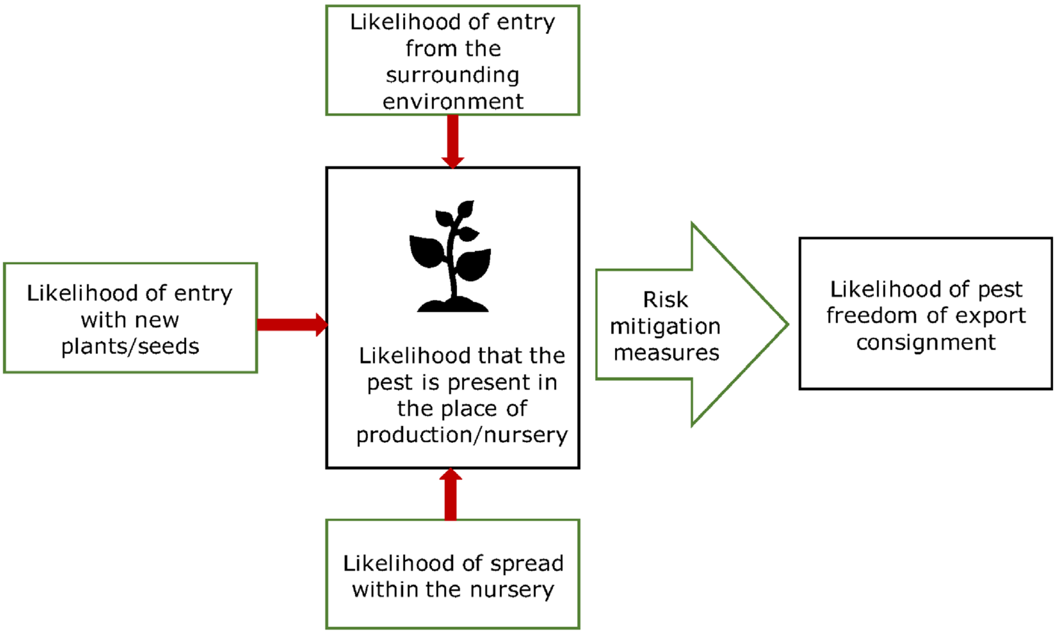


**FIGURE 1** Conceptual framework to assess likelihood that plants are exported free from relevant pests (Source: EFSA PLH Panel, 2019).

Information on the biology, estimates of likelihood of entry of the pest into the nursery and spread within the nursery, and the effect of the measures on a specific pest is summarised in pest data sheets compiled for each pest selected for further evaluation (see Appendix A).

### 2.3.4 | Expert knowledge elicitation

To estimate the pest freedom of the commodities an expert knowledge elicitation (EKE) was performed following EFSA guidance (Annex B.8 of EFSA Scientific Committee, 2018).

The specific question for EKE was defined as follows: 'Taking into account (i) the risk mitigation measures listed in the Dossier and (ii) other relevant information (reported in the specific pest datasheets), how many of 10,000 bags of *Petunia and Calibrachoa* unrooted cuttings will be infested with the relevant pest/pathogen when arriving in the EU?'

The risk assessment considers bags containing 25–80 unrooted cuttings each as the most suitable unit. The following reasoning is given:

(i) There is no quantitative information available regarding clustering of plants during production.
(ii) For the pests under consideration a cross infestation between bags during transport is not likely.

Before the elicitation, the list of pests was screened to identify pests with similar characteristics, risks, host-pest interactions, management practices in the production system. Pests with similar characteristics were grouped for a common assessment.

The uncertainties associated with the EKE were taken into account and quantified in the probability distribution applying the semi-formal method described in section 3.5.2 of the EFSA-PLH Guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018). Finally, the results were reported in terms of the likelihood of pest freedom. The lower 5% percentile of the uncertainty distribution reflects the opinion that pest freedom is with 95% certainty above this limit.

# 3 | COMMODITY DATA

## 3.1 | Description of the commodity

The commodities to be imported are unrooted cuttings (stem with leaves) of *Petunia* spp. (common name: petunia; family: Solanaceae) or *Calibrachoa* spp. (common name: calibrachoa, mini petunia; family: Solanaceae). The cuttings of *Petunia* spp. have four apical leaves developed, 2.5 cm length cuts, 1.0 cm length stem (Figure 2). The cuttings of *Calibrachoa* spp. have six leaves developed with growth point, 2.5 cm length cuts, 1.0 cm length stem (Figure 2).

The age of mother plants from which the cuttings are taken is a minimum of 3 months and a maximum of 10 months.

According to ISPM 36 (FAO, 2019) the commodity can be classified as 'unrooted cuttings'.

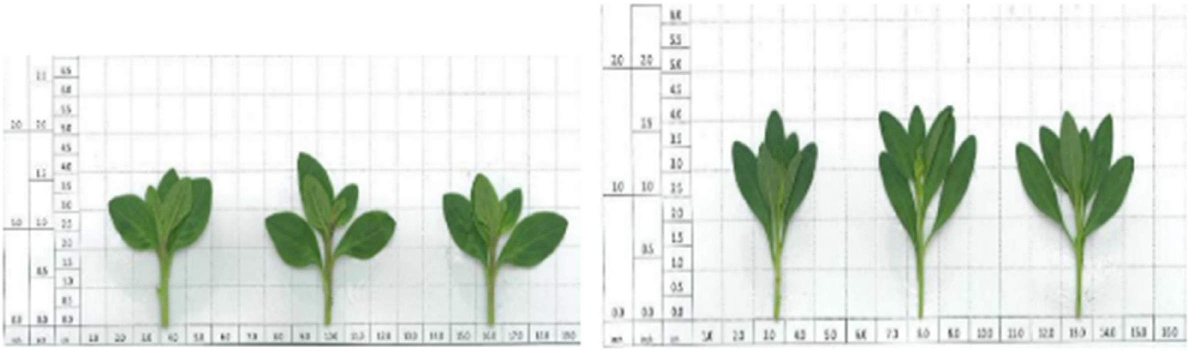

**FIGURE 2** *Petunia* spp. cuttings (on the left) and *Calibrachoa* spp. cuttings (on the right) (Source: Dossier section 1.0 and 2.0).

## 3.2 | Description of the production area

The *Petunia* spp. and *Calibrachoa* spp. production sites are located in the village of Jocotillo, Villa Canales Municipality, Guatemala and Don Gregorio Village, Santa Rosa de Lima Municipality, Santa Rosa, Guatemala (Figures 3 and 4).


**FIGURE 3** Location of production areas in relation to the territory of Guatemala (on the left) and location of the greenhouses (on the right) (Source: Google maps).

**FIGURE 4** The two production areas of the *Petunia* spp. and *Calibrachoa* spp. cuttings destined to the export to the EU (Source: Google maps).

## 3.3 | Production and handling processes

### 3.3.1 | Growing conditions

The production of unrooted cuttings takes place in screened greenhouses with thrips proof netting. The greenhouses have adjoining walls and have separated compartments to prevent the introduction and spread of pests (Figure 5). There are also double doors to enter the greenhouse.

**FIGURE 5** Greenhouse containment walls (Source: Dossier section 1.0, 2.0).

### 3.3.2 | Source of planting material

Plant material used to produce unrooted cuttings of *Petunia* and *Calibrachoa* is imported from EU (Netherlands, Germany) and non-EU countries (Israel and El Salvador). Plant material from EU countries is certified with Naktuinbouw elite system https://www.naktuinbouw.com/inspections/erkenningen/elite. In a request for additional information concerning the certification systems of imported propagation material no useful information was provided by the NPPO of Guatemala on the possible testing regime for potential viruses. This lack of information was taken into account in the expressed uncertainties in the estimation of pest freedom level of the exported material. However, Guatemala requires a Phytosanitary Certificate of Export (CFE) for imports of *Petunia* spp. and *Calibrachoa* spp.

### 3.3.3 | Production cycle

The plants used for production are obtained from tissue culture material (*in vitro*) or unrooted cuttings. The age of the mother plants from which the cuttings are taken ranges from a minimum of 3 months to a maximum of 10 months. The production process for *Petunia* spp. and *Calibrachoa* spp. crops is as follows: the basal ends of the cuttings are treated with auxins: cuttings are immersed for 5 seconds in a solution of 1500 ppm of indole-butyric acid. The cuttings are then planted into the horticultural substrate (sterilised pumice and peat, see below). One week after planting ('seed-time' as indicated in Table 4, is intended as planting time), the presence of roots is checked. Pruning is done on a weekly basis to promote vegetative growth of the plants. The beds are monitored weekly to observe if there are any damaged plants.

In the dossier two production cycles are mentioned, lasting 45 weeks or 50 weeks. Only details of the 45 weeks cycle are provided in the dossier (Table 4).[2]

**TABLE 4** Production cycle (45 weeks) of *Petunia* spp. and *Calibrachoa* spp. cuttings (Source: Dossier section 1.0 and 3.0).

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phenological stage** | Production phase | | | | | **Break** | Seed-time | Vegetative phase | | Production phase | | |

After the vegetative phase (August–September), plants keep growing and cuttings are harvested weekly (Table 4). During the production cycle strict hygienic and preventive measures are in place, such as disinfecting tools and protective clothing (Dossier section 3.0). During the production break growth beds and tools are disinfected (with chlorine 30,000 ppm) and the horticultural substrate with Metam-Sodium. Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. Metam-Sodium is applied according to the label recommendation of the product which is calculated as 0.00292 litres/bag.

Rotation between solanaceous plants and other plant species is applied in the production sites.

### 3.3.4 | Pest monitoring during production

The two companies producing *Petunia* and *Calibrachoa* unrooted cuttings for export have strict protocols in place for managing and mitigating risks of pest entry and spread.

[2]In a request for additional information, the NPPO of Guatemala provided contradictory information regarding the production cycles of the commodities. In this evaluation, the Panel considered the production cycles described in the initial dossier (Dossier section 1) as valid.

The farms are monitored monthly by personnel of the Directorate of Plant Health of the Ministry of Agriculture, Livestock and Food through the Comprehensive Program of Agricultural and Environmental Protection (PIPAA). The PIPAA programme verifies compliance with good agricultural practices and compliance with phytosanitary measures for products that are under the official programme. In addition to this, the farms have an internal surveillance procedure carried out at weekly basis, which consists of the inspection of the production beds and yellow sticky insect traps placed within the production areas.

Before export the final inspection is done by the Regional International Agency for Agricultural Health (OIRSA).

### 3.3.5 | Post-harvest processes and export procedure

Once harvested, the unrooted cuttings of *Petunia* and *Calibrachoa* are placed in plastic bags (25 or 80 cuttings per bag) and transferred to cardboard boxes and stored in cold rooms (Table 5). The packed product is transported to the Air Express Customs in refrigerated containers at temperatures between 10°C and 12°C and sent by flight to the destination country always maintaining the cold chain.

The estimated export volume for the EU is 110 million units (cuttings) throughout the year, having a peak during the months from December to April.

**TABLE 5** Number of cuttings per packing unit.

| Product | Large box capacity | Small box capacity | Room box capacity |
|---|---|---|---|
| *Calibrachoa* spp. | 22,400 units per box (80 cuttings per bag) | 11,200 units per box (80 cuttings per bag) | 5600 units per box (80 cuttings per bag) |
| *Petunia* spp. | 8400 units per box (25 cuttings per bag) | 4200 units per box (25 cuttings per bag) | 2100 units per box (25 cuttings per bag) |

# 4 | IDENTIFICATION OF PESTS POTENTIALLY ASSOCIATED WITH THE COMMODITY

The search for potential pests associated with unrooted cuttings of *Petunia* spp. or *Calibrachoa* spp. resulted in 465 species (see Microsoft Excel® file in Appendix D).

## 4.1 | Selection of relevant EU regulated pests associated with the commodity

The EU listing of Union quarantine pests and protected zone quarantine pests (Commission Implementing Regulation (EU) 2019/2072) is based on assessments concluding that the pests can enter, establish, spread and have potential impact in the EU.

Thirty eight EU regulated (QPs, RNQPs, emergency measures and PZ) species that are present in Guatemala and reported to use *Petunia* spp. or *Calibrachoa* spp. were evaluated for their relevance of being included in this opinion (Table 6, Appendix D).

The relevance of an EU quarantine pest for this opinion was based on evidence that:

a. the pest is present in Guatemala;
b. *Petunia* spp. or *Calibrachoa* spp. are a potential host of the pest;
c. one or more life stages of the pest can be associated with the specified commodity.

For pests regulated as RNQPs only the ones regulated for solanaceous crops were selected for further evaluation. In Table 6, an overview is given of the conclusion for the 38 EU regulated pests that are known to use solanaceous host plants. Nineteen EU regulated pests were selected for further evaluation.

**TABLE 6** Overview of the evaluation of the 38 EU regulated pests present in Guatemala (QPs, RNQPs, emergency measures and PZ) known to use solanaceous host plants or specifically *Petunia* spp. and *Calibrachoa* spp. or for their relevance for this Opinion.

| EPPO code | Pest species | Group | EU-Q status | RNQP info | *Petunia/Calibrachoa* as host | Conclusion |
|---|---|---|---|---|---|---|
| LIBEAS | *'Candidatus* Liberibacter asiaticus' | Bacteria | A1 Quarantine pest (Annex II A) | | No | *Petunia* as host unlikely |
| RALSPS | *Ralstonia pseudosolanacearum* | Bacteria | A1 Quarantine pest (Annex II A) | | Likely | ACTIONABLE |
| RALSSL | *Ralstonia solanacearum* | Bacteria | A2 Quarantine pest (Annex II B) | | Likely | ACTIONABLE |
| LIBEPS | *'Candidatus* Liberibacter solanacearum' | Bacteria | RNQP (Annex IV) | *Solanum* | Uncertain | Reserve list (host status) |
| XANTVE | *Xanthomonas vesicatoria* | Bacteria | RNQP (Annex IV) | *Capsicum, Solanum* | Uncertain | ACTIONABLE |
| GLOMGO | *Glomerella gossypii* | Fungi | PZ Quarantine pest (Annex III) | | No | *Petunia* as host unlikely |
| VERTAA | *Verticillium albo-atrum* | Fungi | RNQP (Annex IV) | *Corylus, Cydonia, Fragaria, Malus, Pyrus* | No | RNQP (No Solanaceae) |
| EOTELE | *Eotetranychus lewisi* | Mite | A1 Quarantine pest (Annex II A) | | Likely | ACTIONABLE |
| ALECWO | *Aleurocanthus woglumi* | Insect | A1 Quarantine pest (Annex II A) | | No | *Petunia* as host unlikely |
| ANSTFR | *Anastrepha fraterculus* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| ANSTLU | *Anastrepha ludens* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| ANTHEU | *Anthonomus eugenii* | Insect | A1 Quarantine pest (Annex II A) | | Yes | Not a pathway |
| PARZCO | *Bactericera cockerelli* | Insect | A1 Quarantine pest (Annex II A) | | Yes | ACTIONABLE |
| BEMITA | *Bemisia tabaci* | Insect | A1 Quarantine pest (Annex II A) | | Yes | ACTIONABLE |
| DIABUH | *Diabrotica undecimpunctata howardi* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| DIABVZ | *Diabrotica virgifera zeae* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| HELIZE | *Helicoverpa zea* | Insecta | A1 Quarantine pest (Annex II A) | | Likely | ACTIONABLE |
| GNORLY | *Keiferia lycopersicella* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| LIRISA | *Liriomyza sativae* | Insect | A1 Quarantine pest (Annex II A) | | Yes | ACTIONABLE |
| PHRDMU | *Phyrdenus muriceus* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| RHYCPA | *Rhynchophorus palmarum* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| LAPHFR | *Spodoptera frugiperda* | Insect | A1 Quarantine pest (Annex II A) | | No | *Petunia* as host unlikely |
| TECASO | *Tecia solanivora* | Insect | A1 Quarantine pest (Annex II A) | | No | Not a pathway |
| TOXOCI | *Aphis citricidus* | Insect | A2 Quarantine pest (Annex II B) | | No | *Petunia* as host unlikely |
| HELIVI | *Chloridea virescens* | Insect | Emergency measures | | Likely | ACTIONABLE |
| EPIXCU | *Epitrix cucumeris* | Insect | Emergency measures | | Yes | ACTIONABLE |
| EPIXSU | *Epitrix subcrinita* | Insect | Emergency measures | | Likely | ACTIONABLE |
| PRODOR | *Spodoptera ornithogalli* | Insect | Emergency measures | | Yes | ACTIONABLE |
| LPTNDE | *Leptinotarsa decemlineata* | Insect | PZ Quarantine pest (Annex III) | | Yes | Not a pathway |
| LIRIHU | *Liriomyza huidobrensis* | Insect | PZ Quarantine pest (Annex III) | | Yes | ACTIONABLE |

**TABLE 6** (Continued)

| EPPO code | Pest species | Group | EU-Q status | RNQP info | *Petunia*/*Calibrachoa* as host | Conclusion |
|---|---|---|---|---|---|---|
| **LIRITR** | *Liriomyza trifolii* | Insect | PZ Quarantine pest (Annex III) | | Yes | ACTIONABLE |
| **MELGMY** | *Meloidogyne enterolobii* | Nematode | A1 Quarantine pest (Annex II A) | | Yes | Not a pathway |
| **PEPGMV** | Pepper golden mosaic virus[a] | Viruses and viroids | A1 Non-EU Begomovirus | | Likely | ACTIONABLE |
| **PHYVV0** | Pepper huasteco yellow vein virus | Viruses and viroids | A1 Non-EU Begomovirus | | Likely | ACTIONABLE |
| **SLCV00** | Squash leaf curl virus | Viruses and viroids | A1 Non-EU Begomovirus | | No | *Petunia* as host unlikely |
| **TOSLCV** | Tomato severe leaf curl virus | Viruses and viroids | A1 Non-EU Begomovirus | | Likely | ACTIONABLE |
| **TYLCV0** | Tomato yellow leaf curl virus | Viruses and viroids | RNQP (Annex IV) | *Solanum* | Yes | ACTIONABLE |
| **TSWV00** | Tomato spotted wilt virus | Viruses and viroids | RNQP (Annex IV) | *Solanum* | Yes | ACTIONABLE |

[a]According to the NPPO of Guatemala Pepper golden mosaic virus is not present, however according to EPPO GD Pepper golden mosaic virus is present in Guatemala (see also Appendix A.2. Begomoviruses).

## 4.2 | Selection of other relevant pests (non-regulated in the EU) associated with the commodity

The information provided by the NPPO of Guatemala, integrated with the search EFSA performed, was evaluated in order to assess whether there are other relevant pests potentially associated with unrooted cuttings of *Petunia* spp. or *Calibrachoa* spp., present in the country of export. For these potential pests that are not regulated in the EU, pest risk assessment information on the probability of introduction, establishment, spread and impact is usually lacking. Therefore, these non-regulated pests that are potentially associated with *Petunia* spp. and *Calibrachoa* spp. were also evaluated to determine their relevance for this opinion based on evidence that:

a. the pest is present in Guatemala;
b. the pest (i) is absent or (ii) has a limited distribution in the EU and it is under official control at least in one of the MSs where it is present;
c. *Petunia* spp. or *Calibrachoa* spp. are a potential host of the pest; one or more life stages of the pest can be associated with the specified commodity;
d. the pest may have an impact in the EU.

Pests that fulfilled all five criteria were selected for further evaluation.

Based on the information collected, 227 potential pests not regulated in the EU, known to be associated with solanaceous host plants or potentially associated with *Petunia* spp. and *Calibrachoa* spp. were evaluated for their relevance to this opinion. Details can be found in the Appendix D (Microsoft Excel® file). Of the evaluated EU non-regulated pests, one species (*Phenacoccus solenopsis)* was selected for further evaluation. More information on these pest species can be found in the pest datasheets (Appendix A).

## 4.3 | Summary of pests selected for further evaluation

Twenty pests that were identified to be present in Guatemala and having potential for association with unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. destined for export are listed in Table 7. The efficacy of the risk mitigation measures applied to the commodity was evaluated for these selected pests.

**TABLE 7** List of relevant pests selected for further evaluation.

| Number | Current scientific name | EPPO code | Taxonomic information | Group | Cluster | Regulatory status |
|---|---|---|---|---|---|---|
| 1 | *Bemisia tabaci* | BEMITA | Hemiptera Aleyrodidae | Insect | | EU Quarantine pest (non-European populations) |
| 2 | Pepper golden mosaic virus (PepGMV) | PEPGMV | Geminiviridae Begomovirus | Virus | Begomovirus | EU Quarantine pest |
| 3 | Pepper huasteco yellow vein virus (PHYVV) | PHYVV0 | Geminiviridae Begomovirus | Virus | Begomovirus | EU Quarantine pest |
| 4 | Tomato severe leaf curl virus (ToSLCV) | TOSLCV | Geminiviridae Begomovirus | Virus | Begomovirus | EU Quarantine pest |
| 5 | Tomato yellow leaf curl virus (TYLCV) | TYLCV0 | Geminiviridae Begomovirus | Virus | Begomovirus | Regulated Non-Quarantine Pest |
| 6 | Tomato spotted wilt virus (TSWV) | TSWV00 | Tospoviridae Orthotospovirus | Virus | Orthotospovirus | Regulated Non-Quarantine Pest |
| 7 | *Liriomyza huidobrensis* | LIRIHU | Diptera Agromyzidae | Insect | Leafminers | Protected Zone Quarantine Pests (Annex III) |
| 8 | *Liriomyza sativae* | LIRISA | Diptera Agromyzidae | Insect | Leafminers | Protected Zone Quarantine Pests (Annex III) |
| 9 | *Liriomyza trifolii* | LIRTR | Diptera Agromyzidae | Insect | Leafminers | Protected Zone Quarantine Pests (Annex III) |
| 10 | *Bactericera cockerelli* | PARZCO | Hemiptera Triozidae | Insect | | EU Quarantine pest |
| 11 | *Phenacoccus solenopsis* | PHENSO | Hemiptera Pseudococcidae | Insect | | Not regulated in the EU |

**TABLE 7** (Continued)

| Number | Current scientific name | EPPO code | Taxonomic information | Group | Cluster | Regulatory status |
|---|---|---|---|---|---|---|
| 12 | *Eotetranychus lewisi* | EOTELE | Acarida Tetranychidae | Mite | | EU Quarantine pest |
| 13 | *Epitrix subcrinita* | EPIXSU | Coleoptera Chrysomelidae | Insect | Epitrix | Emergency measures |
| 14 | *Epitrix cucumeris* | EPIXCU | Coleoptera Chrysomelidae | Insect | Epitrix | Emergency measures |
| 15 | *Helicoverpa zea* | HELIZE | Lepidoptera Noctuidae | Insect | Moth | EU Quarantine pest |
| 16 | *Chloridea virescens* | HELIVI | Lepidoptera Noctuidae | Insect | Moth | Emergency measures |
| 17 | *Spodoptera ornithogalli* | PRODOR | Lepidoptera Noctuidae | Insect | Moth | Emergency measures |
| 18 | *Ralstonia solanacearum* | EALSSL | Burkholderiales Burkholderiaceae | Bacteria | Ralstonia | EU Quarantine pest |
| 19 | *Ralstonia pseudosolanacearum* | RALSPS | Burkholderiales Burkholderiaceae | Bacteria | Ralstonia | EU Quarantine pest |
| 20 | *Xanthomonas vesicatoria* | XANTVE | Lysobacterales Lysobacteraceae | Bacteria | | Regulated Non-Quarantine Pest |

## 4.4 | List of potential pests not further assessed

From the list of pests not selected for further evaluation, the Panel highlighted 21 species (see Appendix C) for which currently available evidence provides no reason to select these species for further evaluation in this Opinion. In particular for the 19 viruses selected there is uncertainty on the pest status in the export country due to the absence of specific surveillance and testing. A specific justification of the inclusion in this list is provided for each species in Appendix C.

# 5 | RISK MITIGATION MEASURES

For each selected pest (Table 7) the Panel assessed the possibility that it could be present in nurseries producing *Petunia* spp. and *Calibrachoa* spp.

The information used in the evaluation of the efficacy of the risk mitigation measures is summarised in a pest data sheet (see Appendix A).

## 5.1 | Possibility of pest presence in the export nurseries

For each selected pest (Table 7) the Panel evaluated the likelihood that the pest could be present in a *Petunia* spp. or *Calibrachoa* spp. nursery by evaluating the possibility that *Petunia* spp. or *Calibrachoa* spp. plants in the export nursery are infested either by:

- introduction of the pest from the environment surrounding the nursery,
- introduction of the pest with new plants/seeds,
- spread of the pest within the nursery.

## 5.2 | Risk mitigation measures proposed

With the information provided by the NPPO Guatemala (Dossier sections 1.0, 2.0 and 3.0), the Panel summarised the risk mitigation measures (see Table 8) that are currently applied in the production nursery.

**TABLE 8** Overview of currently applied risk mitigation measures for *Petunia* and *Calibrachoa* spp. unrooted cuttings designated for export to the EU from Guatemala.

| | Risk mitigation measures | Current measures in Guatemala |
|---|---|---|
| 1 | Growing plants in isolation | The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination. |
| 2 | Dedicated hygiene measures | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Each unit has a specific set of clothes including a disinfection area. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. |
| 3 | Soil treatment | The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |
| 4 | Quality of source plant material | The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (see Section 3.3.2). No details are provided. |
| 5 | Crop rotation | The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| 6 | Disinfection of irrigation water | A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and hydrochloric acid (HCl) to produce chlorine dioxide ($ClO_2$). |
| 7 | Pest monitoring and inspections | Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects.<br>Every week a scouting is done for detection of abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks. |
| 8 | Pesticide treatment | Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0). |
| 9 | Sampling and testing | *Petunia* and *Calibrachoa* plants are laboratory tested using serological techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the respective digital export certificate. The samples are sent to the laboratory each 6–8 weeks to test for viruses. |
| 10 | Packing and handling procedures | The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* spp. and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| 11 | Official supervision by NPPO | Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO. |
| 12 | Surveillance of production area | The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided in the dossier and in the requested additional information. |

**TABLE 9** List of pesticides used in the nursery producing *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings as specified in the dossier.

| Active ingredient or biological agent | Group |
|---|---|
| Acephate | Insects (whiteflies, thrips) |
| Azadiractin | Acari, insects (broad mites, spider mites, thrips, whiteflies) |
| Azoxystrobin | Fungi (downy mildew, powdery mildew, *Alternaria, Sclerotium, Rhizoctonia*, white rust, anthracnosis, *Myrothecium*) |
| *Beauveria bassiana* | Acari, insects (broad mites, thrips, aphids, spider mites) |
| Boscalid + Pyraclostrobin | Fungi (*Botrytis*, downy mildew, powdery mildew, *Alternaria*, *Myrothecium*) |
| Carbendazim | Fungi (*Botrytis*, fungi leave spots, anthracnosis, damping off) |
| Formetanate Hydrochloride | Acari, insects (whiteflies, thrips, aphids, broad mites) |
| Chlorothalonil | Fungi and oomycetes (*Botrytis*, downy mildew, powdery mildew, *Alternaria*, *Phytophthora*, rust, fungi leave spots, *Myrothecium*) |
| Copper | Bacteria, fungi and oomycetes (*Alternaria*, *Phytophthora*) |

**TABLE 9** (Continued)

| Active ingredient or biological agent | Group |
|---|---|
| Diafenthurion | Acari, insects (broad mites, thrips, aphids, spider mites) |
| Emamecetin benzoate | Insects (larvae, thrips, spider mites) |
| Folpet | Fungi (*Botrytis*, *Phytophthora*) |
| Lambda-Cyhalotrin | Insects (whiteflies, thrips, larvae, aphids, leaf minador) |
| Metalaxyl + Mancozeb | Fungi and oomycetes (downy mildew, *Phytophthora*, *Pythium*) |
| Methiocarb | Gastropoda, insects (thrips, spider mites, aphids, slugs) |
| Myclobutanil | Fungi and oomycetes (powdery and downy mildew, *Alternaria*, rust, fungi leave spots) |
| Pyridalyl | Insects |
| Spinoace | Insects |
| Thiocyclam hydrogen oxalate | Insects |
| Thiophanate-Methyl | Fungi |

## 5.3 | Evaluation of the current measures for the selected pests including uncertainties

The relevant risk mitigation measures acting on the selected pests were identified. Any limiting factors on the efficacy of the measures were documented. All the relevant information including the related uncertainties deriving from the limiting factors used in the evaluation are summarised in the pest datasheets provided in Appendix A.

Based on this information, an expert judgement has been given for the likelihood of pest freedom of the commodity taking into consideration the risk mitigation measures acting on the pest and their combination.

An overview of the evaluation of the selected pests is given in the sections below (Sections 5.3.1–5.3.11). The outcome of EKE on pest freedom after the evaluation of the proposed risk mitigation measures is summarised in the Section 5.3.12.

### 5.3.1 | Overview of the evaluation of *Bemisia tabaci*

| **Rating of the likelihood of pest freedom** | **Pest free with few exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9946 out of 10,000 bags | 9980 out of 10,000 bags | 9990 out of 10,000 bags | 9995out of 10,000 bags | 9998 out of 10,000 bags |
| **Proportion of infested bags** | 2 out of 10,000 bags | 5 out of 10,000 bags | 10 out of 10,000 bags | 20 out of 10,000 bags | 54 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>*Bemisia tabaci* is a polyphagous whitefly present in Guatemala and reported occurring in many horticultural crops. Certain *Petunia* species (*Petunia* sp., *P. axillaris*, *P. grandiflora*, *P. integrifolia*, *P. hybrida*) and *Calibrachoa* sp. are reported as Solanaceae host plants for *B. tabaci* (EPPO, online). The pest can be present on host plant species in the neighbouring environment of the nursery producing *Petunia* spp. and *Calibrachoa* spp. cuttings for export to the EU. The pest is very small (1 mm) and can enter the production greenhouse through defects in the greenhouse structure or through hitchhiking on nursery workers. Eggs and nymphs may be present on the harvested cuttings.<br>**Measures taken against the pest and their efficacy**<br>The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). The mother plants used for cutting production are grown in dedicated greenhouses, enclosed with thrips proof nets. Ventilation areas are all screened. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit. The production place is monitored for the presence of pests on a weekly basis by nursery staff. There are regular pesticide treatments with products effective against *B. tabaci*. The NPPO does regular inspections in the greenhouse ensuring compliance with the EU import requirements for *B. tabaci*.<br>**Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings.<br>**Main uncertainties**<br>– No details about the results of surveillance activities on the presence and population pressure of *B. tabaci* in the neighbouring environment of the nursery were provided.<br>– The presence of defects in the greenhouse structure.<br>– There is no detailed information on inspection frequency and design prevalence. | | | | |

## 5.3.2 | Overview of the evaluation of Begomoviruses

| Rating of the likelihood of pest freedom | **Pest free with few exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9974 out of 10,000 bags | 9988 out of 10,000 bags | 9995 out of 10,000 bags | 9998 out of 10,000 bags | 10,000 out of 10,000 bags |
| **Proportion of infested bags** | 0 out of 10,000 bags | 2 out of 10,000 bags | 5 out of 10,000 bags | 12 out of 10,000 bags | 26 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>Pepper huasteco yellow vein virus (PHYVV) and tomato severe leaf curl virus (ToSLCV) are present in Guatemala, while for tomato yellow leaf curl virus (TYLCV) and pepper golden mosaic virus (PepGMV) there are uncertainties concerning their presence and distribution in the country. The natural host range of begomoviruses includes members of the Solanaceae and also from other families; for ToSLCV and TYLCV there is evidence that *Petunia* is a host. *Bemisia tabaci*, the vector of these viruses, is reported to be widespread in Guatemala. The main pathway of entrance of the virus from the surrounding environment in the nursery is through viruliferous *B. tabaci* insects.<br>**Measures taken against the pest and their efficacy**<br>The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). The mother plants used for cutting production are grown in dedicated greenhouses, enclosed with plastic on the roofs and walls. Ventilation areas are all screened. The plastic cover and screens are checked twice per week for holes or cuts. All greenhouses have double doors with an air stream flowing out of the greenhouse when a door is opened. There are hygienic measures in place for nursery workers entering the production unit. The production place is monitored for the presence of pests on a weekly basis by nursery staff. There are regular insecticide treatments with products effective against *B. tabaci*. The NPPO does regular inspections in the greenhouse including the area surrounding the nurseries to ensure compliance with the EU import requirements for *B. tabaci*. Solanaceous plants for export are rotated each season between greenhouses to reduce the risk of pest infection. *Petunia* spp. and *Calibrachoa* spp. plants are regularly inspected for symptoms and tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). However, begomoviruses are not mentioned in the list of virus species tested.<br>**Shortcomings of current measures/procedures**<br>No other major shortcomings were identified in the evaluation with the notable exception of begomovirus monitoring. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported cuttings.<br>**Main uncertainties**<br>– No details about the results of surveillance activities on the presence and population pressure of *B. tabaci* and begomoviruses in the neighbouring environment of the nursery were provided.<br>– The presence of defects in the greenhouse structure.<br>– There is no detailed information on inspection frequency and design prevalence. | | | | |

## 5.3.3 | Overview of the evaluation of tomato spotted wilt virus

| Rating of the likelihood of pest freedom | **Pest free with some exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9927 out of 10,000 bags | 9952 out of 10,000 bags | 9976 out of 10,000 bags | 9992 out of 10,000 bags | 9999 out of 10,000 bags |
| **Proportion of infested bags** | 1 out of 10,000 bags | 8 out of 10,000 bags | 24 out of 10,000 bags | 48 out of 10,000 bags | 73 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>Tomato spotted wilt virus (TSWV infects *Petunia*, tomato, pepper and potato; *Calibrachoa* is expected to be host to both species. TSWV, although not reported it is expected to be present in Guatemala as it is known to have a worldwide distribution and is it reported in all neighbouring countries.<br>TSWV is transmitted by thrips species reported to be widespread in Guatemala. Thrips species are highly polyphagous and can reach high populations on Solanaceae crops. The main pathway of entrance of the virus from the surrounding environment in the nursery is through viruliferous thrips. | | | | |

(Continued)

| | |
|---|---|
| | **Measures taken against the pest and their efficacy**<br>The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). The mother plants used for cutting production are grown in dedicated greenhouses, enclosed with plastic on the roofs and walls. Ventilation areas are all screened. The plastic cover and screens are checked twice per week for holes or cuts. All greenhouses have double doors with an air stream flowing out of the greenhouse when a door is opened. There are hygienic measures in place for nursery workers entering the production unit. The production place is monitored for the presence of pests on a weekly basis by nursery staff. There are regular insecticide treatments with products effective against thrips. The NPPO does regular inspections in the greenhouse including the area surrounding the nurseries to ensure compliance with the EU import requirements for thrips. Solanaceous crops are rotated each season between greenhouses to reduce the risk of pest infection. *Petunia* and *Calibrachoa* plants are regularly inspected for symptoms and tested using serological based techniques for viruses (including INSV and TSWV) and bacteria in different plant production stages (arrival, propagation, production). Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate.<br>**Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported cuttings.<br>**Main uncertainties**<br>– No details on the presence and population pressure of TSWV and thrips in the neighbouring environment of the nursery were provided.<br>– The presence of defects in the greenhouse structure.<br>– There is no detailed information on inspection frequency and design. |

## 5.3.4 | Overview of the evaluation of leafminers

| **Rating of the likelihood of pest freedom** | **Pest free with few exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9962 out of 10,000 bags | 9983 out of 10,000 bags | 9992 out of 10,000 bags | 9997 out of 10,000 bags | 9999 out of 10,000 bags |
| **Proportion of infested bags** | 1 out of 10,000 bags | 3 out of 10,000 bags | 8 out of 10,000 bags | 17 out of 10,000 bags | 38 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>The three leafminer species *Liriomyza huidobrensi, L. sativae* and *L. trifolii* are present in Guatemala and are highly polyphagous as they develop in many crops. *Petunia* and other Solanaceous plants such as tomato and pepper are reported to be hosts.<br>It is possible that local populations of leafminers are present in the neighbouring environment from which leafminer adults can spread over short distances through flight or wind assisted dispersal through defects in the greenhouse structure. Planting material is believed to be a key factor in their long-distance dispersal. When present in the greenhouse, flying adults can spread from infested host plants species within the nursery. Eggs and feeding larvae may be present on leaves of harvested unrooted cuttings.<br>**Measures taken against the pest and their efficacy**<br>Plants in the greenhouse are protected from leafminers that may enter by netting. The imported plant material from Germany, the Netherlands, El Salvador and is reported to be certified (no details provided). Plants in the greenhouse are protected from leafminers that may enter from the surrounding environment by netting. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. All greenhouses have double doors and there is a separation between the different vaults of the greenhouses to limit possible dispersion of the pest. There are hygienic measures in place (e.g. for nursery workers entering the production unit and for the tools used). The production place is monitored for the presence of pests on a weekly basis. There are regular insecticide treatments with products effective against leafminers. The NPPO does regular inspections in the greenhouse ensuring the compliance with the EU import requirements.<br>**Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported unrooted cuttings.<br>**Main uncertainties**<br>– No details on the presence and population pressure of leafminers in the neighbouring environment of the nursery.<br>– The presence of defects in the greenhouse structure.<br>– The efficiency of the hygienic measures, monitoring, inspection, surveillance and the (timing of) the applied insecticides. | | | | |

### 5.3.5 | Overview of the evaluation of *Bactericera cockerelli*

| **Rating of the likelihood of pest freedom** | **Pest free with few exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9964 out of 10,000 bags | 9987 out of 10,000 bags | 9994 out of 10,000 bags | 9997 out of 10,000 bags | 9999 out of 10,000 bags |
| **Proportion of infested bags** | 1 out of 10,000 bags | 3 out of 10,000 bags | 6 out of 10,000 bags | 13 out of 10,000 bags | 36 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>*Bactericera cockerelli* is an EU Quarantine pest reported to be widespread in Guatemala. It is a polyphagous pest and mainly Solanaceous plants are hosts, but it has not been reported to feed on neither *Petunia* spp. nor *Calibrachoa* spp. plants. However the Panel assumes that *Petunia* spp. and *Calibrachoa* spp. are likely to be host plants.<br>This potato psyllid is a small phloem-feeding and polyvoltine insect. *B. cockerelli* is a good flyer and can spread over long distances by wind. In addition, imported mother plants may also be a possible pathway for the pest to enter the greenhouse. Specifically, *B. cockerelli* is present in El Salvador, one of the countries from which mother plants are originating. When present in the greenhouse, flying adults can spread from infested host plants species within the nursery. Eggs, nymphs and adults may be present on hosts plants.<br>**Measures taken against the pest and their efficacy**<br>Insect proof netting prevents *B. cockerelli* from entering the greenhouse. The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. All greenhouses have double doors and there is a separation between the different vaults of the greenhouses to limit possible dispersion of the pest. There are hygienic measures in place (e.g. for nursery workers entering the production unit and for the tools used). The production place is monitored for the presence of pests on a weekly basis. There are regular insecticide treatments with products effective against *B. cockerelli*. The NPPO does regular inspections in the greenhouse ensuring the compliance to with the EU import requirements.<br>**Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported unrooted cuttings.<br>**Main uncertainties**<br>– The host status of *Petunia* spp. and *Calibrachoa* spp. for *B. cockerelli*.<br>– No details on the abundance of the species in El Salvador.<br>– The presence of defects in the greenhouse structure.<br>– The efficiency of the hygienic measures, monitoring, inspection, surveillance and the (timing of) the applied insecticides. | | | | |

### 5.3.6 | Overview of the evaluation of *Phenacoccus solenopsis*

| **Rating of the likelihood of pest freedom** | **Pest free with few exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9947 out of 10,000 bags | 9980 out of 10,000 bags | 9990 out of 10,000 bags | 9995 out of 10,000 bags | 9998 out of 10,000 bags |
| **Proportion of infested bags** | 2 out of 10,000 bags | 5 out of 10,000 bags | 10 out of 10,000 bags | 20 out of 10,000 bags | 53 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>*Phenacoccus solenopsis* is a highly invasive and polyphagous scale present in Guatemala. Given the wide host range of this pest it is possible that local populations of *P. solenopsis* may be present in the neighbouring environment. *Petunia* is reported among the host of *P. solenopsis*. The crawlers have been reported to be commonly dispersed by wind for distances ranging from a few meters to several kilometres.<br>Possible pathways of entry for mealybugs are plant materials of any kind (hiding in a protected site – on the bark, roots, stems and leaves), human transportation, irrigation water, wind, animals and ants.<br>**Measures taken against the pest and their efficacy**<br>Plants in the greenhouse are protected from *P. solenopsis* that may enter by netting. The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. All greenhouses have double doors and there is a separation between the different vaults of the greenhouses to limit possible dispersion of the pest. There are hygienic measures in place (e.g. for nursery workers entering the production unit and for the tools used). The production place is monitored for the presence of pests on a weekly basis. There are regular insecticide treatments with products effective against *P. solenopsis*. The NPPO does regular inspections in the greenhouse ensuring compliance to the EU import requirements. The pest is relatively easy to detect (honeydew) and may be controlled by nurseries with standard insecticide treatments. | | | | |

(Continued)

| | |
|---|---|
| | **Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings.<br>**Main uncertainties**<br>– No details about the results of surveillance activities on the presence and population pressure of *P. solenopsis* in the neighbouring environment of the nursery were provided.<br>– The presence of defects in the greenhouse structure.<br>– There is no detailed information on inspection frequency and design. |

## 5.3.7 | Overview of the evaluation of *Eotetranychus lewisii*

| **Rating of the likelihood of pest freedom** | **Pest free with few exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9959 out of 10,000 bags | 9986 out of 10,000 bags | 9995 out of 10,000 bags | 9998 out of 10,000 bags | 9999 out of 10,000 bags |
| **Proportion of infested bags** | 1 out of 10,000 bags | 2 out of 10,000 bags | 5 out of 10,000 bags | 14 out of 10,000 bags | 41 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>*Eotetranychus lewisi* is a highly polyphagous pest. Given the wide host range of this pest it is possible that local populations of *E. lewisi* may be present in the neighbouring environment. Although this mite has not been reported to feed on *Petunia* spp. and *Calibrachoa* spp. plants, given its polyphagous nature, including Solanaceous host plants, *Petunia/Calibrachoa* could be suitable host plants.<br>Spider mites are dispersed by wind currents in the field, so they may enter the nursery from host plants that might be present in the surrounding environment. Defects in the insect proof structure of the production greenhouses could enable mites to enter, as well as hitchhiking on persons or material entering the greenhouse.<br>**Measures taken against the pest and their efficacy**<br>Plants in the greenhouse are protected from *E. lewisi* that may enter by netting. The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. All greenhouses have double doors and there is a separation between the different vaults of the greenhouses to limit possible dispersion of the pest. There are hygienic measures in place (e.g. for nursery workers entering the production unit and for the tools used). The production place is monitored for the presence of pests on a weekly basis. There are regular insecticide treatments with products effective against *E. lewisi*. The NPPO does regular inspections in the greenhouse ensuring the compliance with the EU import requirements.<br>**Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings.<br>**Main uncertainties**<br>– The presence of defects in the greenhouse structure.<br>– Abundance of *E. lewisi* and the presence and distribution of host plants in the surroundings.<br>– The intensity and the design of surveillance scheme. | | | | |

## 5.3.8 | Overview of the evaluation of *Epitrix* spp.

| **Rating of the likelihood of pest freedom** | **Almost always pest free** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9996 out of 10,000 bags | 9997 out of 10,000 bags | 9998 out of 10,000 bags | 9999 out of 10,000 bags | 10,000 out of 10,000 bags |
| **Proportion of infested bags** | 0 out of 10,000 bags | 1 out of 10,000 bags | 2 out of 10,000 bags | 3 out of 10,000 bags | 4 out of 10,000 bags |

(Continues)

(Continued)

| | |
|---|---|
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>The main host of *E. subcrinita* and *E. cucumeris* is potato (*Solanum tuberosum*), but they have also been reported on many other Solanaceae plants, like several species of the genera *Solanum*, *Physalis* and *Nicotiana* and *Capsicum*. *E. cucumeris* is reported on *Petunia* spp. *Epitrix subcrinita* has not been reported to feed on *Petunia* spp. or *Calibrachoa* spp. plants, however the Panel assumes that *Petunia* and *Calibrachoa* are likely host plants of *E. subcrinita*. Adults of *E. subcrinita* can fly and they may enter the nursery from host plants that might be present in the surrounding environment. Although adults of *E. cucumeris* do not fly they are able to move and they may enter the nursery from host plants that might be present in the surrounding environment. Moreover, the pest may enter the nursery from the soil that may be attached to the equipment. Defects in the insect proof structure of the production greenhouses could enable adults to enter. *Epitrix* adults feeding on unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. could be associated with the commodity. However, they cause typical shot holes that are relatively easily detected and such cuttings should not be acceptable for trade.<br>**Measures taken against the pest and their efficacy**<br>Plants in the greenhouse are protected from *Epitrix* that may enter by netting. The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). The mother plants used for cutting production are grown in dedicated greenhouses, enclosed with plastic on the roofs and walls. Ventilation areas are all screened with insect proof netting. The plastic cover and screens are checked twice per week for holes or cuts. All greenhouses have double doors with an air stream flowing out of the greenhouse when a door is opened. There are hygienic measures in place for nursery workers entering the production unit. The production place is monitored for the presence of pests on a weekly basis by nursery staff. There are regular insecticide treatments with products effective against *Epitrix*. The NPPO does regular inspections in the greenhouse ensuring the compliance with the EU import requirements *for E. cucumeris* and *E. subcrinita*.<br>**Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings.<br>**Main uncertainties**<br>– No details about the results of surveillance activities on the presence and population pressure of the two *Epitrix* species in the neighbouring environment of the nursery were provided.<br>– The presence of defects in the greenhouse structure.<br>– There is no detailed information on inspection frequency and design prevalence. |

## 5.3.9 | Overview of the evaluation of moths (*Helicoverpa zea*, *Chloridea virescens* and *Spodoptera ornithogalli*)

| **Rating of the likelihood of pest freedom** | **Almost always pest free** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9992 out of 10,000 bags | 9995 out of 10,000 bags | 9997 out of 10,000 bags | 9998 out of 10,000 bags | 9999 out of 10,000 bags |
| **Proportion of infested bags** | 1 out of 10,000 bags | 2 out of 10,000 bags | 3 out of 10,000 bags | 5 out of 10,000 bags | 8 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>The moth species *Helicoverpa zea*, *Chloridea virescens* and *Spodoptera ornithogalli* are present in Guatemala (EPPO GD).<br>*H. zea*, *C. virescens* and *S. ornithogalli* are highly polyphagous moths. There is evidence indicating that all the three species are present in Guatemala, despite according to the NPPO of Guatemala *S. ornithogalli* is not present in the country.<br>*C. virescens* and *S. ornithogalli* are reported on *Petunia or Calibrachoa*. There are no host plant records of *Petunia* spp. or *Calibrachoa* spp. for *H. zea*. However, the Panel assumes that *Petunia* spp. and *Calibrachoa* spp. are likely to be host plants.<br>The three moth species could be present on host plant crops cultivated in the area where the export nurseries are located. Moths are good fliers and it is possible that mated females are present near a greenhouse. Given the size of the adult moths (wingspan 3–5 cm) only the presence of large defects in the insect proof structure of the production greenhouses could enable a moth to enter. Hitchhiking moth on persons or material entering the greenhouse is unlikely.<br>**Measures taken against the pest and their efficacy**<br>Plants in the greenhouse are protected from moths that may enter by netting. The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). The mother plants used for cutting production are grown in dedicated greenhouses, enclosed with plastic on the roofs and walls. Ventilation areas are all screened with insect proof nettings. The plastic cover and screens are checked twice per week for holes or cuts. All greenhouses have double doors with an air stream flowing out of the greenhouse when a door is opened. There are hygienic measures in place for nursery workers entering the production unit. The production place is monitored for the presence of pests on a weekly basis by nursery staff. There are regular insecticide treatments with products effective against the moths. The NPPO does regular inspections in the greenhouse ensuring the compliance with the EU import requirements for *H. zea*, *C. virescens* and *S. ornithogalli*.<br>**Shortcomings of current measures/procedures**<br>No shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings.<br>**Main uncertainties**<br>– No details about the results of surveillance activities on the presence and population pressure of the three months in the neighbouring environment of the nursery were provided.<br>– The presence of defects in the greenhouse structure.<br>– There is no detailed information on inspection frequency and design prevalence. | | | | |

## 5.3.10 | Overview of the evaluation of *Ralstonia* spp.

| **Rating of the likelihood of pest freedom** | **Pest free with some exceptional cases** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9916 out of 10,000 bags | 9968 out of 10,000 bags | 9981 out of 10,000 bags | 9989 out of 10,000 bags | 9996 out of 10,000 bags |
| **Proportion of infested bags** | 4 out of 10,000 bags | 11 out of 10,000 bags | 19 out of 10,000 bags | 32 out of 10,000 bags | 84 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>*Petunia hybrida* and *Calibrachoa* sp. are listed as host plants for *R. solanacearum* and *Petunia* is used as experimental host for plant/*R. pseudosolanacearum* molecular interaction studies.<br>*R. solanacearum* and *R. pseudosolanacearum* are present and widespread in Guatemala. They infect numerous cultivated solanaceous plants and are present on numerous wild host plants species.<br>*R. solanacearum* and *R. pseudosolanacearum* are soilborne bacteria. They are transmitted by contaminated soil, irrigation water, tools and infected plant materials. Bacteria enter the plants usually by root injuries and they can also infect plants via stem injuries.<br>The bacteria colonise the xylem vessels. Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. can be systemically infected.<br>**Measures taken against the pest and their efficacy**<br>The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Plants in the greenhouse are protected from infection by *R. solanacearum* and *R. pseudosolanacearum* through contaminated soil by Metam-Sodium disinfection of the production area and the use of new substrate for each production cycle. Irrigation water could be one of the main pathways for the introduction of *R. solanacearum* and *R. pseudosolanacearum* in the facilities. However, irrigation water is treated with Chlorine dioxide.<br>**Shortcomings of current measures/procedures**<br>No major shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings.<br>**Main uncertainties**<br>• No tests specific to *R. solanacearum* and *R. pseudosolanacearum* are reported to be done during production process and at the exporting step.<br>• There is no detailed information on inspection frequency and design.<br>• Presence of unnoticed defects in the water treatment.<br>• Infected plants and infested soil in the surroundings.<br>• Presence and distribution of host plants in the surroundings. | | | | |

## 5.3.11 | Overview of the evaluation of *Xanthomonas vesicatoria*

| **Rating of the likelihood of pest freedom** | **Almost always pest free** (based on the median) | | | | |
|---|---|---|---|---|---|
| **Percentile of the distribution** | 5% | 25% | Median | 75% | 95% |
| **Proportion of pest-free bags** | 9983 out of 10,000 bags | 9991 out of 10,000 bags | 9995 out of 10,000 bags | 9998 out of 10,000 bags | 10,000 out of 10,000 bags |
| **Proportion of infested bags** | 0 out of 10,000 bags | 2 out of 10,000 bags | 5 out of 10,000 bags | 9 out of 10,000 bags | 17 out of 10,000 bags |
| **Summary of the information used for the evaluation** | **Possibility that the pest could become associated with the commodity**<br>*Petunia hybrida* and *Calibrachoa* sp. are not listed as host plants for *Xanthomonas vesicatoria* (EPPO GD, online). However, they have a high potential to be host plants because of the wide host range of *X. vesicatoria* within the solanaceous family. *X. vesicatoria* is a seed borne bacterium. Less frequently, primary infections may be caused by the presence of infected plant debris or volunteers from a previous crop. Secondary innocula released from lesions on leaves and stems are spread via splashing water and wind driven rain.<br>**Measures taken against the pest and their efficacy**<br>The imported plant material from Germany, the Netherlands, El Salvador and Israel is reported to be certified (no details provided). The mother plants used for cutting production are grown in dedicated greenhouses, enclosed with thrips proof nets which prevent entering of *X. vesicatoria* by wind unless the net is damaged during a storm. Ventilation areas are all screened. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit.<br>**Shortcomings of current measures/procedures**<br>No major shortcomings were identified in the evaluation. If all the described measures are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings.<br>**Main uncertainties**<br>– No details about the results of surveillance activities on the presence and population pressure of *X. vesicatoria* in the neighbouring environment of the facilities were provided.<br>– There is no detailed information on inspection frequency and design prevalence. | | | | |

### 5.3.12 | Outcome of expert knowledge elicitation

Table 10 and Figure 6 show the outcome of the EKE regarding pest freedom after the evaluation of the currently proposed risk mitigation measures for the selected pests.

Figure 7 provides an explanation of the descending distribution function describing the likelihood of pest freedom after the evaluation of the currently proposed risk mitigation measures for *Ralstonia* spp. on *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings designated for export to the EU.

**TABLE 10** Assessment of the likelihood of pest freedom following evaluation of current risk mitigation measures against evaluated pests *Bemisia tabaci*, *Bactericera cockerelli*, begomoviruses (pepper golden mosaic virus, pepper huasteco yellow vein virus, tomato severe leaf curl virus, tomato yellow leaf curl virus), leafminers (*Liriomyza huidobrensis, L. sativae, L. trifolii*), *tomato spotted wilt virus*, *Phenacoccus solenopsis*, *Epitrix* (*Epitrix subcrinita, E. cucumeris*), *Eotetranychus lewisi*, moths (*Helicoverpa zea, Chloridea virescens, Spodoptera ornithogalli*), *Ralstonia* (*Ralstonia solancearum, R. pseudosolanacearum*), *Xanthomonas vesicatoria* on *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings designated for export to the EU. In panel A, the median value for the assessed level of pest freedom for each pest is indicated by 'M', the 5% percentile is indicated by L and the 95% percentile is indicated by U. The percentiles together span the 90% uncertainty range regarding pest freedom. The pest freedom categories are defined in panel B of the table.

| Number | Group | Pest species | Sometimes pest free | More often than not pest free | Frequently pest free | Very frequently pest free | Extremely frequently pest free | Pest free with some exceptional cases | Pest free with few exceptional cases | Almost always pest free |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Insects | *Bemisia tabaci* | | | | | **L** | | **M** | **U** |
| 2 | Insects | *Bactericera cockerelli* | | | | | | **L** | **M** | **U** |
| 3 | Viruses | Begomoviruses (pepper golden mosaic virus, pepper huasteco yellow vein virus, tomato severe leaf curl virus, tomato yellow leaf curl virus) | | | | | | **L** | **M** | **U** |
| 4 | Insects | Leafminers (*Liriomyza huidobrensis, L. sativae and L. trifolii*) | | | | | | **L** | **M** | **U** |
| 5 | Viruses | Tomato spotted wilt virus | | | | | **L** | **M** | | **U** |
| 6 | Insects | *Phenacoccus solenopsis* | | | | | **L** | | **M** | **U** |
| 7 | Insects | *Epitrix* (Epitrix subcrinita, E. cucumeris) | | | | | | | | **LMU** |
| 8 | Mites | *Eotetranychus lewisi* | | | | | | **L** | **M** | **U** |
| 9 | Insects | Moths (*Helicoverpa zea, Chloridea virescens, Spodoptera ornithogalli*) | | | | | | | **L** | **MU** |
| 10 | Bacteria | *Ralstonia* (*Ralstonia solancearum, R. pseudosolanacearum*) | | | | | **L** | **M** | | **U** |
| 11 | Bacteria | *Xanthomonas vesicatoria* | | | | | | **L** | | **MU** |

PANEL A

| Pest freedom category | Pest-free plants out of 10,000 |
|---|---|
| Sometimes pest free | ≤ 5000 |
| More often than not pest free | 5000– ≤ 9000 |
| Frequently pest free | 9000– ≤ 9500 |
| Very frequently pest free | 9500– ≤ 9900 |
| Extremely frequently pest free | 9900– ≤ 9950 |
| Pest free with some exceptional cases | 9950– ≤ 9990 |
| Pest free with few exceptional cases | 9990– ≤ 9995 |
| Almost always pest free | 9995– ≤ 10,000 |

| Legend of pest freedom categories | |
|---|---|
| **L** | Pest freedom category includes the elicited lower bound of the 90% uncertainty range |
| **M** | Pest freedom category includes the elicited median |
| **U** | Pest freedom category includes the elicited upper bound of the 90% uncertainty range |

PANEL B

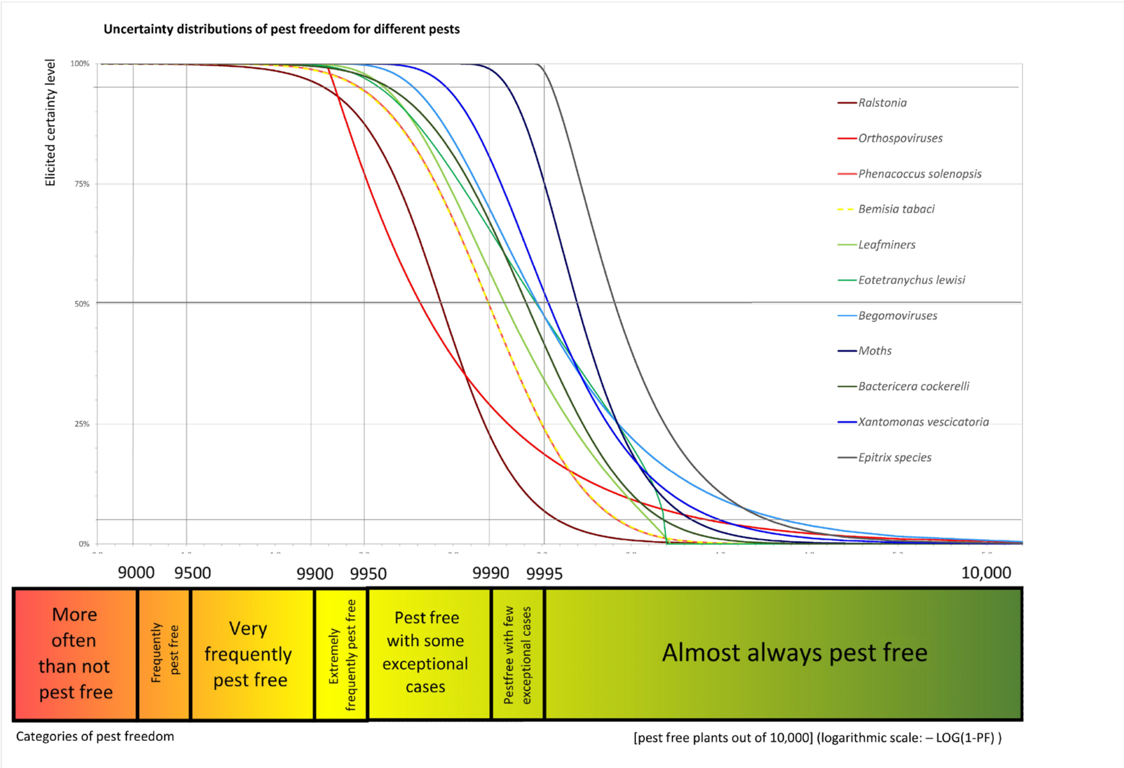


**FIGURE 6** Elicited certainty (*y*-axis) of the number of pest-free *Petunia* spp. and *Calibrachoa* spp. bags (*x*-axis; log-scaled) out of 10,000 bags designated for export to the EU introduced from Guatemala for all evaluated pests visualised as descending distribution function. Horizontal lines indicate the percentiles (starting from the bottom 5%, 25%, 50%, 75%, 95%).

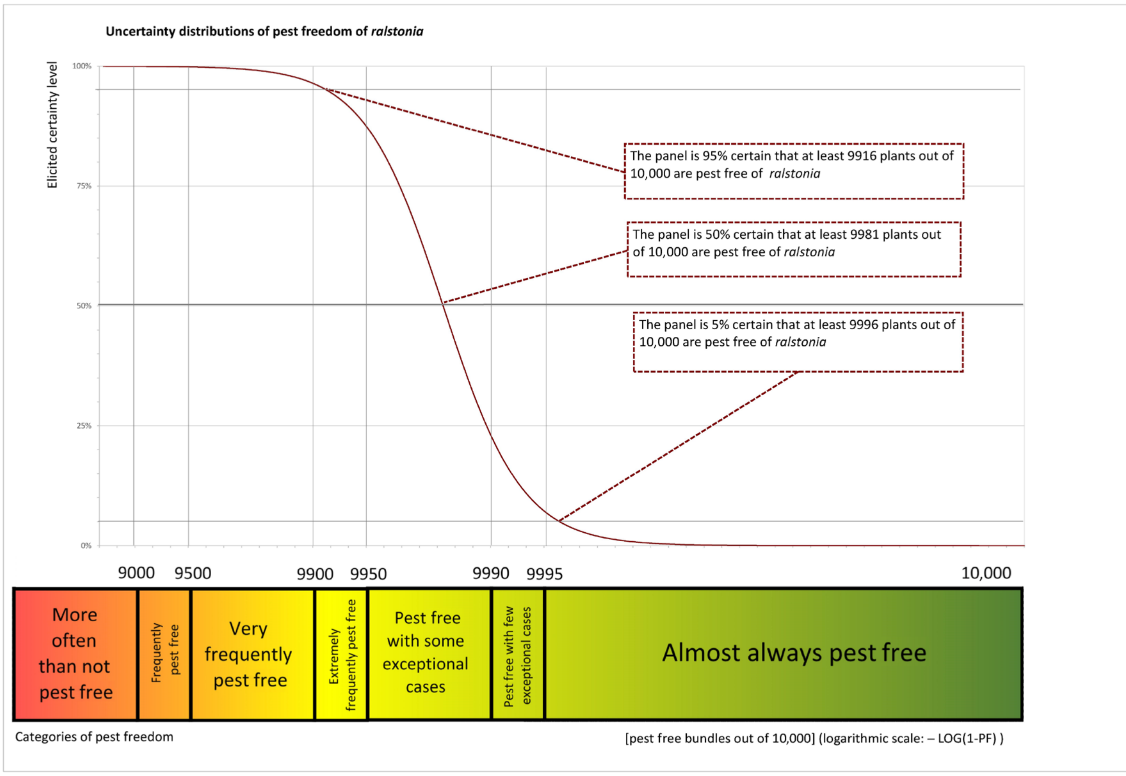


**FIGURE 7** Explanation of the descending distribution function describing the likelihood of pest freedom after the evaluation of the currently proposed risk mitigation measures for plants designated for export to the EU based on the example of *Ralstonia* spp.

# 6 | CONCLUSIONS

There are 20 pests identified to be present in Guatemala and considered to be potentially associated with unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. imported from Guatemala and relevant for the EU. The likelihood of the pest freedom after the evaluation of the implemented risk mitigation measures for unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. designated for export to the EU was estimated. The limited and partially conflicting information provided in the dossier contributes to the wide estimates of pest freedom.

For *B. tabaci*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with few exceptional cases' with the 90% uncertainty range reaching from 'extremely frequently pest free' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9946 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *B. tabaci*.

For *B. cockerelli*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with few exceptional cases' with the 90% uncertainty range reaching from 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9964 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *B. cockerelli*.

For the selected begomoviruses (pepper golden mosaic virus, pepper huasteco yellow vein virus, tomato severe leaf curl virus, tomato yellow leaf curl virus), the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with few exceptional cases' with the 90% uncertainty range reaching from 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9974 and 10,000 bags per 10,000 will be free from the selected begomoviruses species.

For the selected leafminers (*Liriomyza huidobrensis, L. sativae and L. trifolii*), the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'Pest free with few exceptional cases' with the 90% uncertainty range reaching from 'Pest free with some exceptional cases' to 'Almost always pest free'. The EKE indicated, with 95% certainty, that between 9962 and 10,000 bags per 10,000 will be free from the selected leafminers species.

For tomato spotted wilt virus, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with some exceptional cases' with the 90% uncertainty range reaching from 'extremely frequently pest free' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9927 and 10,000 bags per 10,000 will be free from TSWV.

For *P. solenopsis*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with few exceptional cases' with the 90% uncertainty range reaching from 'extremely frequently pest free' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9947 and 10,000 bags per 10,000 will be free from *P. solenopsis*.

For the selected *Epitrix* (*E. subcrinita, E. cucumeris*) species, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'almost always pest free' with the 90% uncertainty range reaching from 'almost always pest free' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9996 and 10,000 bags per 10,000 will be free from the selected *Epitrix* species.

For *E. lewisi*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with few exceptional cases' with the 90% uncertainty range reaching from 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9959 and 10,000 bags per 10,000 will be free from *E. lewisi*.

For moths (*H. zea, C. virescens, S. ornithogalli*), the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'almost always pest free' with the 90% uncertainty range reaching from 'pest free with few exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9992 and 10,000 bags per 10,000 will be free from the selected moths species.

For the selected *Ralstonia (R. solancearum, R. pseudosolanacearum)* species, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with some exceptional cases' with the 90% uncertainty range reaching from 'extremely frequently pest free' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9916 and 10,000 bags per 10,000 will be free from the selected *Ralstonia* species.

For *X. vesicatoria*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'almost always pest free' with the 90% uncertainty range reaching from 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9983 and 10,000 bags per 10,000 will be free from *X. vesicatoria*.

## GLOSSARY

| | |
|---|---|
| Control (of a pest) | Suppression, containment or eradication of a pest population (FAO, 1995, 2017). |
| Entry (of a pest) | Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2017). |
| Establishment (of a pest) | Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2017). |
| Greenhouse | A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment. |
| Impact (of a pest) | The impact of the pest on the crop output and quality and on the environment in the occupied spatial units. |
| Introduction (of a pest) | The entry of a pest resulting in its establishment (FAO, 2017). |
| Measures | Control (of a pest) is defined in ISPM 5 (FAO, 2017) as 'Suppression, containment or eradication of a pest population' (FAO, 1995). Control measures are measures that have a direct effect on pest abundance. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk mitigation measures that do not directly affect pest abundance. |
| Pathway | Any means that allows the entry or spread of a pest (FAO, 2017). |
| Phytosanitary measures | Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2017). |
| Protected zone | A Protected zone is an area recognised at EU level to be free from a harmful organism, which is established in one or more other parts of the Union. |
| Quarantine pest | A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2017)). |
| Regulated non-quarantine pest | A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party (FAO, 2017). |
| Risk mitigation measure | A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A risk mitigation measure may become a phytosanitary measure, action or procedure according to the decision of the risk manager. |
| Spread (of a pest) | Expansion of the geographical distribution of a pest within an area (FAO, 2017). |

## ABBREVIATIONS

| | |
|---|---|
| CABI | Centre for Agriculture and Bioscience International |
| EKE | Expert Knowledge Elicitation |
| EPPO | European and Mediterranean Plant Protection Organization |
| FAO | Food and Agriculture Organization |
| ISPM | International Standards for Phytosanitary Measures |
| PPIS | Plant Protection & Inspection Services |
| PLH | Plant Health |
| PRA | Pest Risk Aassessment |
| RNQPs | Regulated Non-Quarantine Pests |


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## CONFLICT OF INTEREST

If you wish to access the declaration of interests of any expert contributing to an EFSA scientific assessment, please contact interestmanagement@efsa.europa.eu.

## AMENDMENT

An editorial correction was made in February 2024, as some figures were incorrectly inserted in the text and there were few typos in the names of pest species. Specifically, in Appendix A, the Figures A.9 (A, B, and C) were replaced and a correction in the species name was made in Figures A.11 (A, B, and C). The pest species name "Eotetranychus lewisi" was corrected in the abstract and three keywords were removed, as they are already present in the title. These corrections do not materially affect the contents or outcome of this scientific output. To avoid confusion, the original version of the output has been removed from the EFSA Journal but is available on request.

## REQUESTOR

European Commission

## QUESTION NUMBER

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## MAP DISCLAIMER

The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the European Food Safety Authority concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

## REFERENCES

CABI (Centre for Agriculture and Bioscience International). (online). CABI Crop Protection Compendium. https://www.cabi.org/cpc/

Capinera, J. L. (2008). Yellowstriped armyworm, *Spodoptera ornithogalli* (Guenee) (Insecta: Lepidoptera: Noctuidae). IFAS Extension, University of Florida, EENY 216. https://entnemdept.ufl.edu/creatures/veg/leaf/yellowstriped_armyworm.htm

EFSA PLH Panel (EFSA Panel on Plant Health). (2018). Guidance on quantitative Pest Risk Assessment. *EFSA Journal*, *16*(8), 5350. https://doi.org/10.2903/j.efsa.2018.5350

EFSA PLH Panel (EFSA Panel on Plant Health). (2019). Guidance on commodity risk assessment for the evaluation of high risk plants dossiers. *EFSA Journal*, *17*(4), 5668. https://doi.org/10.2903/j.efsa.2019.5668

EFSA Scientific Committee. (2018). Scientific opinion on the principles and methods behind EFSA's guidance on uncertainty analysis in scientific assessment. *EFSA Journal*, *16*(1), 5122. https://doi.org/10.2903/j.efsa.2018.5122

EPPO (European and Mediterranean Plant Protection Organization). (online). EPPO Global Database. https://www.eppo.int/

EUROPHYT. (online). European Union Notification System for Plant Health Interceptions – EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

FAO (Food and Agriculture Organization of the United Nations). (1995). ISPM (International standards for phytosanitary measures) No 4. Requirements for the establishment of pest free areas. https://www.ippc.int/en/publications/614/

FAO (Food and Agriculture Organization of the United Nations). (2017). ISPM (International standards for phytosanitary measures) No. 5. Glossary of phytosanitary terms. FAO, Rome. https://www.ippc.int/en/publications/622/

FAO (Food and Agriculture Organization of the United Nations). (2019). ISPM (International Standards for Phytosanitary Measures) No. 36. Integrated measures for plants for planting. FAO, Rome, 22 pp. https://www.ippc.int/en/publications/636/

TRACES-NT. (online). TRAde Control and Expert System. https://webgate.ec.europa.eu/tracesnt

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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# APPENDIX A

## Data sheets of pests selected for further evaluation via Expert Knowledge Elicitation

## A.1 | *Bemisia tabaci*

### A.1.1 | Organism information

| | |
|---|---|
| **Taxonomic information** | Current valid scientific name: *Bemisia tabaci* (Gennadius, 1889).<br>Synonyms: *Aleurodes inconspicua*, *Aleurodes tabaci*, *Bemisia achyranthes*, *Bemisia bahiana*, *Bemisia costa-limai*, *Bemisia emiliae*, *Bemisia goldingi*, *Bemisia gossypiperda*, *Bemisia gossypiperda mosaicivectura*, *Bemisia hibisci*, *Bemisia inconspicua*, *Bemisia longispina*, *Bemisia lonicerae*, *Bemisia manihotis, Bemisia minima*, *Bemisia minuscula*, *Bemisia nigeriensis*, *Bemisia rhodesiaensis*, *Bemisia signata*, *Bemisia vayssieri*.<br>Name used in the EU legislation: *Bemisia tabaci* Genn. (non-European populations) known to be vector of viruses [BEMITA].<br>Order: Hemiptera<br>Family: Aleyrodidae<br>Common name: Tobacco whitefly, cassava whitefly, cotton whitefly, silver-leaf whitefly, sweet-potato whitefly.<br>Name used in the dossier: *Bemisia tabaci* |
| **Group** | Insects |
| **EPPO code** | BEMITA |
| **Regulated status** | The pest is listed in Annex II/A of Commission implementing Regulation (EU) 2019/2072 as *Bemisia tabaci* Genn. (non-European populations) known to be vector of viruses [BEMITA], and in Annex III as Protected Zone Quarantine Pest (European populations). |
| **Pest status in *Guatemala*** | *Bemisia tabaci* is present in *Guatemala* (CABI, online; EPPO, online). The biotypes Med (formerly referred to as biotype Q), MEAM1 (formerly referred to as biotype B) and New World 1 (formerly referred to as biotype A) are reported from Guatemala to infest many plant host species (Bethke et al., 2008; McKenzie et al., 2012; Shatters et al., 2009; Surapathrudu Kanakala and Murad Ghanim, 2019).<br>Bethke et al., (2008) investigated the presence of *B. tabaci* biotypes in production greenhouses of Poinsettia (*Euphorbia*) and its surrounding environment (weeds and crops) in Guatemala. *B. tabaci* was found to be present inside two greenhouses (on *Euphorbia*) and outside the greenhouse on *Hibiscus*, *Lactuca*, *Cucumis* and *Phaseolus*. |
| **Pest status in the EU** | Not relevant as EU quarantine pest. |
| **Host status on *Petunia* sp. and *Calibrachoa sp.*** | Certain *Petunia* species (*Petunia* sp., *P. axillaris*, *P. grandiflora*, *P. integrifolia*, *P. hybrida*) and *Calibrachoa* sp. are reported as Solanaceae host plants for *B. tabaci* (EPPO, online). *Petunia hybrida* is reported as field-verified host plant for *B. tabaci in* China Iran and Turkey (Bayhan et al., 2006; Li et al., 2011; Samin et al., 2015). In Brasil *B. tabaci is reported to infest* petunia plants in commercial green greenhouses (de Moraes et al., 2017). |
| **PRA information** | – Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory (EFSA PLH Panel, 2013).<br>– Scientific Opinion on the commodity risk assessment of *Persea americana* from Israel (EFSA PLH Panel, 2021)<br>– Scientific report on the commodity risk assessment of specified species of *Lonicera* potted plants from Turkey (EFSA PLH Panel, 2022a).<br>– Scientific Opinion on the commodity risk assessment of *Jasminum polyanthum* unrooted cuttings from Uganda (EFSA PLH Panel, 2022b).<br>– UK Risk Register Details for *Bemisia tabaci* non-European populations (DEFRA, online). |
| **Other relevant information for the assessment** | |
| **Biology** | *Bemisia tabaci* is a complex of at least 40 cryptic species that are morphologically identical but distinguishable at molecular level (Khatun et al., 2018). The species differ from each other in host association, spread capacity, transmission of viruses and resistance to insecticides (De Barro et al., 2011). It is an important agricultural pest that can transmit more than 121 viruses (belonging to genera Begomovirus, Crinivirus, Ipomovirus, Carlavirus and Torradovirus) and cause significant damage to major food crops such as *solanaceous* and cucurbits crops and ornamental plants (EFSA PLH Panel, 2013).<br>*Bemisia tabaci* adult is about 1 mm long. It develops through three life stages: egg, nymph (four instars) and adult (Walker et al., 2009). Nymphs of *B. tabaci* mainly feed on phloem in minor veins of the underside leaf surface (Cohen et al., 1996). Adults feed on both phloem and xylem of leaves (Walker et al., 2009).<br>*Bemisia tabaci* is multivoltine with up to 15 generations per year (Ren et al., 2001). The life cycle from egg to adult requires from 2.5 weeks up to 2 months depending on the temperature (Norman et al., 1995) and the host plant (Coudriet et al., 1985). *B. tabaci* has a high reproductive potential and each female can lay more than 300 eggs during their lifetime (Gerling et al., 1986), which can be found mainly on the underside of the leaves (CABI, online). During oviposition, females insert eggs with the pedicel directly into leaf tissue (Paulson and Beardsley, 1985).<br>Out of all life stages, only the first instar nymph (crawler) and adults are mobile. Movement of crawlers by walking is very limited, usually within the leaf where they hatched (Price and Taborsky, 1992) or to more suitable neighbouring leaves. The average distance was estimated to be within 10–70 mm (Summers et al., 1996). For these reasons, they are not considered to be good colonisers. On the contrary, adults can fly reaching quite long distances in a search of a permanent host. According to Cohen et al. (1988), some of the marked individuals were trapped 7 km away from the initial place after 6 days. Long-distance passive dispersal by wind is also possible (Byrne, 1999). |

(Continued)

| | | |
|---|---|---|
| **Symptoms** | **Main type of symptoms** | Wide range of symptoms can occur on plants due to direct feeding of the pest, contamination of honeydew and sooty moulds, transmitted viruses and phytotoxic responses. Plants exhibit one or more of these symptoms: chlorotic spotting, vein yellowing, intervein yellowing, leaf yellowing, yellow blotching of leaves, yellow mosaic of leaves, leaf curling, leaf crumpling, leaf vein thickening, leaf enations, leaf cupping, stem twisting, plant stunting, wilting, leaf loss and silvering of leaves (CABI, online; EPPO, 2004). |
| | **Presence of asymptomatic plants** | No asymptomatic period is known to occur in the infested plants. However, eggs and first instar larvae are difficult to detect. Symptoms of the infestation by the insect are visible. *B. tabaci* is a vector of several viruses and their infection could be asymptomatic. |
| | **Confusion with other pathogens/ pests** | *Bemisia tabaci* can be easily confused with other whitefly species such as B. *afer, Trialeurodes lauri, T. packardi, T. ricini, T. vaporariorum* and *T. variabilis*. A microscopic slide is needed for morphological identification (EPPO, 2004). Different species of *B. tabaci* complex can be distinguished using molecular methods (De Barro et al., 2011). |
| **Host plant range** | *B. tabaci* is a polyphagous pest with a wide host range, including more than 1000 different plant species (Abd-Rabou and Simmons, 2010). | |
| **What life stages could be expected on the commodity** | All life stages of *B. tabaci* (eggs, larvae and adults) are present on the leaves of the plants<br>*B. tabaci* is continuously intercepted in the EU on different commodities including plants for planting and unrooted cuttings (EUROPHYT/TRACES-NT, online). Therefore, the commodity is a pathway for *B. tabaci*. | |
| **Surveillance information** | There are no targeted surveys for the presence of *B. tabaci* in Guatemala. | |

## A.1.2 | Possibility of pest presence in the nursery

### A.1.2.1 | Possibility of entry from the surrounding environment

*B. tabaci* is a polyphagous whitefly that is widespread in Guatemala and reported occurring in many horticultural crops, such as melon (Bethke et al., 2008). It is likely that *B. tabaci* is present in the area where the nurseries are located. For another similar commodity in Guatemala (Euphorbia cuttings for export) it was shown that *B. tabaci* was present in production greenhouses and on plants in the environment of the greenhouse (Bethke et al., 2008)). Flying adults of *B. tabaci* can be transferred by the wind over kilometres and could enter the nursery from host plants that might be present in the surrounding environment. *Petunia/Calibrachoa* cuttings are produced in a greenhouse protected against insects by screened windows and double doors. Small insects as *B. tabaci* (1 mm) may enter the greenhouse through defects in the protective screens or as hitchhiker on clothes of nursery staff. The use of yellow sticky cards to monitor insect presence suggests that insects are able to enter the production facilities.

<u>Uncertainties</u>

- It is not known what the *B. tabaci* population pressure is in the surrounding environment of the nursery.
- Presence and distribution of host plants in the surroundings.
- The presence of defects in the greenhouse structure.

### A.1.2.2 | Possibility of entry with new plants/seeds

Mother plants used for the production of unrooted cuttings originate from the Netherlands, Germany, El Salvador and Israel. There is a possibility that *B. tabaci* could enter the nursery with infested propagation material of host plants species.

<u>Uncertainties</u>

- The origin of the propagation material in relation to the infested areas.
- The presence and the numbers of other host plants in the export nursery.

### A.1.2.3 | Possibility of spread within the nursery

*B. tabaci* can be present in other host plants in other production units of the nursery. When present, flying adults can spread from infested host plants within the nursery. *Petunia* spp. for export are produced in a separate unit with hygienic standards (double doors, clean uniforms).

<u>Uncertainties</u>

- There are no uncertainties.

### A.1.3 | Information from interceptions

*B. tabaci* is the most intercepted pest species on plants for planting imported into the EU, including unrooted cuttings. In the EUROPHYT/TRACES-NT database there are 2 records of interceptions of *B. tabaci* on *Petunia* sp. and 1 records of interception on *Calibrachoa* sp. from Israel. There were 10 interceptions of *B. tabaci* on different commodities (*Hibiscus* sp.: 2; *Euphorbia pulcherrima*: 4; *Euphorbia* sp.: 1; *Euphorbia trigona*: 1; *Eupatorium purpureum*: 1; *Ocimum* sp.: 1) imported into the EU from Guatemala.

### A.1.4 | Evaluation of the risk mitigation options

In the table below, all risk mitigation measures currently applied in Guatemala are listed and described and an indication of their effectiveness on *B. tabaci* is provided:

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing *B. tabaci* and crawlers that may enter from the surrounding environment. *B. tabaci* may be introduced through defects in the greenhouse. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* and *Calibrachoa* are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of whitefly.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/ Calibrachoa* production units. |
| Soil treatment | N | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2).<br>Evaluation:<br>*B. tabaci* is present in El Salvador and Israel.<br>Uncertainties:<br>The details of the certification schemes and the phytosanitary status of the imported material from the non-EU countries. |
| Crop rotation | N | Description:<br>Solanaceae crops for export are changing each season the greenhouses to reduce the risk about the infection with pathogens or virus. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfection of irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of *B. tabaci* adults.<br>Uncertainties:<br>The efficiency of monitoring and inspection. |

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0).<br>Evaluation:<br>The applied insecticides are effective against *B. tabaci.*<br>Uncertainties:<br>The efficacy of the applied insecticide and its timing is not known. |
| Sampling and testing | N | Description:<br>*Petunia* and *Calibrachoa* plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>For the EU import of plants there are requirements in place for all host plants (including *Petunia*) of Non-EU Begomoviruses and its vector Bemisia tabaci (point 7 of Annex VII of Regulation (EU) 2019/2072).<br>In summary the requirements are:<br>1. Official statement that no symptoms of begomoviruses have been observed on the plants during their complete cycle of vegetation.<br>2. The plants have been subjected to an effective treatment ensuring the eradication of *Bemisia tabaci* and the other vectors of the Union quarantine pests and have been found free thereof prior to export.<br>The panel assumes that the NPPO checks this requirement and acts accordingly when begomovirus symptoms or *B. tabaci* is detected in a production plot destined for export to EU.<br>Evaluation:<br>The monitoring can detect the presence of *B. tabaci.*<br>Uncertainties:<br>– The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of *B. tabaci*. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of surveillance scheme. |

## A.1.5 | Overall likelihood of pest freedom

### A.1.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* spp. and *Calibrachoa* spp. are not a preferred host.
- The Dispersal capacity of *B. tabaci* adults is limited.
- Low population pressure of *B. tabaci* in the surrounding environment, due to the limited presence of preferred host plants.
- Greenhouse structure is insect-proof and entrance is thus unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected because of the typical symptoms on leaves.
- Rotation of compartments (Solanaceae, other), dedicated compartments for export.
- Application of the insecticides have a good efficacy against *B. tabaci*.
- At harvest and packing, cuttings with symptoms will be detected.
- 25 cuttings per bag.

### A.1.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *B. tabaci* has been intercepted on *Petunia* spp. and *Calibrachoa* spp. Plants (from Israel) and on *Hibiscus*, *Euphorbia*, *Eupatorium* and *Ocimum* plants from Guatemala.
- *B. tabaci* is present throughout Guatemala and they have a wide host range, mainly Solanaceous plant, therefore it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *B. tabaci* is present and abundant (e.g. melon).
- Presence of *B. tabaci* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *B. tabaci*.
- 80 cutting per bag.

### A.1.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- Tendency for the low scenario and good production conditions.
- High uncertainty for values below median.
- Less uncertainty for higher values.

### A.1.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The main uncertainty is the population pressure of *B. tabaci* in the surrounding environment.
- High uncertainty for values below median.
- Less uncertainty for higher values.

### A.1.6 | Elicitation outcomes of the assessment of the pest freedom for *Bemisia tabaci*

The following Tables show the elicited and fitted values for pest infestation (Table A.1) and pest freedom (Table A.2).

**TABLE A.1** Elicited and fitted values of the uncertainty distribution of pest infestation by *Bemisia tabaci* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 1 | | | | | 5 | | 10 | | 20 | | | | | 100 |
| EKE | 0.923 | 1.34 | 1.86 | 2.69 | 3.72 | 5.01 | 6.43 | 10.0 | 15.6 | 20.0 | 26.9 | 37.1 | 53.9 | 74.4 | 108 |

*Note:* The EKE results is the *Lognorm (16.893, 23.001)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.2.

**TABLE A.2** The uncertainty distribution of plants free of *Bemisia tabaci* per 10,000 bugs of unrooted cuttings calculated by Table A.1.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9900 | | | | | 9980 | | 9990 | | 9995 | | | | | 9999 |
| EKE results | 9892 | 9926 | 9946 | 9963 | 9973 | 9980 | 9984 | 9990 | 9994 | 9995 | 9996 | 9997 | 9998.1 | 9998.7 | 9999.1 |

*Note:* The EKE results are the fitted values.

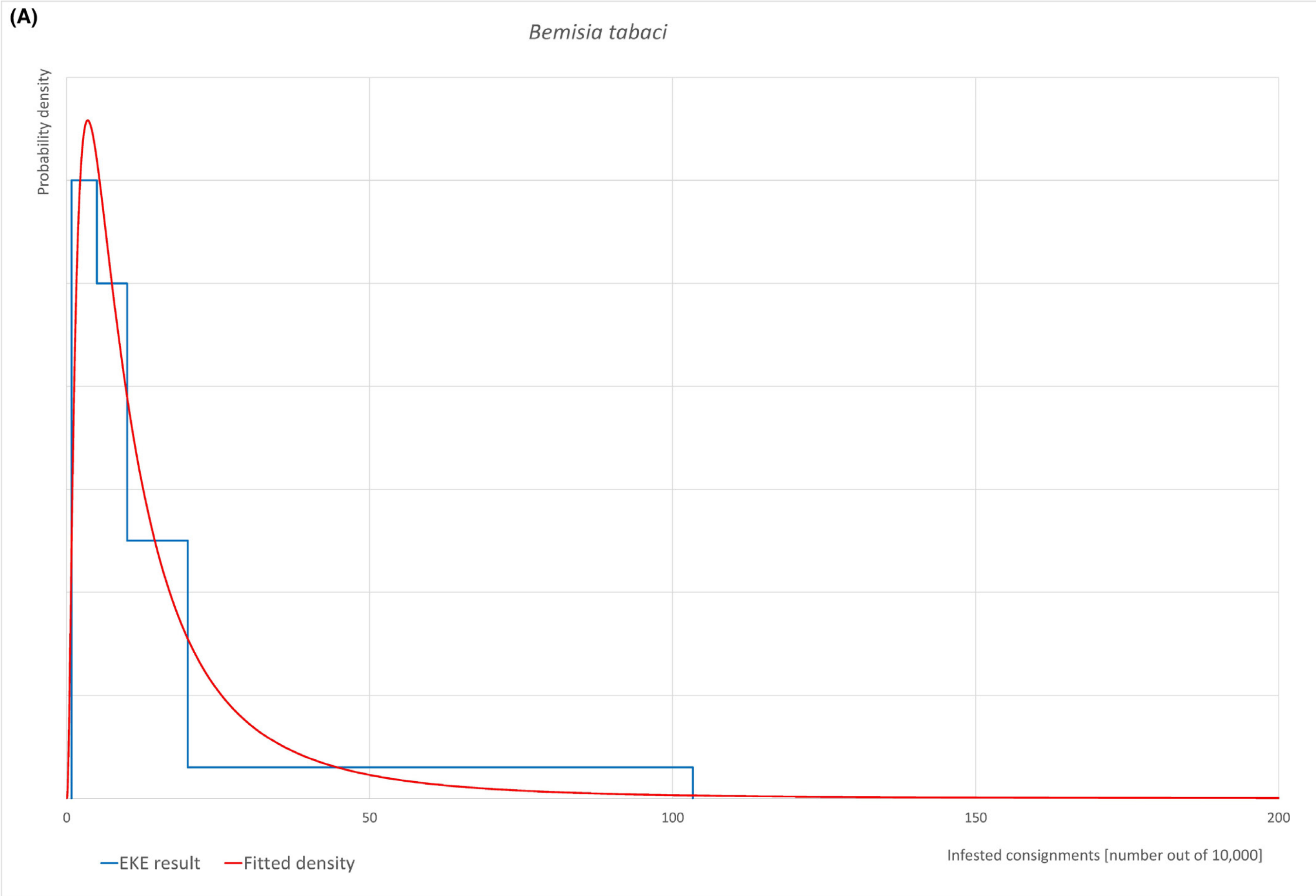


**FIGURE A.1** (Continued)

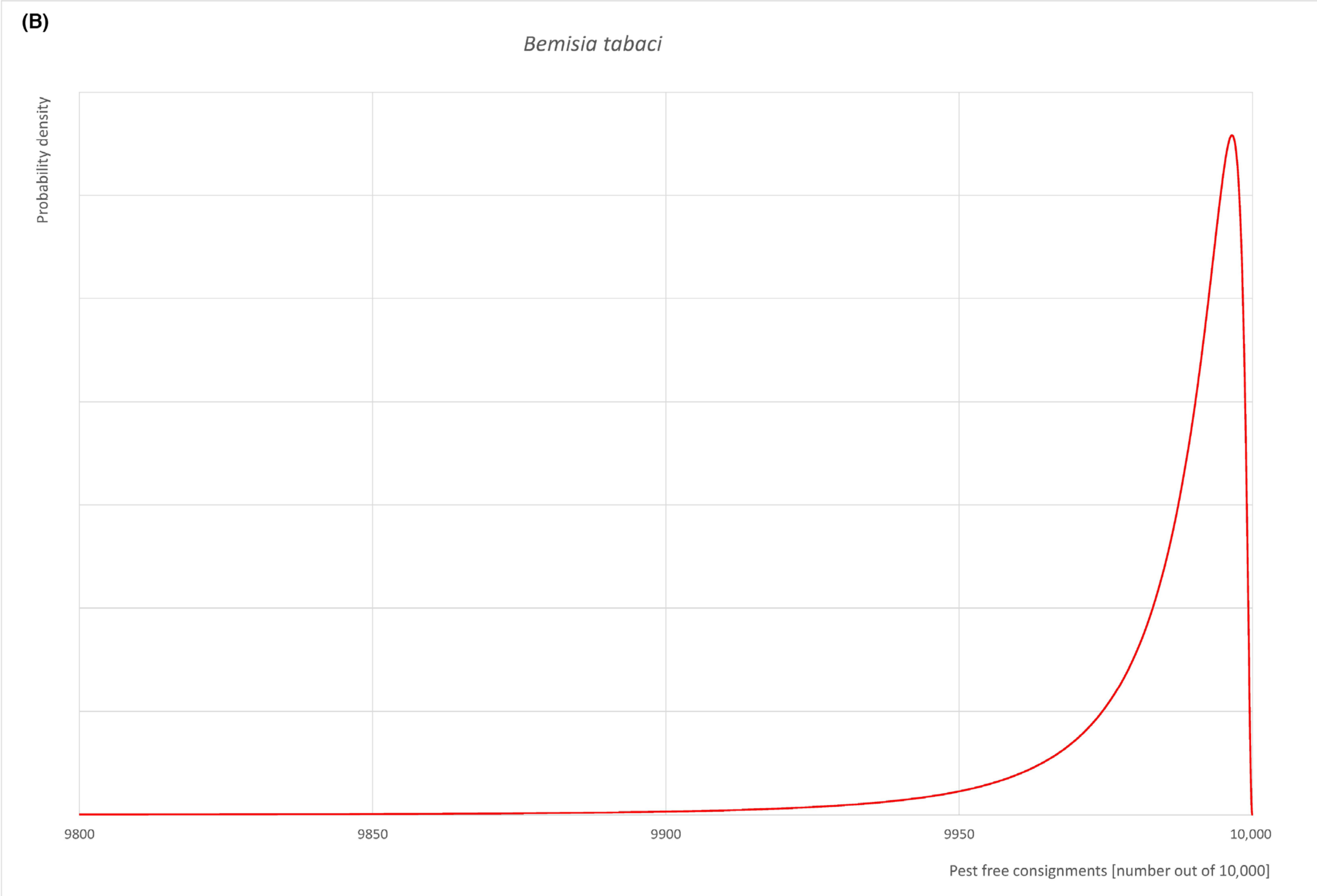


**FIGURE A.1** (Continued)

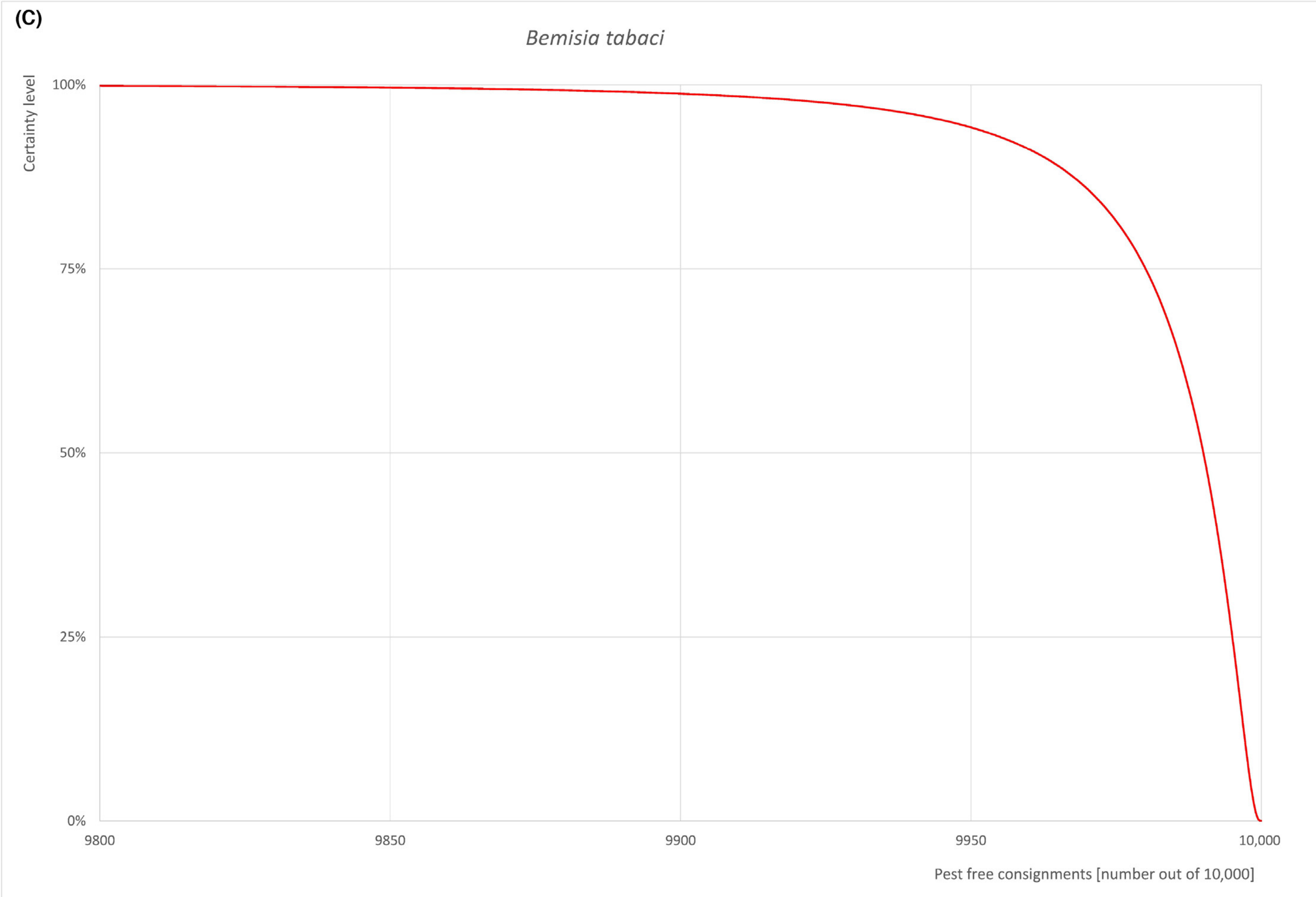


**FIGURE A.1** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Bemisia tabaci* complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags.

## A.1.7 | Reference list


Abd-Rabou, S., & Simmons, A. M. (2010). Survey of reproductive host plants of *Bemisia tabac*i (Hemiptera: Aleyrodidae) in Egypt, including new host records. *Entomological News*, 121, 456–465. https://doi.org/10.3157/021.121.0507

Bayhan, E., Ulusoy, M. R., & Brown, J. K. (2006). Host range, distribution, and natural enemies of *Bemisia tabaci* biotype (Hemiptera, Aleyrodidae) in Turkey. *Journal of Pest Science*, 79, 233–240. https://doi.org/10.1007/s10340-006-0139-4

Bethke, J. A., Byrne, F. J., Hodges, G. S., McKenzie, C. L., & Shatters Jr, R. G. (2009). First record of the Q biotype of the sweetpotato whitefly, *Bemisia tabaci*, in Guatemala. *Phytoparasitica*, *37*, 61–64. https://doi.org/10.1007/s12600-008-0009-0

Byrne, D. N. (1999). Migration and dispersal by the sweet potato whitefly, *Bemisia tabaci*. *Agricultural and Forest Meteorology*, 97, 309–316. https://doi.org/10.1016/s0168-1923(99)00074-x

CABI (Centre for Agriculture and Bioscience International), online. Datasheet *Bemisia tabaci* (tobacco whitefly). https://www.cabi.org/cpc/datasheet/8927

CABI (Centre for Agriculture and Bioscience International), online. Datasheet *Bemisia tabaci* MEAM10 (silverleaf whitefly). https://www.cabi.org/cpc/datasheet/8925

Cohen, A. C., Henneberry, T. J., & Chu, C. C. (1996). Geometric relationships between whitefly feeding behavior and vascular bundle arrangements. *Entomologia Experimentalis et Applicata*, 78, 135–144.142. https://doi.org/10.1111/j.1570-7458.1996.tb00774.x

Cohen, S., Kern, J., Harpaz, I., & Ben-Joseph, R. (1988). Epidemiological studies of the tomato yellow leaf curl virus (TYLCV) in the Jordan Valley, Israel. *Phytoparasitica*, 16, 25527259. https://doi.org/10.1007/bf02979527

Coudriet, D. L., Prabhaker, N., Kishaba, A. N., & Meyerdirk, D. E. (1985). Variation in developmental rate on different host and overwintering of the sweetpotato whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae). *Environmental Entomology*, 14, 516–51519. https://doi.org/10.1093/ee/14.4.516

De Barro, P. J., Liu, S.-S., Boykin, L. M., & Dinsdale, A. B. (2011). *Bemisia tabaci*: A statement of species status. *Annual Review of Entomology*, 56, 1–150419. https://doi.org/10.1146/annurev-ento-112,408-085504

de Moraes, L. A., Marubayashi, J. M., Yuki, V. A., Ghanim, M., Bello, V. H., De Marchi, B. R., … Pavan, M. A. (2017). New invasion of *Bemisia tabaci* Mediterranean species in Brazil associated to ornamental plants. *Phytoparasitica*, *45*, 517–525. https://doi.org/10.1007/s12600-017-0607-9

DEFRA (Department for Environment, Food and Rural Affairs), online. UK Risk Register Details for *Bemisia tabaci* non-European populations. https://planthealthportal.defra.gov.uk/pests-and-diseases/uk-plant-health-risk-register/viewPestRisks.cfm?cslref=13756&riskId=13756

EFSA PLH Panel (EFSA Panel on Plant Health), 2013. Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory. *EFSA Journal*, 11(4), 3162. https://doi.org/10.2903/j.efsa.2013.3162

EFSA PLH Panel (EFSA Panel on Plant Health), 2013. Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory. *EFSA Journal*, 11(4), 3162. https://doi.org/10.2903/j.efsa.2013.3162

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Chatzivassiliou, E., Di Serio, F., dos Santos Baptista, P. C., Gonthier, P., Jaques Miret, J. A., Justesen, A. F., MacLeod, A., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Reignault, P. L., Stefani, E., Thulke, H.-H., Van der Werf, W., Vicent Civera, A., Yuen, J., Zappal_a, L., Debode, J., Manceau, C., Gardi, C., Mosbach-Schulz, O., & Potting, R. (2022a). Scientific report on the commodity risk assessment of specified species of *Lonicera* potted plants from Turkey. *EFSA Journal*, 20(1), 7014. https://doi.org/10.2903/j.efsa.2022.7014

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Chatzivassiliou, E., Di Serio, F., Baptista, P., Gonthier, P., Jaques Miret, J. A., Fejer Justesen, A., MacLeod, A., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Reignault, P. L., Stefani, E., Thulke, H.-H., Van der Werf, W., Vicent Civera, A., Yuen, J., Zappal_a, L., Debode, J., Manceau, C., Gardi, C., Mosbach-Schulz, O., & Potting, R. (2022b). Scientific Opinion on the commodity risk assessment of *Jasminum* polyanthum unrooted cuttings from Uganda. *EFSA Journal*, 20(5), 7300. https://doi.org/10.2903/j.efsa.2022.7300

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M.-A., Jaques Miret, J. A., Justesen, A. F., MacLeod, A. F., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Potting, R., Reignault, P. L., Thulkem H.-H., Van der Werf, W., Vicent Civera, A., Zappal_a, L., G_omez, P., Lucchi, A., Urek, G., Tramontini, S., Mosbach-Schulz, O., de la Pe ~ na, E., & Yuen, J. (2021). Scientific Opinion on the commodity risk assessment of *Persea americana* from Israel. *EFSA Journal*, 19(2), 6354. https://doi.org/10.2903/j.efsa.2021.6354

EPPO (European and Mediterranean Plant Protection Organization). online. *Bemisia tabaci* (BEMITA). https://gd.eppo.int/taxon/BEMITA

EPPO (European and Mediterranean Plant Protection Organization). (2004). PM 7/35. *Bemisia tabaci*. OEPP/EPPO Bulletin, 34, 155–157.

EUROPHYT, online. European Union Notification System for Plant Health Interceptio–s - EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

Gerling, D., Horowitz, A. R., & Baumgaertner, J. (1986). Autecology of *Bemisia tabaci*. *Agriculture, Ecosystems & Environment*, 17, 5–19. https://doi.org/10.1016/0167-8809(86)90022-8

Kanakala, S., & Ghanim, M. (2019). Global genetic diversity and geographical distribution of *Bemisia tabaci* and its bacterial endosymbionts. *PloS one*, *14*(3), e0213946. https://doi.org/10.1371/journal.pone.0213946

Khatun, M. F., Jahan, S. H., Lee, S., & Lee, K. Y. (2018). Genetic diversity and geographic distribution of the *Bemisia tabaci* species complex in Bangladesh. *Acta Tropica*, 187, 28–36. https://doi.org/10.1016/j.actatropica.2018.07.021

Li, S. J., Xue, X., Ahmed, M. Z., Ren, S. X., Du, Y. Z., Wu, J. H., Cuthbertson, A. G. S., & Qiu, B. L. (2011). Host plants and natural enemies of *Bemisia tabaci* (Hemiptera, Aleyrodidae) in China. *Insect Science*, 18, 101–120. https://doi.org/10.1111/j.1744-7917.2010.01395.x

McKenzie, C. L., Bethke, J. A., Byrne, F. J., Chamberlin, J. R., Dennehy, T. J., Dickey, A. M., … Shatters Jr, R. G. (2012). Distribution of *Bemisia tabaci* (Hemiptera: Aleyrodidae) biotypes in North America after the Q invasion. *Journal of Economic Entomology*, *105*(3), 753–766. https://doi.org/10.1603/EC11337

Norman, J. W., Stansty, D. G., Ellsworth, P. A., & Toscano, N. C. P. C. (1995). Management of silverleaf whitefly: A comprehensive manual on the biology, economic impact and control tactics. USDA/CSREES Grant Pub. 93-EPIX-1-0102. 13 pp.

Paulson, G. S., & Beardsley, J. W. (1985). Whitefly (Hemiptera: Aleyrodidae) egg pedicel insertion into host plant stomata. *Annals of the Entomological Society of America*, 78, 506–508. https://doi.org/10.1093/aesa/78.4.506

Price, J. F., & Taborsky, D. (1992). Movement of immature *Bemisia tabaci* (Homoptera: Aleyrodidae) on poinsettia leaves. *The Florida Entomologist*, 75, 151–153. https://doi.org/10.2307/3495495

Ren, S.-X., Wang, Z.-Z., Qiu, B.-L., & Xiao, Y. (2001). The pest status of *Bemisia tabaci* in China and non-chemical control strategies. *Insect Science*, 8, 279–288. https://doi.org/10.1111/j.1744-7917.2001.tb00453.x

Samin, N., Ghahari, H., & Behnood, S. (2015). A contribution to the knowledge of whiteflies (Hemiptera: Aleyrodidae) in Khorasan and Semnan Provinces, Iran. *Acta Phytopathologica et Entomologica Hungarica*, *50*(2), 287–295. https://doi.org/10.1556/038.50.2015.2.12

Shatters Jr, R. G., Powell, C. A., Boykin, L. M., Liansheng, H. E., & McKenzie, C. L. (2009). Improved DNA barcoding method for Bemisia tabaci and related Aleyrodidae: development of universal and Bemisia tabaci biotype-specific mitochondrial cytochrome c oxidase I polymerase chain reaction primers. *Journal of Economic Entomology*, *102*(2), 750–758. https://doi.org/10.1603/029.102.0236

Paulson, G. S., & Beardsley, J. W. (1985). Whitefly (Hemiptera: Aleyrodidae) egg pedicel insertion into host plant stomata. *Annals of the Entomological Society of America*, 78, 506–508. https://doi.org/10.1093/aesa/78.4.506

Price, J. F., & Taborsky, D. (1992). Movement of immature *Bemisia tabaci* (Homoptera: Aleyrodidae) on poinsettia leaves. *The Florida Entomologist*, 75, 151–153. https://doi.org/10.2307/3495

Ren, S.-X., Wang, Z.-Z., Qiu, B.-L., & Xiao, Y. (2001). The pest status of *Bemisia tabaci* in China and non-chemical control strategies. *Insect Science*, 8, 279–288. https://doi.org/10.1111/j.1744-7917.2001.tb0045

TRACES-NT. (online). TRAde Control and Expert System.

Walker, G. P., Perring, T. M., & Freeman, T. P. (2009). Life history, functional anatomy, feeding and mating behaviour. In Stansly, P. A. & Naranjo, S. E. (eds.), *Bemisia*: Bionomics and management of a global pest. Springer, Dordrecht, Netherlands. pp. 109–162_43.x.

## A.2 | Begomoviruses

### A.2.1 | Organism information

<table>
<tr><td>Name of the organisms in the cluster</td><td>Pepper golden mosaic virus (PEPGMV)<br>Pepper huasteco yellow vein virus (PHYVV0)<br>Tomato severe leaf curl virus (TOSLCV)<br>Tomato yellow leaf curl virus (TYLCV0)<br>Reasons for clustering: The above listed viruses belong in the same genus (Begomovirus), and they share the same biology and epidemiology characteristics that affect the risk they pose for EU.</td></tr>
<tr><td>Group</td><td>Virus and viroids<br>Geminiviridae<br>Begomovirus</td></tr>
<tr><td>Regulated status</td><td>Pepper golden mosaic virus (PepGMV), pepper huasteco yellow vein virus (PHYVV) and tomato severe leaf curl virus (ToSLCV) are regulated as quarantine pests (as a non-EU begomoviruses) in Commission Implementing Regulation (EU) 2019/2072, ANNEX II, Part A.<br>Tomato yellow leaf curl virus (TYLCV) is regulated as an RNQP in Commission Implementing Regulation (EU) 2019/2072, ANNEX IV, Part I.</td></tr>
<tr><td>Pest status in Guatemala</td><td>Pepper golden mosaic virus (PepGMV): according to EPPO GD PepGMV is present in Guatemala, and in the neighbouring countries while according to NPPO of Guatemala PepGMV is not known to occur in Guatemala (Dossier section 5.0).<br>Pepper huasteco yellow vein virus (PHYVV): according to NPPO of Guatemala PHYVV0 is present in Guatemala (Dossier section 3.0).<br>Tomato severe leaf curl virus (ToSLCV): according to NPPO of Guatemala TOSLCV is present in Guatemala (Dossier section 3.0).<br>Tomato yellow leaf curl virus (TYLCV): according to EPPO GD TYLCV is not present in Guatemala, while according to CABI is present.<br>Uncertainties: The limited number of publications from Guatemala can lead to an underestimation of the number of viruses present. For Pepper golden mosaic (PepGMV) virus there is an uncertainty on the pest status in Guatemala. No specific surveys are carried out.</td></tr>
<tr><td>Pest status in the EU</td><td>Not relevant as EU quarantine or regulated pests.</td></tr>
<tr><td>Host status on Petunia sp./Calibrachoa sp.</td><td><table>
<tr><th>Virus name</th><th>Petunia/Calibrachoa host status</th><th>Solanaceae host plants</th></tr>
<tr><td>Pepper golden mosaic virus (PepGMV)</td><td>No data</td><td>tomato, pepper, tobacco</td></tr>
<tr><td>Pepper huasteco yellow vein virus (PHYVV)</td><td>No data</td><td>tomato, pepp</td></tr>
<tr><td>Tomato severe leaf curl virus (ToSLCV)</td><td>Petunia is a natural host</td><td>tomato</td></tr>
<tr><td>Tomato yellow leaf curl virus (TYLCV)</td><td>Petunia is a natural host</td><td>tomato, potato, pepper, tobacco</td></tr>
</table>
<u>Uncertainties</u>:<br>There are no records that Petunia sp. or Calibrachoa sp. plants are hosts of PepGMV and PHYVV and that Calibrachoa sp. plants are hosts of ToSLCV and TYLCV. However, begomoviruses infecting solanaceous species are expected to have an extended host range especially within the Solanaceae family (Hancinský et al., 2021; Devendran et al., 2022). Therefore, Petunia sp. and Calibrachoa sp. are likely to be host plants of all these viruses.</td></tr>
<tr><td>PRA information</td><td>Available Pest Risk Assessments:<br>– Scientific Opinion on the risks to plant health posed by Bemisia tabaci species complex and viruses it transmits for the EU territory (Health (PLH), 2013).</td></tr>
</table>

(Continued)

| | |
|---|---|
| **Other relevant information for the assessment** | |
| **Biology** | **Transmission:**<br>Begomoviruses are transmitted by the whitefly *Bemisia tabaci* species complex most probably in a circulative, non-propagative manner. The minimum acquisition access period (AAP) and inoculation access period ranges from 10 to 60 min with increasing frequency of transmission when the AAP is extended. Following acquisition, some begomoviruses are retained in the whitefly vector for a period of several weeks up to the entire lifespan (Ran Rosen et al., 2015). For TYLCV, a single insect is capable of acquiring and transmitting the virus to infect tomato plants. Even nymphs can ingest and transmit begomoviruses. All evidence reported so far supports that infectious begomoviruses are not transovarially passed onto the insect progeny (EFSA, 2013). Most of the *B. tabaci* species complex members may transmit most, if not all, begomoviruses; however, the transmission efficiencies vary significantly among different *B. tabaci* species and sometimes among different populations of the same species (EFSA, 2013; Ran Rosen et al., 2015).<br>Like all plant viruses that systemically infect their host, begomoviruses can be also transmitted via the vegetative propagation material. The only begomovirus for which seed transmission has been proved is tomato leaf curl New Delhi in bitter gourd (*Momordica charantia* L.) (Gomathi Devi et al., 2023). There are no other means of begomoviruses transmission.<br>**Uncertainty on transmission**<br>Seed transmission of the begomoviruses in *Petunia* sp or *Calibrachoa* sp.<br>**Host range and distribution of host plants in the environment:**<br>The natural crop-hosts of **PepGMV** include pepper (*Capsicum annum* L.), tomato (*Solanum lycopersicum*), tomatillo (*Physalis ixocarpa*), cucurbits (*Cucumis sativus*, *Cucurbita pepo* var. moschata, *C. pepo, C. argyrosperma* and *Sechium edule*), tobacco plants (*Nicotiana tabacum*) as well as *Erythrina* spp., the latter being a member of the Fabaceae family. and *Capsicum frutescens* are experimental hosts of the virus. The weeds *Datura stramonium* and *D. metel* are wild experimental hosts of the virus (EPPO GD; Castro et al., 2013; Holguín-Peña et al., 2004; McLaughlin, et al., 2008; Méndez-Lozano and Rivera-Bustamante, 2001).<br>The natural crop-hosts of **PHYVV** include pepper (*Capsicum annum* L.), tomato (*Solanum lycopersicum*) and tomatillo (*Physalis ixocarpa*). Among wild species PHYVV is infecting *Nicotiana glauca, Solanum elaeagnifolium, Solanum nigrescens* and *S. rostrarum* (Melendrez-Bojorquez et al., 2016; Méndez-Lozano and Rivera-Bustamante, 2001) **ToSLCV** is known to infect tomato among cultivated species and *Datura stramonium* among weeds (Holguín-Peña, 2003).<br>**TYLCV** has a large host range including species in many families (Amaranthaceae, Chenopodiaceae, Compositae, Convolvulaceae, Cruciferae, Euphorbiaceae, Geraniaceae, Leguminosae, Malvaceae, Orobanchaceae, Plantaginaceae, Primulaceae, Solanaceae, Umbelliferae and Urticaceae) (CABI, 2012; Papayiannis et al., 2011). Among cultivated plants it infects tomato, bean (*Phaseolus vulgaris*), petunia (*Petunia hybrida*) and lisianthus (*Eustoma grandiflorum*). Common weeds infected by TYLCV are *Conyza sumatrensis*, *Convolvulus* sp., *Cynanchum acutum*, *Cuscuta* sp., *Chenopodium murale*, *Datura stramonium*, *Dittrichia viscosa, Malva parviflora* and *Solanum nigrum* which either exhibit severe symptoms or remain asymptomatic (CABI, 2012; Jorda et al., 2001).<br>All of these begomoviruses are expected to have a host range that includes more species especially within the Solanaceae family including also additional wild species (Devendran et al., 2022; Hancinský et al., 2021; Prajapat et al., 2013).<br>**Uncertainty on host range**<br>The actual host range of most begomoviruses (besides TYLCV) is largely unknown.<br>**Ecology and biology of the vectors:**<br>*B. tabaci* is present and widespread in Guatemala (EPPO GD).<br>*B. tabaci* is a highly polyphagous invasive species complex and can reach high populations on Solanaceae crops especially during warm weather conditions (Jiao et al., 2012).<br>**Symptoms on *Petunia/Calibrachoa*:**<br>Symptoms of begomovirus infections in plants consist of leaf curling or vein yellowing or green to bright yellow mosaic symptoms and leaf deformation. Early infections result in severe growth reduction, stunting and deterioration of the entire plant and the entire loss of the crop while infections at later stages of development are often mild (EFSA, 2013). *Petunia* plants infected with begomoviruses are expected to exhibit symptoms easy to be detected by an inspector such as leaf chlorosis and distortion, apical distortion and swellings of the veins on the underside of the leaf; plants infected when young may not develop flowers (described on petunia by TYLCV; Sikron et al., 1995). Upward leaf curling, yellowing and vein yellowing or yellow mosaic, and size reduction in leaves have been also described on petunia by another begomovirus, Chilli leaf curl virus (Al-Shihi et al., 2014). However, there is an asymptomatic phase of all systemic virus infections. Temperature and light intensity are expected to affect the speed of systemic infection (usually within 2 to 3 weeks) and disease severity. |
| **Evidence that the commodity can be a pathway** | Unrooted cuttings of *Petunia* sp. or *Calibrachoa* sp. can be systemically infected by begomoviruses and/or infested by viruliferous whiteflies. |
| **Surveillance information** | There are no targeted surveys for begomoviruses in Guatemala. |

## A.2.2 | Possibility of pest presence in the nursery

### A.2.2.1 | Possibility of entry from the surrounding environment

The natural host range of begomoviruses includes members of the Solanaceae but also from other families. These viruses are naturally transmitted by *B. tabaci* (Brown, 1989) and both the viruses and its vector are present in Guatemala (CABI, EPPO; online). Most begomovirus infections are associated with pepper and tomato plants. However, some of them can also infect other cultivated plants, while weeds can also act as a reservoir for several begomoviruses (Prajapat et al., 2013). The main pathway of entrance of the virus from the surrounding environment in the nursery is through viruliferous *B. tabaci* insects. Defects in the insect proof structure of the production greenhouses could enable whiteflies to enter, as well as hitchhiking whiteflies on persons or materials entering the greenhouse.

Uncertainties:

- Presence of defects in the greenhouse structure.
- Infection (virus) and infestation (vector) pressure in the surroundings.
- Presence and distribution of host plants in the surroundings.

#### A.2.2.2 | Possibility of entry with new plants/seeds

Plant material (cuttings) for *Petunia/Calibrachoa* mother plants used for the production of unrooted cutting originate from the Netherlands, Germany, El Salvador and Israel. The above listed non-EU begomoviruses are not present in the Netherlands and Germany, but TYLCV is present in Israel and there are not surveys to confirm the absence of the other begomoviruses in El Salvador and Israel. In all countries a certification scheme is in place for *Petunia/Calibrachoa*, however the details are not known. Incoming mother plants are not tested in the nursery for begomovirus at the start of the production (Dossier section 1.0, 4.0, 5.0).

Other solanaceous and non-solanaceous plants are produced in the same nursery and their cultivation rotates within the nursery greenhouses/compartments. No data are provided for the identity, proportion, origin and phytosanitary status of other than *Petunia/Calibrachoa* plants produced in the same nursery.

Uncertainties:

- The detail of the *Petunia/Calibrachoa* certification schemes in the non-EU countries.
- The proportion of *Petunia/Calibrachoa* mother plants coming from non-EU countries.
- The presence of begomoviruses in El Salvador and Israel.
- The origin and the host status for begomoviruses and the phytosanitary status of other plant species (solanaceous, non-solanaceous) entering the same nursery.
- The phytosanitary requirements for imports into Guatemala.

#### A.2.2.3 | Possibility of spread within the nursery

*Petunia* spp. and *Calibrachoa* spp. are cultivated in dedicated compartments for their cultivation with no other plant species. However, other plants (solanaceous and non-solanaceous) possible hosts of begomoviruses are cultivated and *B. tabaci* could be present in other greenhouses/compartments of the nursery. Viruliferous *B. tabaci* could spread begomoviruses between the different or within the same greenhouse/compartment. Begomoviruses may also spread by vegetative propagation of infected mother plants.

Uncertainties:

- The presence and density of the begomoviruses and *B. tabaci* in the nursery.
- The presence and the host status for begomoviruses of other plant species (solanaceous, non-solanaceous) growing in the same nursery.

### A.2.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions of *Begomoviruses* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala.

### A.2.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination. |

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| | | Evaluation:<br>Plants in the greenhouse are protected from *B. tabaci* that may enter from the surrounding environment. *B. tabaci* may be introduced through defects in the greenhouse or as hitchhikers on greenhouse staff. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>– Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Each unit have a specific change a disinfection area.<br>*Petunia* spp.and *Calibrachoa* spp. are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of viruses.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| Soil treatment | N | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from EU (Germany, The Netherlands) and non-EU countries (El Salvador, Israel) and are reported to be certified.<br>Evaluation:<br>The material originated from non-EU countries (Israel and El Salvador) is certified, hence expected to comply with the respective phytosanitary legislation. If begomovirus monitoring (inspections, testing) is included in the certification schemes, *Petunia* spp. or *Calibrachoa* spp. plants are expected to be free of symptoms and tested negative for begomoviruses.<br>Uncertainties:<br>– The details of the certification schemes and if begomovirus monitoring is included in those schemes.<br>– The phytosanitary status of the imported material from the non-EU countries. |
| Crop rotation | N | Description:<br>The production plots for Solanaceae crops destined for export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfect irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects.<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of *B. tabaci* and of begomoviruses. However, early infections cannot be detected due to the lack of symptoms.<br>Uncertainties:<br>– The efficiency of monitoring and inspection.<br>– The length of the latent period till the expression of symptoms. |
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0).<br>Evaluation:<br>The applied insecticides are effective against the vector *B. tabaci*. However, *B. tabaci* and especially some species of the complex (e.g. MED) are known for having developed resistance to some insecticides.<br>Uncertainties:<br>– The efficacy and timing of the applied insecticide are not known. |

(Continues)

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Sampling and testing | Y | Description:<br>*Petunia* spp. and *Calibrachoa* spp. plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus.<br>Evaluation: There are not antibodies and/or serological techniques (immunostrips) available against the above mentioned begomoviruses except for TYLCV. Serological techniques may fail to detect early infections where virus concentration is below the detection limit of method used.<br>There is a molecular (PCR) generic test able to detect begomoviruses including PHYVV, PepGMV, ToSLCV and TYLCV. However, according to the dossier no molecular method is used.<br>Uncertainties:<br>The use and the efficiency of serological techniques for the detection of TYLCV. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* sp. and *Calibrachoa* sp. cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pests and diseases. An inspection certificate is issued and stored at the nursery as proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>The monitoring can detect the presence of *B. tabaci* and as consequence the nursery will be under official control according the point 7 c, Annex VII of the EU Reg. 2019/2072 (*'the plants have been subjected to an effective treatment ensuring the eradication of Bemisia tabaci and the other vectors of the Union quarantine pests and have been found free thereof prior to export'*).<br>Once begomoviruses can be transmitted by a single *B. tabaci* individual, some infections may occur before the development of a detectable whitefly population. Infected *Petunia* sp. And *Calibrachoa* sp. plants are expected to exhibit distinct symptoms to be detected however, these symptoms are not obvious in the early stages of infection. Especially in large plants and high canopy densities the infected plants that are expected to show a more dwarfed appearance may be covered by the neighbouring, full-in-size healthy plants.<br>Uncertainties:<br>– The efficiency of monitoring and inspection. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>Surveillance in the area surrounding the nurseries could provide data on the presence and abundance of the viruses and their vectors. However, no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of the surveillance scheme. |

## A.2.5 | Overall likelihood of pest freedom

### A.2.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- PepGMV and PHYVV has not been reported to infect *Petunia/Calibrachoa*.
- Begomoviruses has not been reported on *Petunia/Calibrachoa* in Guatemala.
- Begomoviruses have never been intercepted on produce from Guatemala.
- Certification system for mother plants in non- EU countries ensure the absence of begomoviruses in the source material.
- Low infection pressure (prevalence of host plants) of begomoviruses in the surrounding environment.
- No infection pressure (prevalence of host plants) of begomoviruses in other greenhouses/compartments of the nursery.
- Transfer of infected *B. tabaci* from virus-sources (infected host plants) in the surrounding environment to the greenhouse plants is very difficult because of insect proof structure and its efficient inspection of the greenhouse and the strict hygienic measure in place preventing the natural and human-assisted movement of the whiteflies.
- *Petunia/Calibrachoa* is not a preferred host for *B. tabaci*.

- The scouting monitoring regime is effective and infected plants by begomoviruses or *B. tabaci* individuals present in the nurseries are expected to be easily detected.

  - Application of the insecticides have a good efficacy against whiteflies.
  - At harvest and packing, cuttings with symptoms are easy to be detected.
  - *tabaci* is not a good flyer and dispersal is mainly dependent on wind or human-assisted movement.
  - The inspection regime is effective (detection and treatment).
  - Physical separation of different lots offers in case of infestation the restriction of the affected plants.

A.2.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- Even if there is no evidence that *Petunia/Calibrachoa* is a host plant for PepGMV and PHYVV, given the sensitivity of solanaceous hosts it is likely that petunia/calibrachoa is a suitable host plant.
- Solanaceous are very sensitive to begomovirus infections and infections are reported in Guatemala.

  - High population pressure in highly preferred host (e.g. abandoned infected field of highly preferable host close to the greenhouse).
  - Certification system for mother plants in non- EU countries does not ensure the absence of begomoviruses in the source material.

- Presence of *B. tabaci* and begomoviruses in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure or whiteflies hitchhike on greenhouse staff or materials.
- Transmission of begomoviruses via vegetative propagated material increases the probability of their entry and establishment in the nursery on *Petunia/Calibrachoa* or other host plant species.
- *B. tabaci* has developed insecticide resistance to the applied insecticides.

  - *B. tabaci* is widespread in GA and considering its wide host range it is likely that host plants are present in the surrounding environment.
  - Presence of whiteflies species in the environment is not monitored.
  - Early (asymptomatic) infections cannot be visually detected.

A.2.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

The value of the median is estimated based on:

- Solanaceous are sensitive/generic hosts for begomoviruses, therefore petunia/calibrachoa is expected to be host also for PepGMV and PHYVV.
- There are no records of interceptions from Guatemala.
- The protective effect of the greenhouse structure.
- The insecticides treatments are moderately effective against *B. tabaci*.
- The high density of the mother plants in the nurseries before cutting prevents the detection of infected plants.

A.2.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile / interquartile range)

- There is low uncertainty about the protective effect of the greenhouse structure.

## A.2.6 | Elicitation outcomes of the assessment of the pest freedom for begomoviruses

The following Tables show the elicited and fitted values for pest infestation (Table A.3) and pest freedom (Table A.4).

**TABLE A.3** Elicited and fitted values of the uncertainty distribution of pest infestation by begomoviruses per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 0 | | | | | 2 | | 5 | | 12 | | | | | 40 |
| EKE | 0.0275 | 0.0895 | 0.219 | 0.542 | 1.07 | 1.87 | 2.82 | 5.31 | 8.99 | 11.6 | 15.4 | 20.1 | 26.3 | 32.4 | 40.1 |

The EKE results is the *BetaGeneral (0.779, 15.279, 0, 170)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.4.

**TABLE A.4** The uncertainty distribution of plants free of begomoviruses per 10,000 bugs of unrooted cuttings calculated by Table A.3.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9960 | | | | | 9988 | | 9995 | | 9998 | | | | | 10,000 |
| EKE results | 9960 | 9968 | 9974 | 9980 | 9985 | 9988 | 9991 | 9995 | 9997 | 9998.1 | 9998.9 | 9999.5 | 9999.8 | 9999.9 | 10,000.0 |

The EKE results are the fitted values.

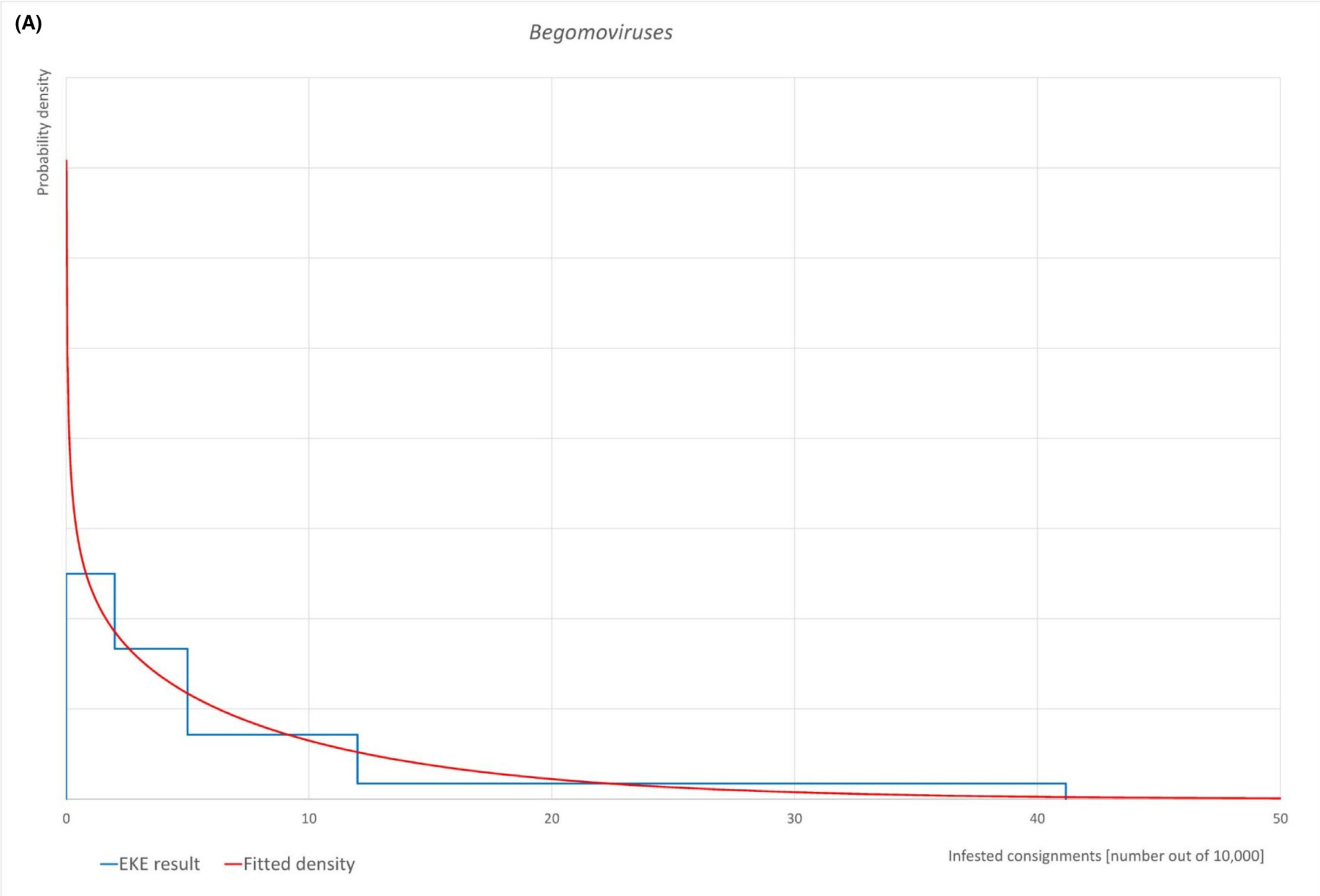


**FIGURE A.2** (Continued)

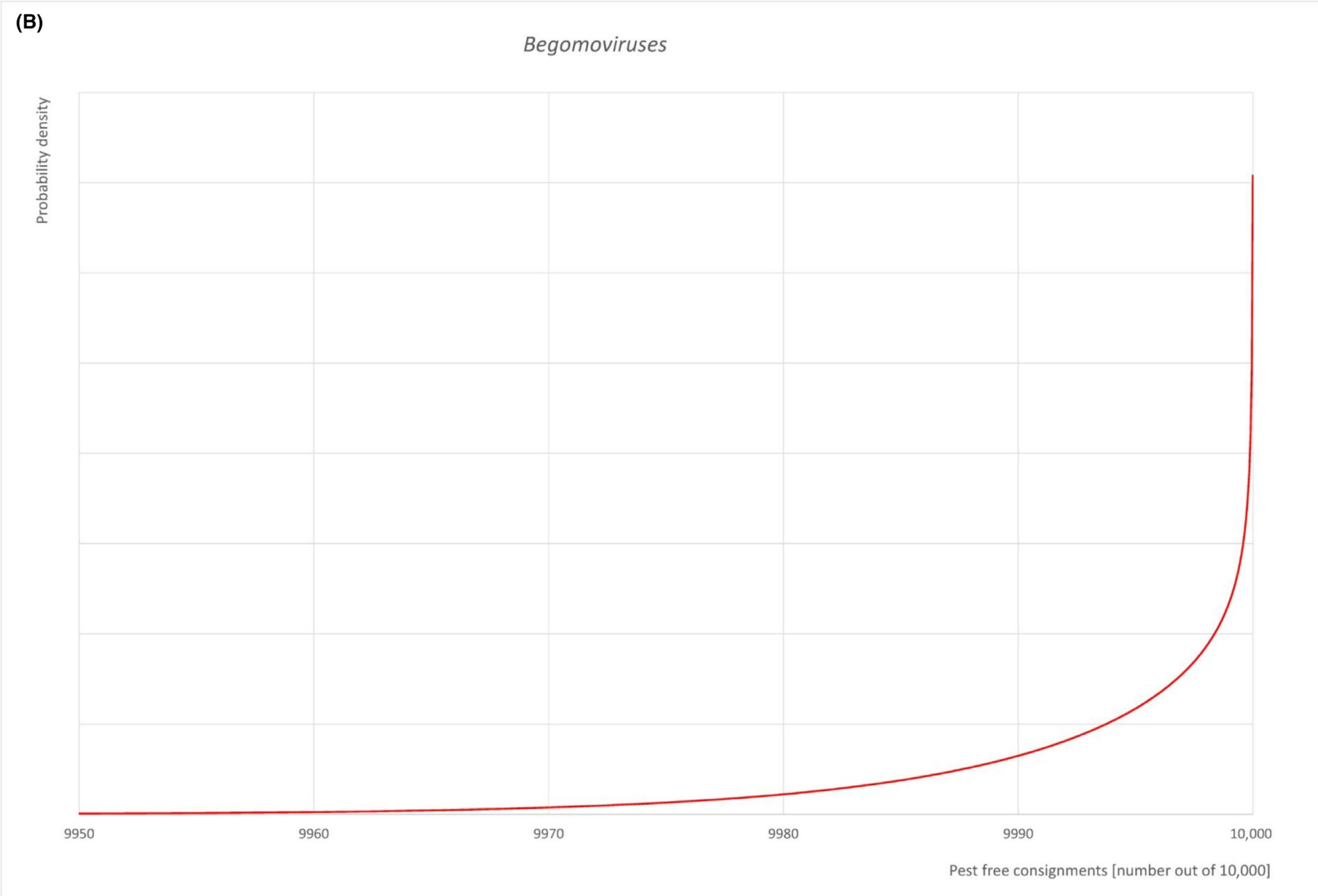


**FIGURE A.2** (Continued)

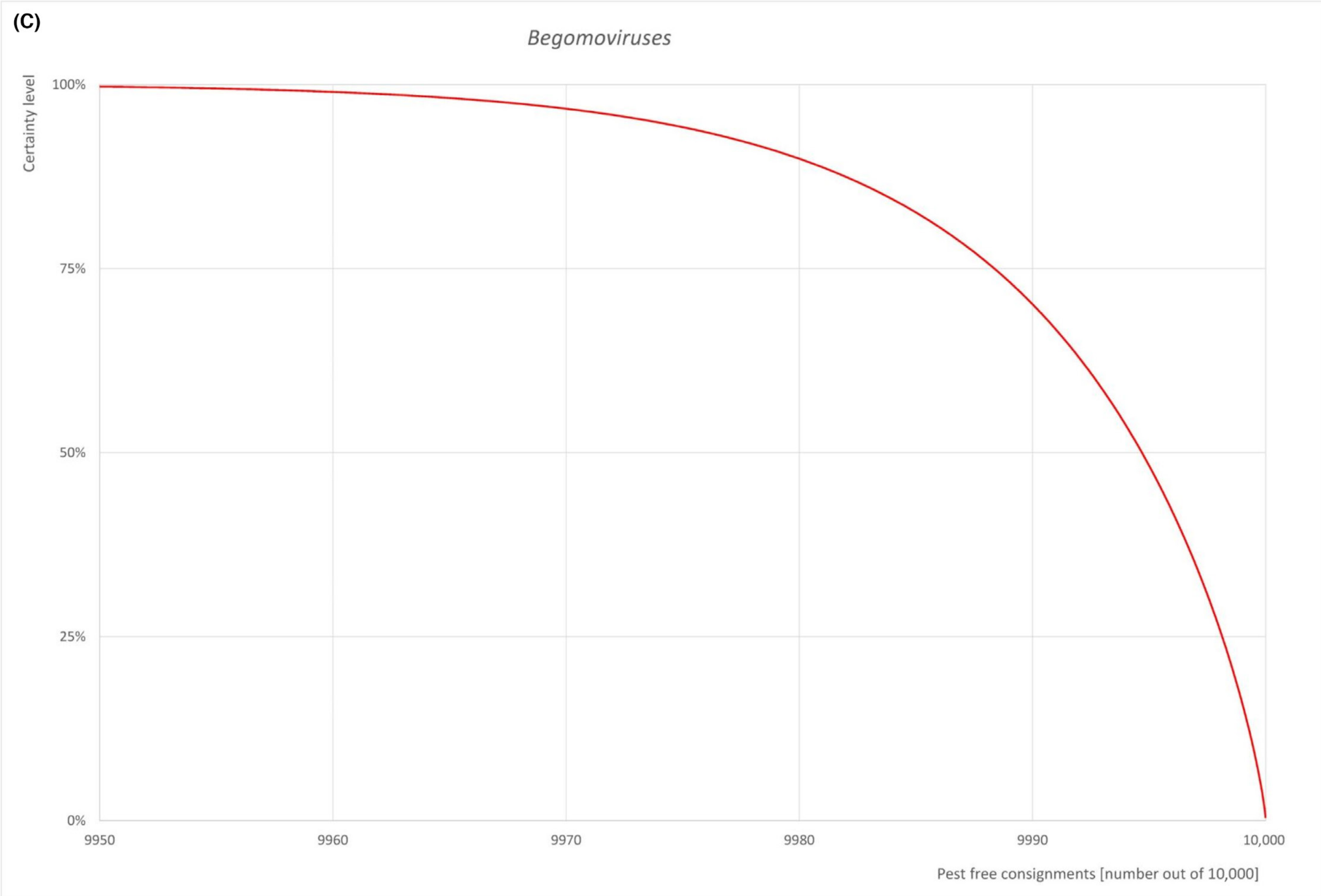


**FIGURE A.2** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for begomoviruses complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags

## A.2.7 | Reference list


Ala-Poikela, M., Svensson, E., Rojas, A., Horko, T., Paulin, L., Valkonen, J.P.T., & Kvarnheden, A., (2005). Genetic diversity and mixed infections of begomoviruses infecting tomato, pepper and cucurbit crops in Nicaragua. *Plant Pathology*, 54, 448–459. https://doi.org/10.1111/j.1365-3059.2005.01226.x

Al-Shihi, A. A., Akhtar, S., & Khan, A. J. (2014). Identification of chili leaf curl virus causing leaf curl disease of *Petunia* in Oman. Plant Diseases, 98(4), 572. https://doi.org/10.1094/PDIS-06-13-0678-PDN

Barboza, N., Blanco-Meneses, M., Esker, P., Moriones, E., & Inoue-Nagata, A. K., (2018). Distribution and diversity of begomoviruses in tomato and sweet pepper plants in Costa Rica. *Annals of Applied Biology*, 172, 20–32. https://doi.org/10.1111/aab.12398

Brown, J. K. (1989). A whitefly-transmitted *Geminivirus* from peppers with tigré disease. *Plant Diseases*, 73, 610. https://doi.org/10.1094/PD-73-0610E

Brown, J. K., Idris, A. M., Ostrow, K. M., Goldberg, N., French, R., & Stenger, D. C., (2005). Genetic and phenotypic variation of the pepper golden mosaic virus complex. *Phytopathology*, 95, 1217–1224. https://doi.org/10.1094/PHYTO-95-1217

Carrillo-Tripp, J., Lozoya-Gloria, E., & Rivera-Bustamante, R.F. (2007). Symptom remission and specific resistance of pepper plants after infection by pepper golden mosaic virus. *Phytopathology*, 97, 51–59. https://doi.org/10.1094/PHYTO-97-0051

Castro, R. M., Moreira, L., Rojas, M. R., Gilbertson, R. L., Hernández, E., Mora, F., & Ramírez, P. (2013). Occurrence of squash yellow mild mottle virus and pepper golden mosaic virus in potential new hosts in Costa Rica. *The Plant Pathology Journal*, 29, 285–293. https://doi.org/10.5423/PPJ.OA.12.2012.0182

Czosnek, H., Hariton-Shalev, A., Sobol, I., Gorovits, R., & Ghanim, M. (2017). The incredible journey of begomoviruses in their whitefly vector. *Viruses*, 9(10), 273. https://doi.org/10.3390/v9100273

De La Torre, R., Lotrakul, P., Valverde, R. A., Sim, J., & Gomez, A. (1998). Identification of a *Geminivirus* infecting pepper in Costa Rica. *Phytopathology*, 88, S21–S21.

Devendran, R., Kumar, M., Ghosh, D., Yogindran, S., Karim, M.J., & Chakraborty, S., (2022). Capsicum-infecting begomoviruses as global pathogens: Host–virus interplay, pathogenesis, and management. *Trends Microbiology*, 30, 170–184. https://doi.org/10.1016/j.tim.2021.05.007

EFSA PLH Panel (EFSA Panel on Plant Health). (2013). Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory. *EFSA Journal*, 11(4), 3162. https://doi.org/10.2903/j.efsa.2013.3162

EUROPHYT. (online). European Union Notification System for Plant Health Interceptions – EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

Gomathi Devi, R., Jothika, C., Sankari, A., Lakshmi, S., Malathi, V. G., Renukadevi, P. (2023). Seed transmission of begomoviruses: a potential threat for bitter gourd cultivation. *Plants*, 12, 1396. https://doi.org/10.3390/plants12061396

Hančinský, R., Mihálik, D., Mrkvová, M., Candresse, T., & Glasa, M. (2020). Plant viruses infecting Solanaceae family members in the cultivated and wild environments: A Review. *Plants*, *9*, 667. https://doi.org/10.3390/plants9050667

Holguín-Peña, R. J., Juárez, R. V., & Rivera-Bustamante, R. F. (2004). Pepper golden mosaic virus affecting tomato crops in the Baja California Peninsula, Mexico. *Plant Diseases*, 88, 221–221. https://doi.org/10.1094/PDIS.2004.88.2.221A

Holguín-Peña, R. J., Vázquez Juárez, R., & Rivera-Bustamante, R. F. (2003). First report of a *Geminivirus* associated with leaf curl in Baja California Peninsula tomato fields. *Plant Diseases*, 87, 1397–1397. https://doi.org/10.1094/PDIS.2003.87.11.1397A

Jiao, X. G., Xie, W., Wang, S. L., Wu, Q. J., Zhou, L., Pan, H. P., et al. (2012). Host preference and nymph performance of B and Q putative species of *Bemisia tabaci* on three host plants. *Journal of Pest Sciences*, 85, 423–430. 10.1007/s10340-012-0441-2

Jordá, C., Font, I., Martínez, P., Juarez, M., Ortega, A., & Lacasa, A. (2001). Current status and new natural hosts of tomato yellow leaf curl virus (TYLCV) in Spain. *Plant Disease*, 85(4), 445–445.

Lotrakul, P., Valverde, R.A., De La Torre, R., Sim, J., & Gomez, A. (2000). Occurrence of a strain of Texas pepper virus in Tabasco and Habanero pepper in Costa Rica. *Plant Diseases*, 84, 168–172. https://doi.org/10.1094/PDIS.2000.84.2.168

McLaughlin, P. D., McLaughlin, W. A., Maxwell, D. P., & Roye, M. E. (2008). Identification of begomoviruses infecting crops and weeds in Belize. *Plant Viruses*, 2, 58–63.

Medina-Ramos, G., Almaráz, R., Bujanos Muñiz, R., Guevara-Gonzalez, R., Tierranegra-Garcia, N., Guevara-Olvera, L., Chavira, M., & Pacheco, I. (2008). Co-transmission of pepper huasteco yellow vein virus and pepper golden mosaic virus in chili pepper by *Bemisia tabaci* (Genn.). *Journal of Entomology*, 5, 176–184. https://doi.org/10.3923/je.2008.176.184

Melendrez-Bojorquez, N., Magallanes-Tapia, M. A., Armenta-Anaya, C., Camacho-Beltrán, E., Rodríguez-Negrete, E. A., Leyva-López, N. E., & Méndez-Lozano, J. (2016). Pepper huasteco yellow vein virus associated to sweet pepper disease in Sinaloa, Mexico. *Plant Diseases*, 100. https://doi.org/10.1094/PDIS-02-16-0226-PDN

Méndez-Lozano, J., Rivera-Bustamante, R. F., Fauquet, C. M., & la Torre-Almaraz, R. D. (2001). Pepper huasteco virus and pepper golden mosaic virus are geminiviruses affecting tomatillo (*Physalis ixocarpa*) crops in Mexico. *Plant Diseases*, 85, 1291–1291. https://doi.org/10.1094/PDIS.2001.85.12.1291A

Méndez-Lozano, J., Torres-Pacheco, I., Fauquet, C. M., & Rivera-Bustamante, R. F. (2003). Interactions between geminiviruses in a naturally occurring mixture: pepper huasteco virus and pepper golden mosaic virus. *Phytopathology*, 93,, 270–277. https://doi.org/10.1094/PHYTO.2003.93.3.270

Papayiannis, L. C., Katis, N. I., Idris, A. M., & Brown, J. K. (2011). Identification of weed hosts of Tomato yellow leaf curl virus in Cyprus. *Plant Disease*, 95(2), 120–125. https://doi.org/10.1094/PDIS-05-10-0346

Prajapat R., Marwal, A., & Gaur, R. K. (2014). Begomovirus associated with alternative host weeds: A critical appraisal. *Archives of Phytopathology and Plant Protection*, 47(2), 157–170. https://doi.org/10.1080/03235408.2013.805497

Paximadis, M., Idris, A. M., Torres-Jerez, I., Villarreal, A., Rey, M. E. C., Brown, J. K. (1999). Characterization of tobacco geminiviruses in the old and new world. *Archives of Virology*, 144, 703–717. https://doi.org/10.1007/s007050050537

Rosen, R., Kanakala, S., Kliot, A., Pakkianathan, B. C., Abu Farich, B., Santana-Magal, N., Elimelech, M., Kontsedalov, S., Lebedev, G., Cilia, M., & Ghanim, M. (2015). Persistent, circulative transmission of begomoviruses by whitefly vectors. *Current Opinion in Virology*, 15, 1–8, https://doi.org/10.1016/j.coviro.2015.06.008

Sikron, N., Cohen, J., Shoval, S., & Gera, A. (1995). Virus diseases in *Petunia*. *Phytoparasitica*, 23, 273.

Zerbini, F. M., Briddon, R. W., Idris, A., Martin, D. P., Moriones, E., Navas-Castillo, J., Rivera-Bustamante, R., Roumagnac, P., & Varsani, A. (2017). ICTV virus taxonomy profile: *Geminiviridae*. *Journal of Genetics Virology*, 98, 131–133. https://doi.org/10.1099/jgv.0.000738

## A.3 | *Eotetranychus lewisi*

### A.3.1 | Organism information

| | |
|---|---|
| **Taxonomic information** | Current valid scientific name: *Eotetranychus lewisi* (McGregor, 1943).<br>Synonyms: *Tetranychus lewisi*<br>Name used in the EU legislation: *Eotetranychus lewisi*<br>Order: Acarida<br>Family: Tetranychidae<br>Common name: Lewis spider mite<br>Name used in the dossier: *Eotetranychus lewisi* |
| **Group** | Mites |
| **EPPO code** | EOTELE |
| **Regulated status** | Quarantine pest in the EU (Annex II Part A) |
| **Pest status in Guatemala** | Present (EPPO, online) |
| **Pest status in the EU** | No relevant as a quarantine pest. |
| **Host status on *Petunia* spp. and *Calibrachoa* spp** | *Eotetranychus lewisi* is a pest of 86 plant species belonging to 26 different families (EPPO, online; EFSA, 2017). Although this mite has not been reported to feed on *Petunia* spp. and *Calibrachoa* spp. plants, given its polyphagous nature including Solanaceous host plants (*Solanum elaeagnifolium*, *Solanum* sp.), the Panel assumes that Petunia/Calibrachoa are suitable host plants.<br>Uncertainties: the host status of *Petunia* spp. and *Calibrachoa* spp. *plants* to *Eotetranychus lewisi*. |
| **PRA information** | A pest risk assessment of *Eotetranychus lewisi* has been prepared by EFSA (2017).<br>EFSA, 2017. Pest risk assessment of *Eotetranychus lewisi* for the EU territory. EFSA Journal, 15(10), 4878. |

| | | |
|---|---|---|
| **Other relevant information for the assessment** | | |
| **Biology** | *Eotetranychus lewisi* is a polyphagous spider mite that feeds upon the leaves and fruits of more than 86 plant species (EPPO, online). On most host plants the mite feeds on the underside of leaves, mostly close to the main veins. As the infestation increases *E. lewisi* spread to all parts of the leaves (EPPO, 2006; EFSA, 2014). The life cycle of the mite includes five stages: egg, larva, protonymph, deutonymph and adult (EFSA, 2014). The females start their oviposition in less than 24 hours after emergence and deposited five eggs per day on average at temperatures from 17°C to 23°C (McGregor, 1943). The eggs hatch after 3.33 days while the larval and nymphal developmental period is 3.60 and 3.65 days, respectively, on strawberry leaves at 25°C (Kaur and Zalom, 2017). According to Lai and Lin (2005) on poinsettia leaves at 26°C the egg hatching takes an average of 2.5 days while the larval and nymphal stages last 1.8 and 3.7 days, respectively. The fecundity of *E. lewisi* is 41.25 eggs/mite at 25°C (Kaur and Zalom, 2017). The lower development temperature threshold of *E. lewisi* from egg to adult is between 8.3°C and 9.0°C while the upper development threshold is 28.2°C (Lai and Lin, 2005). Development from egg to adult takes 8.0 days on poinsettia leaves at 26°C (Lai and Lin, 2005) and 10.58 days on strawberry leaves at 25°C (Kaur and Zalom, 2017). The life cycle of the mite is completed in 19.35 days on strawberry leaves at 25°C (Kaur and Zalom, 2017). The egg to adult survival rate of *E. lewisi* on poinsettia leaves at 26°C is 85% but drops considerably to approximately 30% at 28°C (Lai and Lin, 2005). Females live for 16 days at 24°C (Lai and Lin, 2005). In southern Europe, the *E. lewisi* can complete over 10 generations per year (EFSA, 2017). Body length ranges from 0.270 to 0.360 mm. | |
| **Symptoms** | **Main type of symptoms** | Symptoms of infestation vary according to the host plant. On poinsettia, the mite feeds on the underside of the leaves and causes a speckled or peppered appearance on the foliage. The colour of the leaves become pale as the chlorophyl is lost. When there is a heavy infestation profuse webbing is produced especially around the flowering parts. Extensive feeding cause leaf drop. (Doucette, 1962). On citrus, the mite feeding either on the fruit or the leaf, causes pigment extraction which results in a stippling of the rind and epidermis with paler spots (McGregor, 1943). Heavy infestations cause silvering on lemons and silvering or russeting on oranges (Jeppson et al., 1975). On strawberry, causes chlorosis and bronzing of the leaves, and at high densities a reduction in fruit production (EFSA, 2014). On papaya, feeding causes chlorosis and distortion of the young leaves. In severe infestations, the young leaves lose their laminas, while the leaf veins remain (EPPO, 2023). |
| | **Presence of asymptomatic plants** | No asymptomatic period is known to occur. |
| | **Confusion with other pathogens/pests** | *Eotetranychus lewisi* is similar in colour to *Tetranychus urticae* but it is a little smaller and narrower with several small greenish spots, in contrast to *Tetranychus urticae* that has only two greenish spots (Gilrein, 2006).<br>A diagnostic protocol for *E. lewisi* is given by EPPO (2006). |

(Continues)

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| | |
|---|---|
| **Host plant range** | *Eotetranychus lewisi* is a highly polyphagous pest. The most significant hosts are several species of *Citrus* (*C. limon, C. paradisi, C. sinensis*), peaches (*Prunus persica*), the castor oil plants (*Ricinus communis*), *Fragaria* x *ananassa* and *Euphorbia* spp. Many other cultivated and wild plant species have also been reported as host plants like olive trees, cotton, figs, papaws and vines as well as several tree species like acacias, pines and aspens (EPPO, online; EFSA, 2017).<br>It should be noted that the report of a plant species as a host of *E. lewisi* does not necessarily mean that the mite can complete its life cycle on the species or that it can cause economic damage. Therefore, there is uncertainty regarding the exact host status of some of the reported host plant species (EFSA, 2017). |
| **What life stages could be expected on the commodity** | Eggs, larvae, nymphs and adults may be present on host plants.<br>No information for this pest on *Petunia* spp. or *Calibrachoa* spp. plants is available. |
| **Surveillance information** | *E. lewisi* is reported to be present in *Euphorbia pulcherrima* cultivations in the highlands of the country. There is no information of surveillance in the surrounding environment of the nurseries. |

## A.3.2 | Possibility of pest presence in the nursery

### A.3.2.1 | Possibility of entry from the surrounding environment

*E. lewisi* is a pest of many plants of various families and it is reported to be present in Guatemala, especially in the highlands. Given the wide host range of this pest it is possible that local populations of *E. lewisi* may be present in the neighbouring environment. Spider mites are dispersed by wind currents in the field (EPPO, 2023), so they may enter the nursery from host plants that might be present in the surrounding environment. Defect in the insect proof structure of the production greenhouses could enable mites to enter, as well as hitchhiking on persons or material entering the greenhouse.

Uncertainties:

- Presence of defect in the greenhouse structure.
- Abundance of *E. lewisi* in the surroundings.
- Presence and distribution of host plants in the surroundings.

### A.3.2.2 | Possibility of entry with new plants/seeds

Mother plants used for the production of unrooted cutting originate from the Netherlands, Germany, El Salvador and Israel. *E. lewisi* is present in El Salvador. *E. lewisi* could be introduced with mother plants from El Salvador.

Uncertainties:

- The abundance of the species in El Salvador
- The host status of *E. lewisi* on *Petunia* spp. and *Calibrachoa* spp.

### A.3.2.3 | Possibility of spread within the nursery

When present, mites searching for food sources can spread from infested host plants within the nursery. Movement within the nursery is limited and mainly related to hitchhiking.

Uncertainties:

- there are no uncertainties.

## A.3.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions of *E. lewisi* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala.

## A.3.4 | Risk Mitigation Measures applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing *E. lewisi* that may enter from the surrounding environment. *E. lewisi* may be introduced through defects in the greenhouse. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>– Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* spp. and *Calibrachoa* spp. are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of mites.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| Soil treatment | Y | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses.<br>Evaluation: Growing substrate is kept free from eggs and larvae of *E. lewisi*. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2)<br>Evaluation:<br>The species, *E. lewisi* is not known to be present in these countries except El Salvador.<br>Uncertainties:<br>The abundance of the species in El Salvador. |
| Crop rotation | N | Description:<br>The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfect irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whitefly, shoreflies and other flying insects<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of *E. lewisi* adults.<br>Uncertainties:<br>– The efficiency of monitoring and inspection. |
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0).<br>Evaluation:<br>The applied insecticides are effective against *E. lewisi.*<br>Uncertainties:<br>– The efficacy of the applied insecticide and its timing is not known. |

(Continues)

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Sampling and testing | N | Description:<br>*Petunia* spp. and *Calibrachoa* spp. plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber<br>The shipment of *Petunia* spp. and *Calibrachoa* spp. cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>The monitoring can detect the presence of *E. lewisi*.<br>Uncertainties:<br>– The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>Surveillance on *Euphorbia pulcherrima* cultivations allows to detect *E. lewisi* that is present mainly in highlands of the country.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of *E. lewisi*. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of surveillance scheme. |

## A.3.5 | Overall likelihood of pest freedom

### A.3.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* spp. and *Calibrachoa* spp. are not a preferred host.
- *E. lewisi* has never been intercepted on produce from Guatemala.
- Dispersal capacity of *E. lewisi* is limited.
- Low population pressure of *E. lewisi* in the surrounding environment, due to absence of preferred host plants.
- Greenhouse structure is insect-proof and entrance is thus unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected because of the typical symptoms on leaves.
- Application of the insecticides have a good efficacy against *E. lewisi*.
- At harvest and packing, cuttings with symptoms will be detected.

### A.3.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *E. lewisi* is present throughout Guatemala and has a wide host range, therefore it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *E. lewisi* is present and abundant (e.g. Citrus).
- Presence of *E. lewisi* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Due to their small size detection is difficult.
- Insecticide treatments are not targeting *E. lewisi*.

### A.3.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The protective effect of the greenhouse structure.
- The insecticides treatments are effective.
- There are no records of interceptions from Guatemala.

### A.3.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range))

- The main uncertainty is the population pressure of *E. lewisi* in the surrounding environment.
- High uncertainty for values below median.
- Less uncertainty for higher values.

### A.3.6 | Elicitation outcomes of the assessment of the pest freedom for *E. lewisi*

The following Tables show the elicited and fitted values for pest infestation (Table A.5) and pest freedom (Table A.6).

**TABLE A.5** Elicited and fitted values of the uncertainty distribution of pest infestation by *Eotetranychus lewisi* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 1 | | | | | 2 | | 5 | | 15 | | | | | 70 |
| EKE | 1.00 | 1.01 | 1.03 | 1.12 | 1.37 | 1.89 | 2.69 | 5.39 | 10.4 | 14.4 | 20.6 | 29.0 | 41.0 | 53.4 | 70.1 |

*Note*: The EKE results is the *BetaGeneral (0.46487, 47.39, 1, 1050)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.6.

**TABLE A.6** The uncertainty distribution of plants free of *Eotetranychus lewisi* per 10,000 bugs of unrooted cuttings calculated by Table A.5.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9930 | | | | | 9985 | | 9995 | | 9998 | | | | | 9999 |
| EKE results | 9930 | 9947 | 9959 | 9971 | 9979 | 9986 | 9990 | 9995 | 9997 | 9998.1 | 9998.6 | 9998.88 | 9998.97 | 9998.99 | 9999.00 |

*Note*: The EKE results are the fitted values.

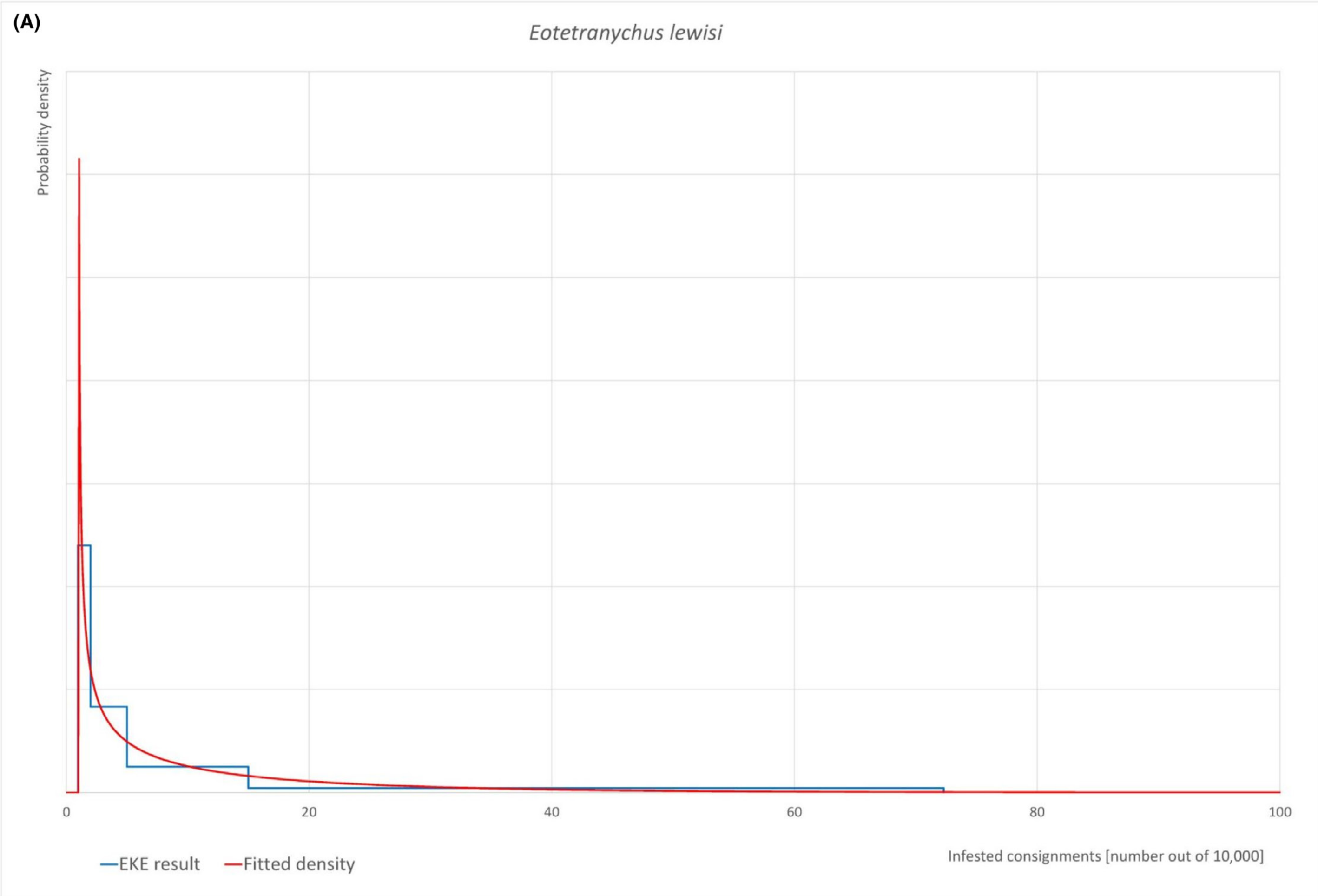


**FIGURE A.3** (Continued)

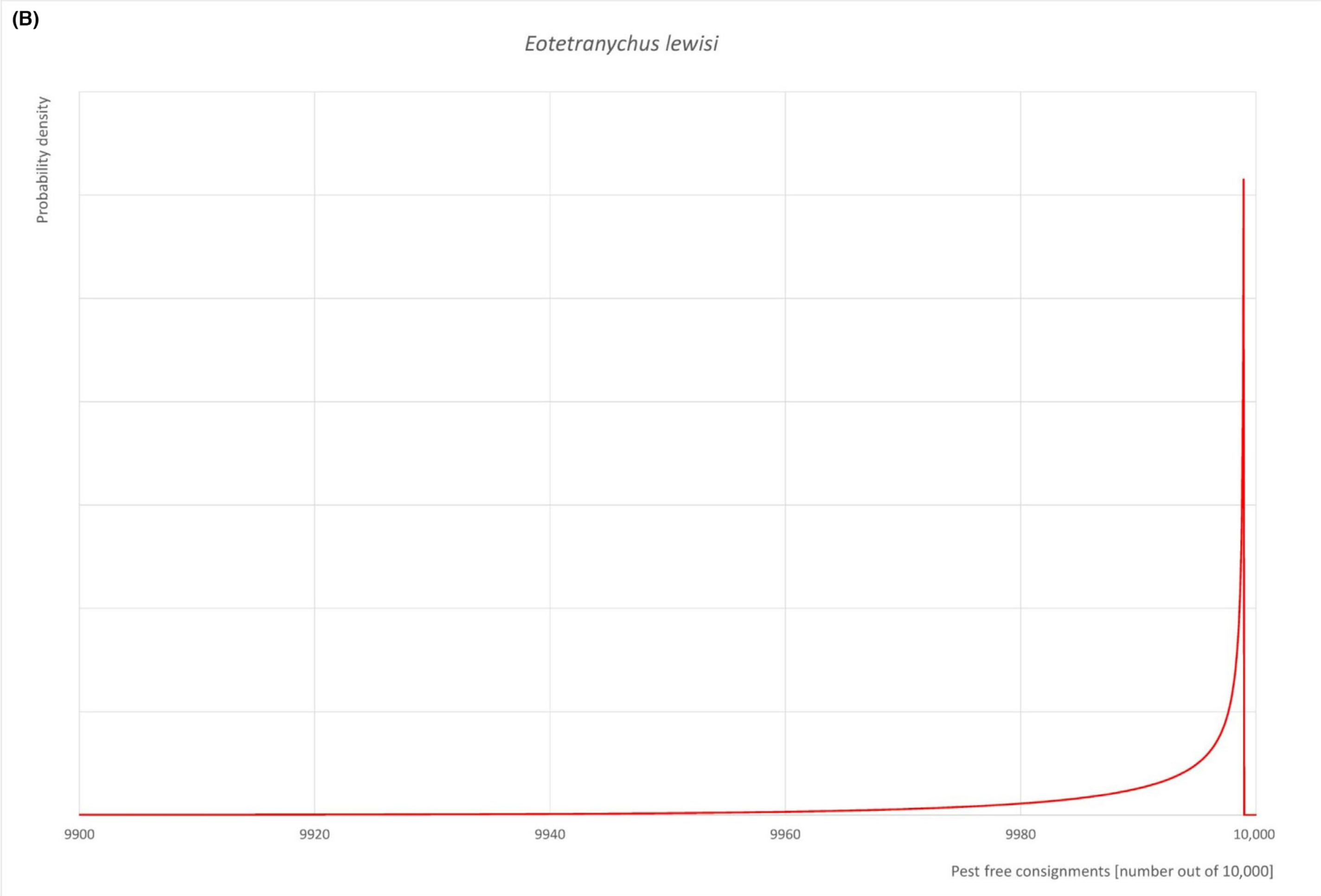


**FIGURE A.3** (Continued)

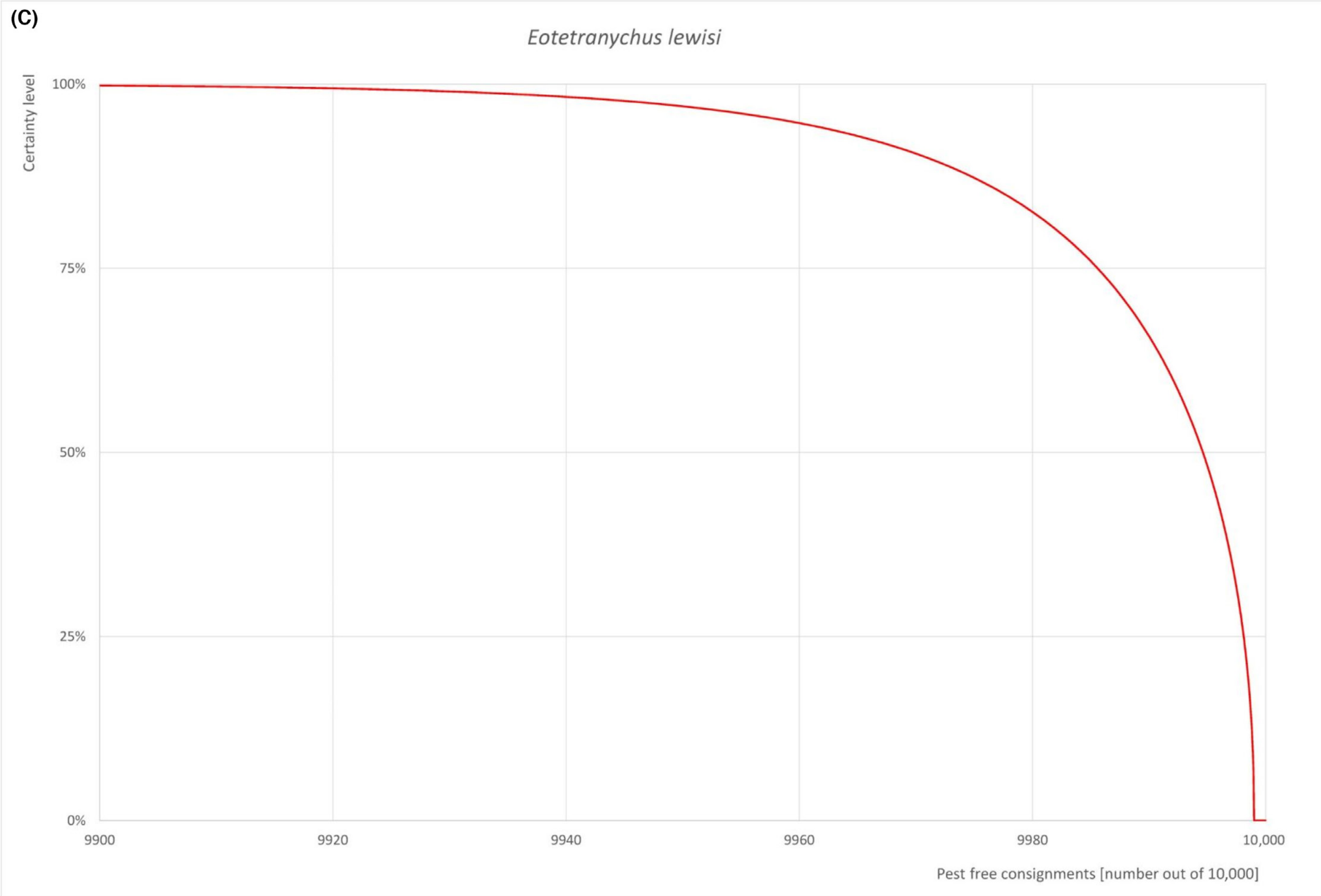


**FIGURE A.3** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Eotetranychus lewisi* complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags

### A.3.6 | Reference list

Doucette, C. F. (1962). The lewis mite, *Eotetranychus lewisi*, on greenhouse *Poinsettia*. *Journal of Economic Entomology*, 55, 139–140. https://doi.org/10.1093/jee/55.1.139

EFSA PLH Panel (EFSA Panel on Plant Health). (2014). Scientific Opinion on the pest categorisation of *Eotetranychus lewisi*. *EFSA Journal*, 12(7), 3776. https://doi.org/10.2903/j.efsa.2014.3776

EFSA PLH Panel (EFSA Panel on Plant Health). (2017). Pest risk assessment of *Eotetranychus lewisi* for the EU territory. *EFSA Journal*, 15(10), 4878. https://doi.org/10.2903/j.efsa.2017.4878

EPPO (European and Mediterranean Plant Protection Organization). (2006). Diagnostic protocol for *Eotetranychus lewisi* PM 7/68 (1). *EPPO Bulletin*, 36(1), 161–163. https://doi.org/10.1111/j.1365-2338.2006.00929.x

EPPO (European and Mediterranean Plant Protection Organization) (online). *Eotetranychus lewisi* (EOTELE). https://gd.eppo.int/taxon/EOTELE

EPPO (European and Mediterranean Plant Protection Organization). (2023). *Eotetranychus lewisi* EPPO datasheets on pests recommended for regulation. https://gd.eppo.int

EUROPHYT (online). Interceptions of harmful organisms in imported plants and other objects. https://food.ec.europa.eu/plants/plant-health-and-biosecurity/europhyt/interceptions_en

Gilrein, D. (2006). Managing lewis mites on *Poinsettia*. https://gpnmag.com/article/managing-lewis-mites-poinsettia

Jeppson, L. R., Keifer, H. H., & Baker, E. W. (1975). Mites injurious to economic plants. University of California Press, Berkeley (US). https://doi.org/10.1525/9780520335431

Kaur P., & Zalom G. F. (2017). Effect of temperature on the development of *Tetranychus urticae* and *Eotetranychus lewisi* on strawberry. *Journal of Entomology and Zoology Studies*, 5(4), 441–444.

Lai H.S., & Lin F. C. (2005). Development and population parameters of the lewis spider mite, *Eotetranychus lewisi*, on *Poinsettia*. *Plant Protection Bulletin* (Taichung), 47, 379–390.

McGregor, E. A. (1943). A new spider mite on citrus in southern California (Acarina: Tetranychidae). *Proceedings of the Entomological Society of Washington*, 45, 127–129.

## A.4 | *Epitrix* species

### A.4.1 | Organism information

| | | | |
|---|---|---|---|
| **Name of the organisms in the cluster** | *Epitrix subcrinita* EPIXSU<br>*Epitrix cucumeris* EPIXCU<br>Reasons for clustering:<br>The life cycle of the *Epitrix* species that are pests on potatoes is similar (Eyre and Giltrap, 2013). | | |
| **Group** | Common name: potato flea beetle<br>Coleoptera: Chrysomelidae | | |
| **Regulated status** | They are listed in the Commission Implementing Decision 2012/270/EU as regards emergency measures to prevent the introduction into and the spread within the Union of *Epitrix cucumeris* (Harris), *Epitrix similaris* (Gentner), *Epitrix subcrinita* (Lec.) and *Epitrix tuberis* (Gentner). | | |
| **Host status on *Petunia* sp./*Calibrachoa* sp.** | **Species** | **Petunia/Calibrachoa host status** | **Solanaceae host plants** |
| | *Epitrix subcrinita* | It has not been reported to feed on *Petunia* spp. and *Calibrachoa* spp. plants. | Main host is potato (*Solanum tuberosum*), but it has also been reported on many other Solanaceae plants, like several species of the genera *Solanum*, *Physalis* and *Nicotiana* and *Capsicum*. |
| | *Epitrix cucumeris* | *Epitrix cucumeris* is a pest of *Petunia* spp. but it has not been reported to feed on *Calibrachoa* spp. | Main host is potato (*Solanum tuberosum*), but it has also been reported on many other Solanaceae plants, like several species of the genera *Solanum*, *Physalis* and *Nicotiana* *Capsicum* and Nicotiana. |
| | Uncertainties: the host status of *Calibrachoa* spp. | | |
| **Pest status in Guatemala** | *Epitrix subcrinita* and *Epitrix cucumeris* according to EPPO are present in Guatemala. | | |
| **Pest status in EU** | No relevant as EU emergency measures pests. | | |
| **PRA information** | Available Pest Risk Assessments:<br>Two pest risk analyses on *Epitrix species* have been prepared. The first one was prepared by EPPO (2010) and the second one by the Norwegian Scientific Committee for Food and Environment (2019).<br>EPPO. (2010). Pest risk analysis for *Epitrix* species damaging potato tubers. Document 11–17790. Paris.<br>PRA. (2019). Pest risk assessment of selected *Epitrix* species. Scientific Opinion of the Panel on Plant Health of the Norwegian Scientific Committee for Food and Environment. VKM Report 2019: 17. | | |
| **Other relevant information for the assessment** | | | |
| **Biology** | **Dispersal:** Natural spread of Epitrix species is expected to be limited because adults tend only to fly short distances when in search of a new food supply. There is considerable uncertainty as to how far they could potentially fly in search of a suitable host. (EPPO PM 9/22 (1) *Epitrix* species damaging potato tubers Bulletin OEPP/EPPO Bulletin (2016) 46(3), 556–566.<br>**Host range and distribution of host plants in the environment:**<br>The most significant host of *E. cucumeris* is potato (*Solanum tuberosum*), but it has also been reported many other Solanaceae as hosts plants, like several species of the genera *Solanum*, *Physalis* and *Petunia* as well as *Capsicum annuum* and *Nicotiana tabacum* (EPPO, online). In general, adults of *Epitrix* species are reported to feed on a wide range of host plants, but solanaceous plants are preferred (EFSA, 2019). | | |

(Continued)

| | |
|---|---|
| | Adults of *Epitrix* species are reported to feed occasionally on plants from the families Amaranthaceae, Asteraceae, Brassicaceae, Chenopodiaceae, Cucurbitaceae and Fabaceae particularly in periods when solanaceous crops are not available, such as spring and autumn. It should be noted that foliage feeding does not necessarily imply egg laying and larval survival. Completion of life cycle of the *Epitrix* species on *Solanum tuberosum* is well documented but there is little data for other host plant species. Thus, the host range of the species is not fully reliable.<br>**Ecology and biology:**<br>In spring when the temperature warms up the adults, which overwinter in the soil, become active. They feed on the leaves of potatoes or other host plant species and the females lay their eggs near the base of host plants in the soil., Hatching larvae move to the roots of host plants where they feed and sometimes cause severe damage. The larvae feed on the roots for 2–4 weeks and develop through several instars. When they complete their development, they stop feeding, abandon the roots and pupate in a chamber from soil particles (Boavida et al., 2019; EPPO, 2005; Eyre and Giltrap, 2013). The new adults emerge from the soil 4–10 days after pupation (EFSA, 2019) and search for plants for feeding (Boavida et al., 2019). In autumn, the adult flea beetles overwinter usually near fields that were planted with potatoes the previous season, buried in the soil or under leaf litter and other debris (Hoffman et al., 1999).<br>*Epitrix cucumeris* has only one generation per year in Canada (Senanayake and Holliday, 1989), but field observations indicate that the species can have two or three generations per year in Portugal (EFSA, 2019). The preoviposition period is 5–6 days and the duration of the oviposition period is 35–55 days. Adults of *E. cucumeris* do not fly (EPPO, 2005). Adult beetles may feed on foliage from a wide variety of plants, but these plants are not always true host plants that can support larval development (PRA, 2019).<br>The duration of the life cycle of *Epitrix subcrinita* is approximately 49.2 days at 21°C. In western Washington state *Epitrix subcrinita* has two generations per year (Jones, 1944).<br>The adults of *E. cucumeris* are small black beetles, 1.6–2.0 mm long, with rows of punctures along the elytra arranged into striae and one row of white setae between elytral striae. The hind femurs are enlarged, adapted to jumping.<br>The adults of *E. subcrinita* are small brassy dark brown beetles with rows of short white hairs across the elytra, 1.76–2.27 mm long, with testaceous antennae. The hind femurs are enlarged, adapted to jumping.<br>**Symptoms on *Petunia/Calibrachoa***:<br>Adults of *Epitrix* species mainly feed on the upper surface of leaves of host plants and less often on the lower surface and produce typical shot-like holes with a 1–1.5 mm diameter on these leaves (EFSA, 2019; Eyre and Giltrap, 2013).<br>No asymptomatic plants are known to occur. |
| **What life stages could be expected on the commodity** | *Epitrix* adults feeding on unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. could be associated with the commodity. However, they cause typical shot holes that are relatively easily detected and cuttings should not be acceptable for trade. |
| **Surveillance information** | There are no targeted surveys for *Epitrix* in Guatemala. |

### A.4.2 | Possibility of pest presence in the nursery

#### A.4.2.1 | Possibility of entry from the surrounding environment

*E. cucumeris* and *E. subcrinita* are pests of many plants of Solanaceae and of other plant families and it is reported to be present in Guatemala. Given the wide host range of these species it is possible that local populations are present in the neighbouring environment. Adults of *E. subcrinita* can fly and they may enter the nursery from host plants that might be present in the surrounding environment. Although adults of *E. cucumeris* do not fly they are able to move and they may enter the nursery from host plants that might be present in the surrounding environment. Moreover, the pest may enter the nursery from the soil that may be attached to the equipment (EPPO, 2010). Defects in the insect proof structure of the production greenhouses could enable adults to enter.

Uncertainties:

- Presence of defect in the greenhouse structure.
- Abundance of *Epitrix* spp in the surroundings.
- Presence and distribution of host plants in the surroundings.

Taking into consideration the above evidence and uncertainties, the Panel considers that the pest can enter a greenhouse from the surrounding area.

#### A.4.2.2 | Possibility of entry with new plants/seeds

Mother plants used for the production of unrooted cutting originate from the Netherlands, Germany, El Salvador and Israel. The above listed *Epitrix* species are not present in these countries.

Uncertainties:

- The presence of the species in El Salvador.

#### A.4.2.3 | Possibility of spread within the nursery

When present, adults searching for food sources can spread from infested host plants within the nursery. Other host plants hosts of *Epitrix* adults could be present in the nurseries.

Uncertainties:

- There is no information on the presence of other host plants of *Epitrix spp* in the nurseries.

### A.4.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions of *E. cucumeris* and *E. subcrinita* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala. Export of *Petunia* spp. and *Calibrachoa* spp. from Guatemala to EU is prohibited, therefore there are no interception records for *Petunia* spp. and *Calibrachoa* spp. from Guatemala.

### A.4.4 | Risk Mitigation Measures applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing Epitrix adults that may enter from the surrounding environment. *Epitrix adults* may be introduced through defects in the greenhouse. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>– Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* spp. and *Calibrachoa* spp. are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of *Epitrix*.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| Soil treatment | Y | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses.<br>Evaluation: Growing substrate is kept free from eggs and larvae of *Epitrix*. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2).<br>Evaluation:<br>The species, *E. cucumeris* and *E. subcrinita* are not known to be present in these countries. They are reported from other countries in Central America.<br>Uncertainties:<br>The presence of the species in El Salvador. |
| Crop rotation | N | Description:<br>The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfection of irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whitefly, shoreflies and other flying insects<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of *Epitrix* adults. Feeding damage by adults is easy to detect.<br>Uncertainties:<br>− The efficiency of monitoring and inspection. |
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 9.0).<br>Evaluation:<br>The applied insecticides are effective against *Epitrix* adults.<br>Uncertainties:<br>− The efficacy of the applied insecticide and its timing is not known. |
| Sampling and testing | N | Description:<br>*Petunia* spp. and *Calibrachoa* spp. plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* spp. and *Calibrachoa* spp. cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official Supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>The monitoring can detect the presence of *Epitrix* adults.<br>Uncertainties:<br>− The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of Epitrix adults. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>− The intensity and the design of surveillance scheme. |

## A.4.5 | Overall likelihood of pest freedom

### A.4.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* spp. and *Calibrachoa* spp. are not a preferred host.
- *Epitrix spp* has never been intercepted on produce from Guatemala.
- Dispersal capacity of *Epitrix* adults is limited.
- Low population pressure of *Epitrix* species in the surrounding environment, due to the limited presence of preferred host plants.
- Greenhouse structure is insect-proof and entrance is thus unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected.
- Application of the insecticides have a good efficacy against *Epitrix* adults.
- At harvest and packing, cuttings with symptoms will be detected.

#### A.4.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *E. cucumeris* and *E. subcrinita* are present throughout Guatemala and they have a wide host range, mainly solanaceous plant, including *Petunia* (*E. cucumeris*) and it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *E. cucumeris* and *E. subcrinita* are present and abundant (e.g. potato, tomato).
- Presence of *E. cucumeris* and *E. subcrinita* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *E. cucumeris* and *E. subcrinita*.

#### A.4.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The protective effect of the greenhouse structure.
- The insecticides treatments are effective.
- There are no records of interceptions from Guatemala.

#### A.4.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The main uncertainty is the population pressure of the two *Epitrix* species in the surrounding environment.
- High uncertainty for values below median
- Less uncertainty for higher values

### A.4.6 | Elicitation outcomes of the assessment of the pest freedom for *Epitrix*

The following Tables show the elicited and fitted values for pest infestation (Table A.7) and pest freedom (Table A.8).

**TABLE A.7** Elicited and fitted values of the uncertainty distribution of pest infestation by *E. subcrinita* and *E. cucumeris* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 0 | | | | | 1 | | 2 | | 3 | | | | | 5 |
| EKE | 0.0733 | 0.153 | 0.267 | 0.472 | 0.725 | 1.03 | 1.33 | 1.95 | 2.65 | 3.04 | 3.50 | 3.96 | 4.41 | 4.73 | 5.01 |

*Note*: The EKE results is the *BetaGeneral (1.2604, 2.0485, 0, 5.5)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.8.

**TABLE A.8** The uncertainty distribution of plants free of *E. subcrinita* and *E. cucumeris* per 10,000 bugs of unrooted cuttings calculated by Table A.7.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9995 | | | | | 9997 | | 9998 | | 9999 | | | | | 10,000 |
| EKE results | 9995 | 9995 | 9996 | 9996 | 9996 | 9997 | 9997 | 9998.0 | 9998.7 | 9999.0 | 9999.3 | 9999.5 | 9999.7 | 9999.8 | 9999.9 |

*Note*: The EKE results are the fitted values.

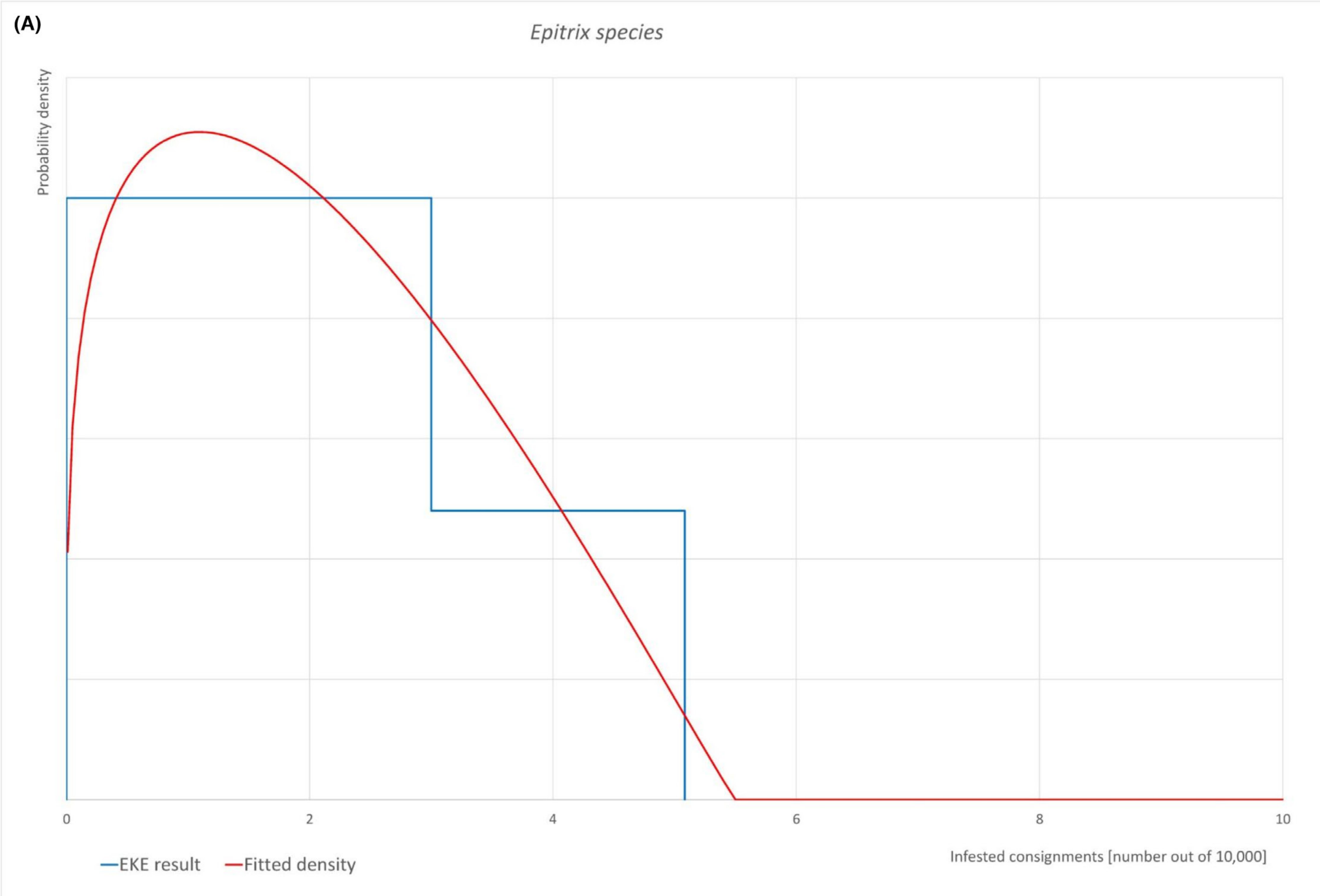


**FIGURE A.4** (Continued)

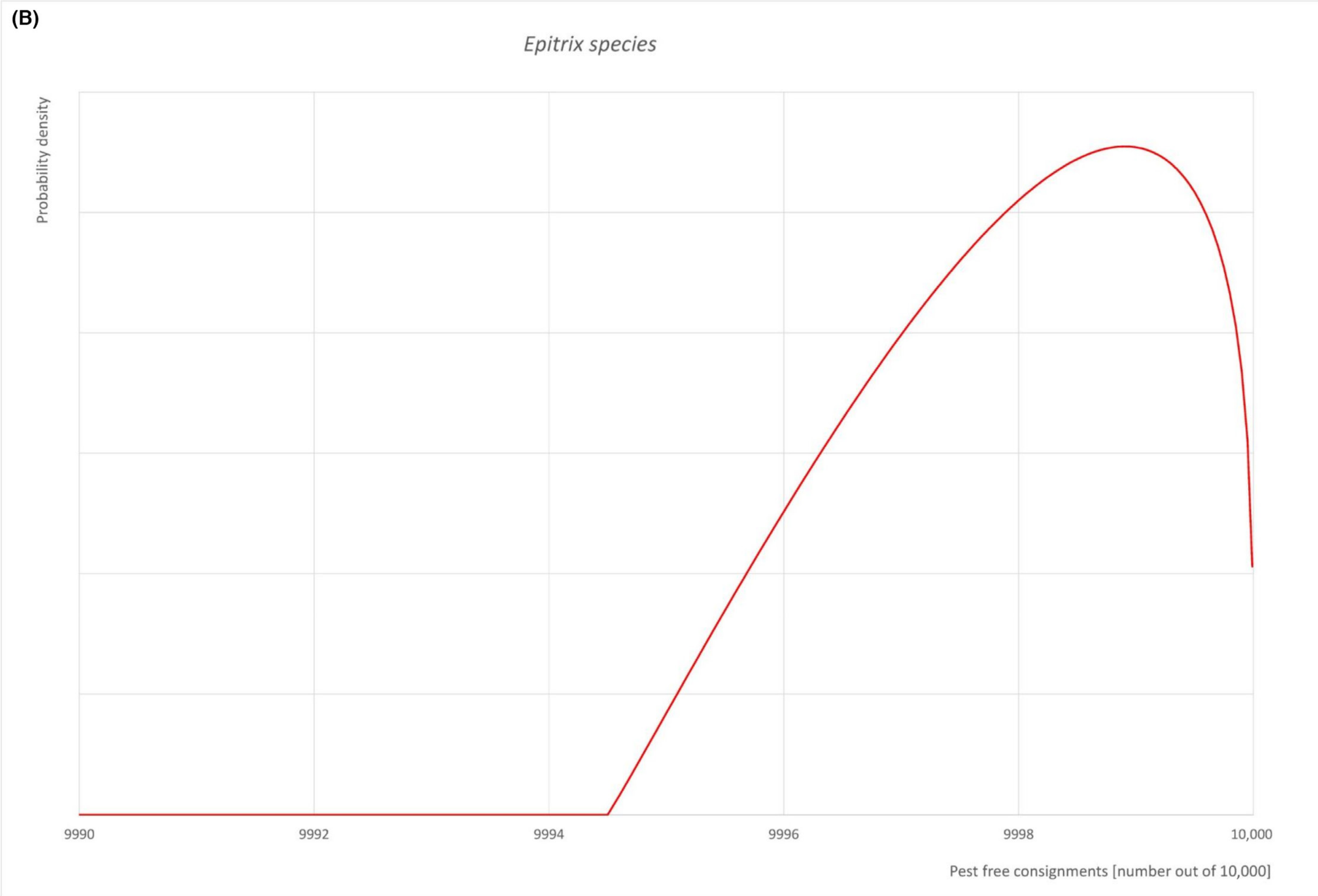


**FIGURE A.4** (Continued)

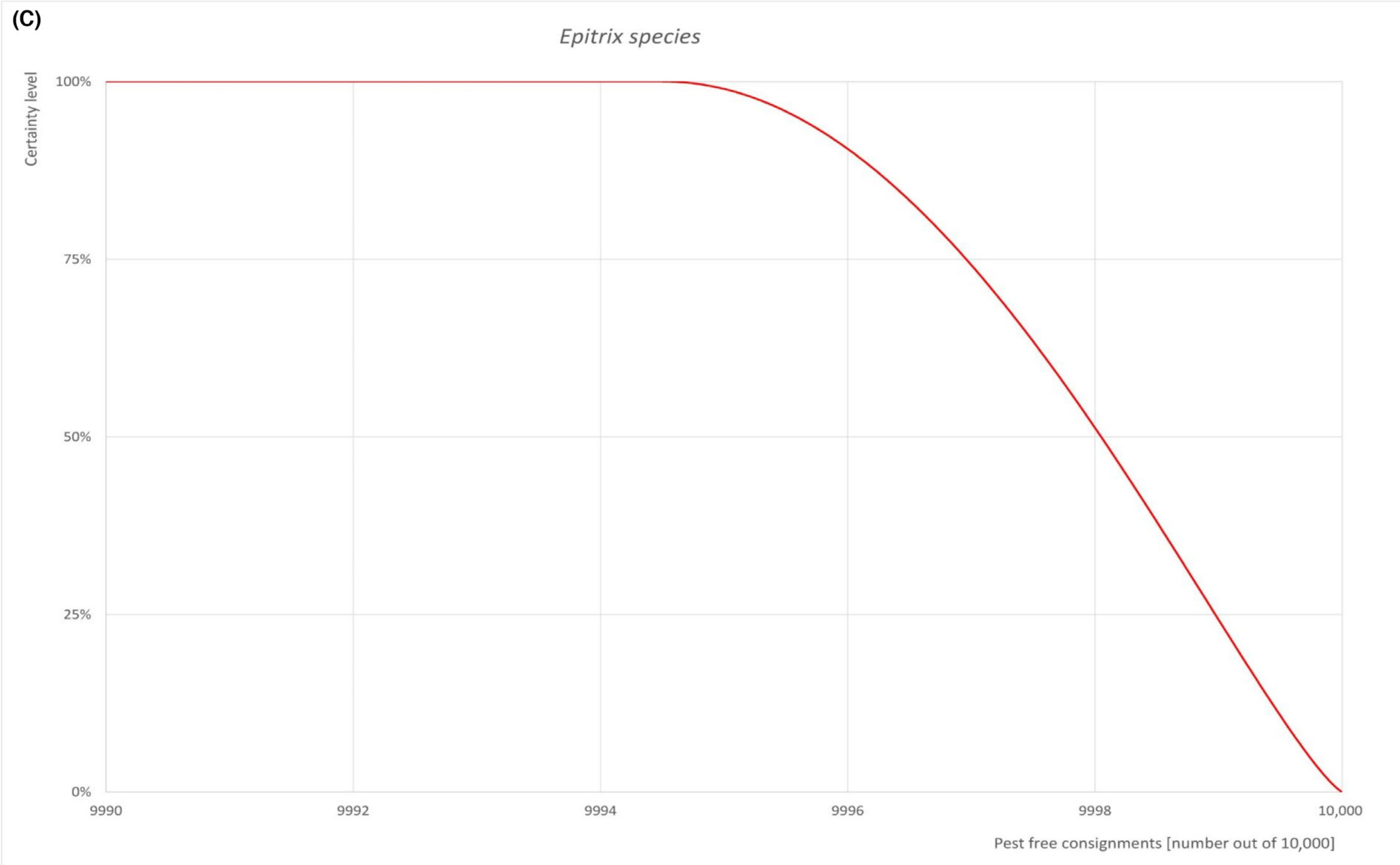


**FIGURE A.4** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Epitrix* complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags

## A.4.7 | Reference list


Bienkowski, A. O., & Orlova-Bienkowskaja, M. J. (2016). Key to Holarctic species of *Epitrix* flea beetles (Coleoptera: Chrysomelidae: Galerucinae: Alticini) with review of their distribution, host plants and history of invasions. *Zootaxa*, 4175, 401–435. https://doi.org/10.11646/zootaxa.4175.5.1

Boavida, C., & Germain, J. F. (2009). Identification and pest status of two exotic flea beetle species newly introduced in Portugal: *Epitrix* similaris Gentner and *Epitrix cucumeris* (Harris). Bulletin OEPP/EPPO Bulletin, 39, 501–508. https://doi.org/10.1111/j.1365-2338.2009.02339.x

Boavida, C., Santos, M., & Naves, P. (2019). Biological traits of *Epitrix papa* (Coleoptera: Chrysomelidae: Alticinae), a new potato pest in Europe, and implications for pest management. *Agricultural and Forest Entomology*, 1–9. https://doi.org/10.1111/afe.12344

EFSA (European Food Safety Authority). (2019). Pest survey card on *Epitrix cucumeris*, *Epitrix papa*, *Epitrix subcrinita* and *Epitrix tuberis*. EFSA Supporting publication, EN-1571. https://doi.org/10.2903/sp.efsa.2019.EN-1571

EPPO (European and Mediterranean Plant Protection Organization) (online). *Epitrix cucumeris* (EPIXCU). https://gd.eppo.int/taxon/EPIXCU

EPPO (European and Mediterranean Plant Protection Organization). (2005). Datasheets on pests recommended for regulation. EPPO Bulletin, 35(3), 363–364. https://doi.org/10.1111/j.1365-2338.2005.00850.x

EPPO (European and Mediterranean Plant Protection Organization). (2010). Pest risk analysis for *Epitrix* species damaging potato tubers. Document 11–17790. Paris. https://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm

EPPO (European and Mediterranean Plant Protection Organization). (2017). PM 7/109 (2) *Epitrix cucumeris, Epitrix papa, Epitrix subcrinita, Epitrix tuberis*. Bulletin OEPP/EPPO Bulletin, 47(1), 10–17. https://doi.org/10.1111/epp.12362

EUROPHYT (online). European Union Notification System for Plant Health Interceptions – EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

Eyre, D., & Giltrap, N. (2013). *Epitrix* flea beetles: New threats to potato production in Europe. *Pest Management Science*, 69, 3–6. https://doi.org/10.1002/ps.3423

Hoffman, M., Hoebeke, R., & Dillard, H. (1999). Flea Beetle Pests of Vegetables. Vegetable crops Fact sheet, NYS IPM, Cornell University. https://hdl.handle.net/1813/43272

Jones, E. W. (1944). Biological studies of two potato flea beetles in eastern Washington. *Journal of Economic Entomology*, 37, 9–12. https://doi.org/10.1093/jee/37.1.9

PRA (Pest risk assessment). (2019). Pest risk assessment of selected Epitrix species. Scientific Opinion of the panel on plant health of the Norwegian scientific committee for food and environment. *VKM Report*, 17.

Senanayake, D. G., & Holliday, N. J. (1989). Seasonal abundance of foliage-dwelling insect pests in commercial fields and insecticide-free plots of potato in Manitoba. *The Canadian Entomologist*, 121, 253–265. https://doi.org/10.4039/Ent121253-3

TRACES-NT (online). TRAde Control and Expert System. https://webgate.ec.europa.eu/tracesnt


## A.5 | Leafminers

### A.5.1 | Organism information

| | | | |
|---|---|---|---|
| **Name of the organisms in the cluster** | *Liriomyza huidobrensis* (Blanchard) (LIRIHU)<br>*Liriomyza sativae* (Blanchard) (LIRISA)<br>*Liriomyza trifolii* (Burgess) (LIRTR)<br>Reasons for clustering:<br>The three leafmining species have a very similar biology and are therefore evaluated as a group. | | |
| **Group** | Order: Diptera<br>Family: Agromyzidae | | |
| **Regulated status** | Commission Implementing Regulation (EU) 2019/2072 (Annex III) in specific protected zones. | | |
| **Host status on *Petunia* sp./*Calibrachoa* sp.** | **Pest name** | **Petunia/Calibrachoa host status** | **Solanaceae host plants** |
| | *L. huidobrensis* | *Petunia* spp. | Pepper, Tomato |
| | *L. sativae* | *Petunia* spp. | Potato, Tomato |
| | *L. trifolii* | *Petunia* spp. | Pepper, Tomato |
| | Uncertainties: | | |
| **Pest status in Guatemala** | *L. huidobrensis*, *L. sativae* and *L. trifolii* according to EPPO/CABI/Guatemala NPPO are present in Guatemala. | | |
| **Pest status in EU** | No relevant as EU quarantine. | | |
| **PRA information** | Available Pest Risk Assessments:<br>Scientific Opinion on the risks to plant health posed by *Liriomyza huidobrensis* (Blanchard) and *Liriomyza trifolii* (Burgess) to the EU territory with the identification and evaluation of risk reduction options (EFSA, 2012). | | |

(Continues)

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| **Other relevant information for the assessment** | |
|---|---|
| **Biology** | **Host range and distribution of host plants in the environment:**<br>*Liriomyza huidobrensis* is a highly polyphagous species and develops in many different vegetable and flower crops inside as well as outside the greenhouse (Mujica et al., 2017; Weintraub and Horowitz, 1995). Major host plants of *L. huidobrensis* are *Apium graveolens, Capsicum annuum, Chrysanthemum x morifolium, Cucumis melo, Cucumis sativus, Lactuca sativa, Phaseolus vulgaris, Solanum lycopersicum* and *Verbena* hybrids (EPPO, online a).<br>*Liriomyza sativae* is a highly polyphagous species, with more than 60 host plants in 18 different botanical families (EFSA et al., 2020; Xu et al., 2022). Hosts include cultivated monocots (e.g. maize, sorghum) and dicots (e.g. potatoes, cabbages, sugar beet, melons), and ornamentals (e.g. dahlia, phlox), as well as weed species (EFSA, 2020). Major host plants of *L. sativae* are *Cucurbita pepo*, *Solanum lycopersicum* and *Solanum tuberosum* (EPPO, online b).<br>*Liriomyza trifolii* is a highly polyphagous species *(Stegmaier, 1966)*. The host range of *L. trifolii* includes over 400 species of plants in 28 families including both ornamental crops and vegetables (CABI, online). The main host families and species include: Apiaceae (*A. graveolens*); Asteraceae (*Aster* spp., *Chrysanthemum* spp., *Gerbera* spp., *Dahlia* spp., *Ixeris stolonifera*, *Lactuca sativa*, *Lactuca* spp., *Zinnia* spp.); Brassicaceae (*Brassica* spp.); Caryophyllaceae (*Gypsophila* spp.); Chenopodiaceae (*Spinacia oleracea*, *Beta vulgaris*); Cucurbitaceae (*Cucumis* spp., *Cucurbita* spp.); Fabaceae (*Glycine max*, *Medicago sativa*, *Phaseolus vulgaris*, *Pisum sativum*, *Pisum* spp., *Trifolium* spp., *Vicia faba*); Liliaceae (*A. cepa, Allium sativum*) and Solanaceae (*Capsicum annuum*, *Capsicum frutescens*, *Petunia* spp., *Solanum lycopersicum*, *Solanum* spp.) (CABI, online; EFSA, 2012). Major host plants of *L. trifolii* are *Apium graveolens* and *Chrysanthemum x morifolium* (EPPO, online c).<br>**Characteristics of the pests:**<br>Size of adults; The wing length of the *Liriomyza* species is between 1.3–2.25 mm (EPPO PM7/53(2) Liriomyza).<br>Population build-up/Season effects on crops.<br>Dispersal capacities.<br>*Liriomyza* species are polyphagous. On Solanaceae crops *Liriomyza* can reach high populations.<br>**Symptoms on Petunia/Calibrachoa:**<br>The presence of *Liriomyza* at the first state of infestation (eggs, oviposition punctures) are difficult to detect.<br>Feeding punctures appear as white speckles between 0.13 and 0.15 mm in diameter. Oviposition punctures are smaller (0.05 mm) and are more uniformly round. Mines are usually white with dampened black and dried brown areas. They are typically serpentine, tightly coiled and of irregular shape, increasing in width as larvae mature (CABI, online). |
| **What life stages could be expected on the commodity** | *Petunia* is reported as a host plant. Eggs and feeding larvae may be present on leaves of harvested unrooted cuttings. |
| **Surveillance information** | There are no targeted surveys for *Liriomyza* in Guatemala. |

## A.5.2 | Possibility of pest presence in the nursery

### A.5.2.1 | Possibility of entry from the surrounding environment

Leafminers are polyphagous pests that are reported to be present in Guatemala. Given the wide distribution range of host plants, it is possible that local populations of Leafminers are present in the neighbouring environment.

Adults leafminer can naturally spread over short distances through flight or wind assisted dispersal (EFSA, 2012; Plant Health Australia, 2020). Human activity is believed to be a key factor in the rapid spread of both *Liriomyza* species particularly via host planting material and cut flowers, which are the main means of long-distance dispersal (EFSA, 2012).

Uncertainties:

There are no uncertainties.

### A.5.2.2 | Possibility of entry with new plants/seeds

Leafminers species could enter the nursery with infested propagation material of host plants species.

Other solanaceous and non-solanaceous plants are produced in the same nursery and their cultivation rotates within the nursery greenhouses/compartments.

Uncertainties:

There are no uncertainties

### A.5.2.3 | Possibility of spread within the nursery

When present, flying adults searching for food sources can spread from infested host plants species within the nursery. Hitchhiking of leafminers flies (adults) on human clothes is unlikely.

Uncertainties:

The physical separation of the *Petunia/Calibrachoa* units from the other units present in the greenhouse.

### A.5.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions of *Liriomyza huidobrensis, Liriomyza sativae, Liriomyza trifolii* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala.

### A.5.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing of leafminers that may enter from the surrounding environment. Leafminers may be introduced through defects in the greenhouse or as hitchhikers on clothing of greenhouse staff. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>– Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* spp. and *Calibrachoa* spp. are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of leafminers.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| Soil treatment | N | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2).<br>Evaluation:<br>The imported material is certified, and for this reason is checked for visual symptoms and it is expected to be free from leafminers.<br>Uncertainties: No details are given on the certification system. |
| Crop rotation | N | Description:<br>The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfection of irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of leafminers.<br>Uncertainties:<br>– The efficiency of monitoring and inspection. |

(Continues)

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0).<br>Evaluation:<br>The applied insecticides are effective against the vector leafminers.<br>Uncertainties:<br>– The efficacy of the applied insecticide and its timing is not known. |
| Sampling and testing | N | Description:<br>Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate.<br>Evaluation: |
| Packing and handling procedures | Y | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber<br>The shipment of *Petunia* spp. and *Calibrachoa* spp. cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers.<br>Evaluation:<br>The collection of cuttings and their sorting will allow to identify and remove the possible infested cuttings. |
| Official supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>The monitoring can detect the presence of leafminers.<br>Uncertainties:<br>– The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of the pests. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of surveillance scheme. |

## A.5.5 | Overall likelihood of pest freedom

### A.5.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *L. huidobrensis, L. sativae, L. trifolii* have been reported on *Solanaceae* and on *Petunia* spp.
- *Calibrachoa* spp. is not a preferred host.
- Visible symptoms on leaves will allow to easily detect the pests.
- *L. huidobrensis, L. sativae, L. trifolii* have never been intercepted on produce from Guatemala.
- Dispersal capacity of *L. huidobrensis, L. sativae, L. trifolii* are limited to the first instar stage (crawler).
- Low population pressure of *Liriomyza huidobrensis, L. sativae, L. trifolii* in the surrounding environment, because of active natural enemies or absence of preferred host plants.
- Transfer of *L. huidobrensis, L. sativae, L. trifolii* from sources in the surrounding environment to the greenhouse plants is very difficult because dispersal is mainly dependent on human-assisted movement of the first instar stage (crawler) and hygienic measures are in place to prevent this.
- Greenhouse structure is insect-proof and entrance is thus unlikely.
- Rotation of compartments, break of 1 month in the cultivation and dedicated compartments for *Petunia/Calibrachoa* will reduce the probability of infestation.
- The scouting monitoring regime is effective, insects are expected to be easily detected because of the production of honeydew.
- Application of the insecticides Mainspring (a.i. Cyantraniliprole) and Movento (a.i. spirotetramat) have a good efficacy against the scale insect *L. huidobrensis, L. sativae, L. trifolii.*
- At harvest and packing, cuttings with symptoms will be detected.
- 25 cuttings per bag.

### A.5.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *L. huidobrensis, L. sativae, L. trifolii* are present throughout Guatemala and they have a wide host range, mainly Solanaceous plants, including *Petunia* spp. and it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *L. huidobrensis, L. sativae, L. trifolii* is present and abundant (e.g. pepper, tomato) and natural enemy activity is low.
- Presence of leafminer species in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure or leafminer insects hitchhike on greenhouse staff.
- Insecticide treatments are not targeting to leafminer insects.
- Although there are no evidence that *Petunia* spp and *Calibrachoa* spp. are host plants for *Leafminers* given the polyphagous nature of this insects it is likely that *Petunia* spp. and *Calibrachoa* spp. are suitable host plants.
- 80 cuttings per bag.

### A.5.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The protective effect of the greenhouse structure.
- The insecticides treatments are not targeting leafminer insects but are moderately effective.
- There are no records of interceptions from Guatemala.

### A.5.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The main uncertainty is the population pressure of the leafminers species in the surrounding environment.
- High uncertainty for values below median.
- Less uncertainty for higher values.

### A.5.6 Elicitation outcomes of the assessment of the pest freedom for Leafminers

The following Tables show the elicited and fitted values for pest infestation (Table A.9) and pest freedom (Table A.10).

**TABLE A.9** Elicited and fitted values of the uncertainty distribution of pest infestation *Liriomyza huidobrensis, Liriomyza sativae* and *Liriomyza trifolii* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 1 | | | | | 4 | | 7 | | 18 | | | | | 60 |
| EKE | 0.996 | 1.08 | 1.25 | 1.68 | 2.39 | 3.45 | 4.73 | 8.11 | 13.2 | 16.9 | 22.2 | 29.0 | 38.4 | 47.7 | 60.1 |

*Note:* The EKE results is the *BetaGeneral (0.77672, 66.82, 0.96, 1000)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.10.

**TABLE A.10** The uncertainty distribution of plants free of *infestation Liriomyza huidobrensis, Liriomyza sativae and Liriomyza trifolii* per 10,000 bugs of unrooted cuttings calculated by Table A.9.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9940 | | | | | 9982 | | 9993 | | 9996 | | | | | 9999 |
| EKE results | 9940 | 9952 | 9962 | 9971 | 9978 | 9983 | 9987 | 9992 | 9995 | 9996.5 | 9997.6 | 9998.3 | 9998.8 | 9998.9 | 9999.0 |

*Note:* The EKE results are the fitted values.

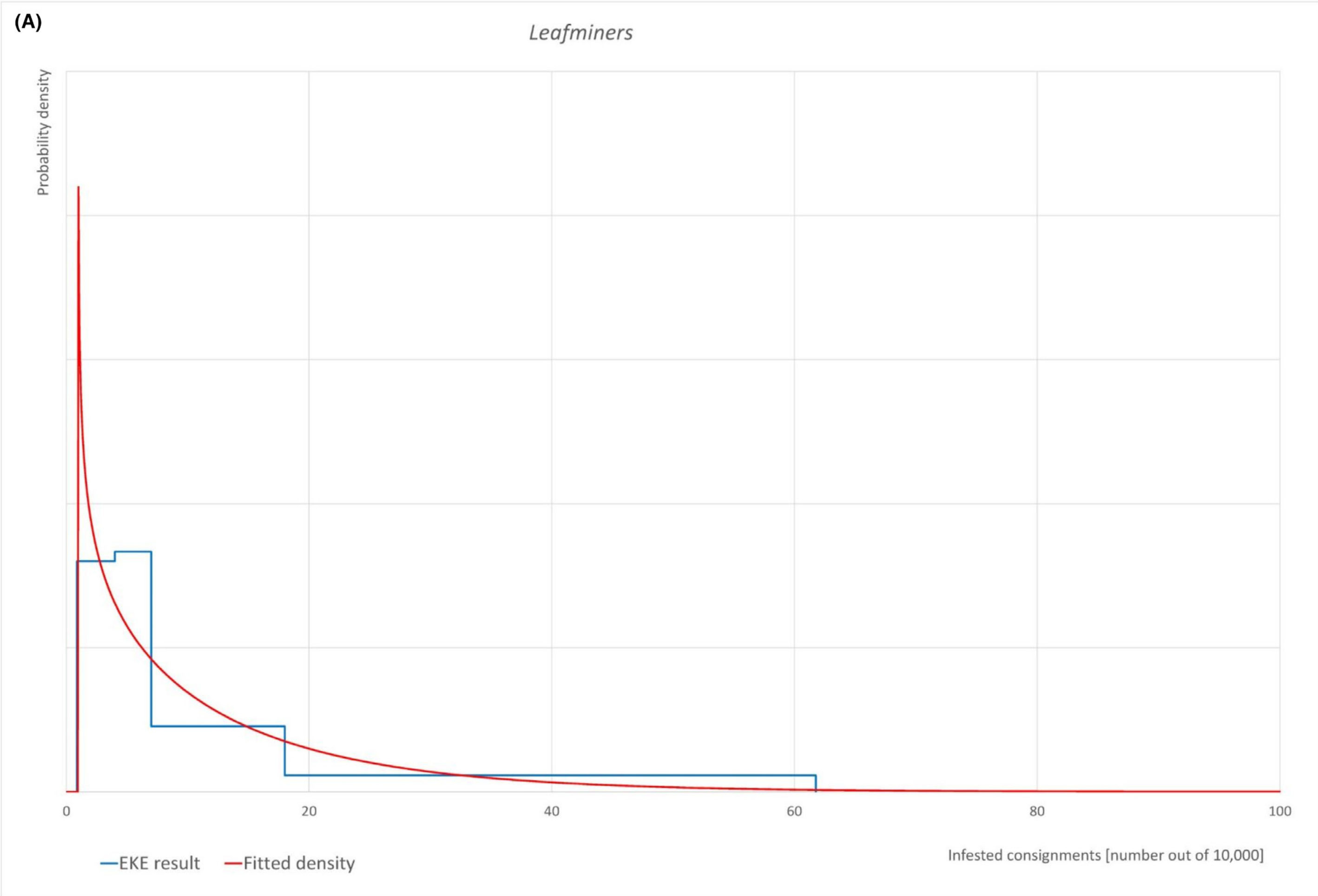


**FIGURE A.5** (Continued)

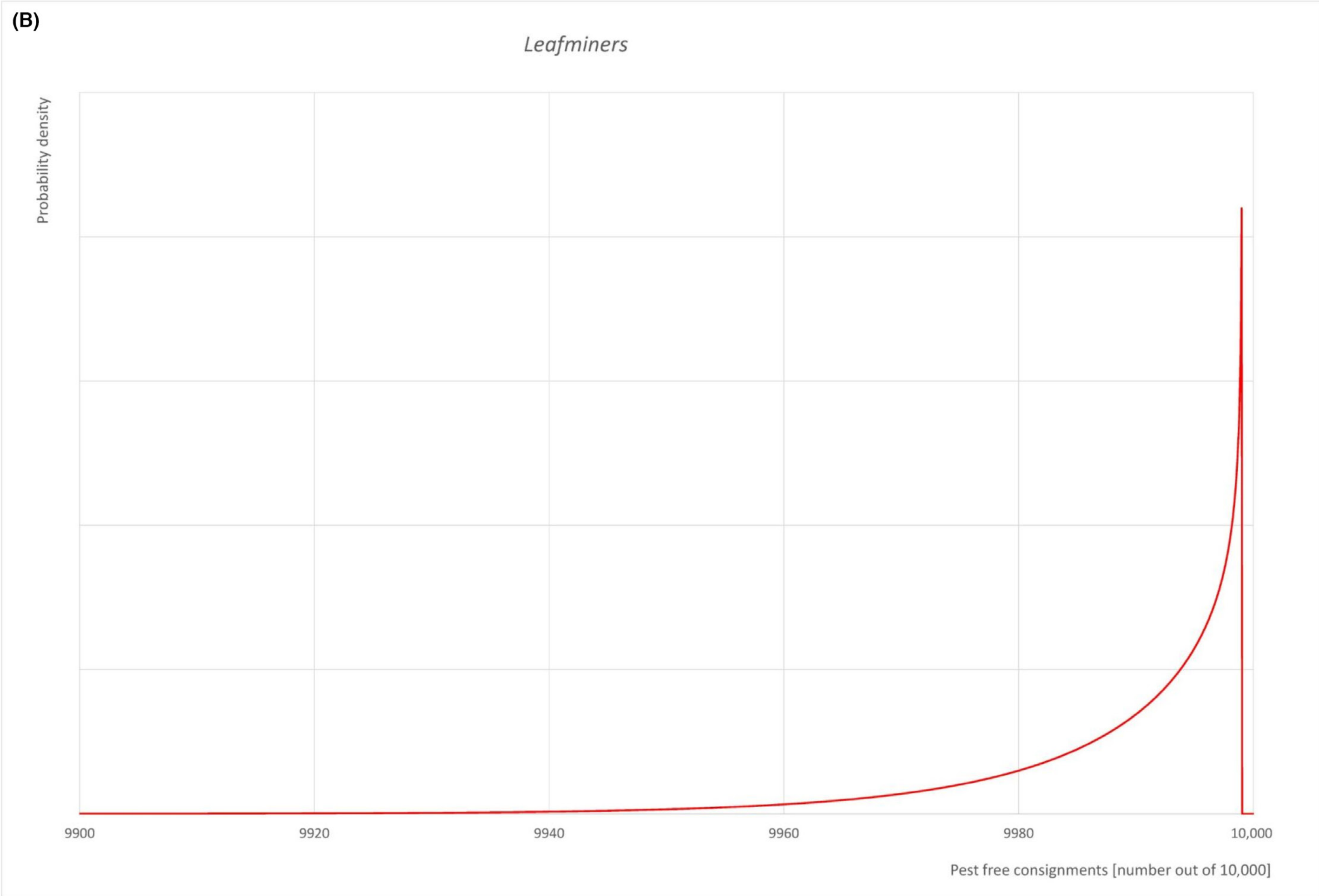


**FIGURE A.5** (Continued)

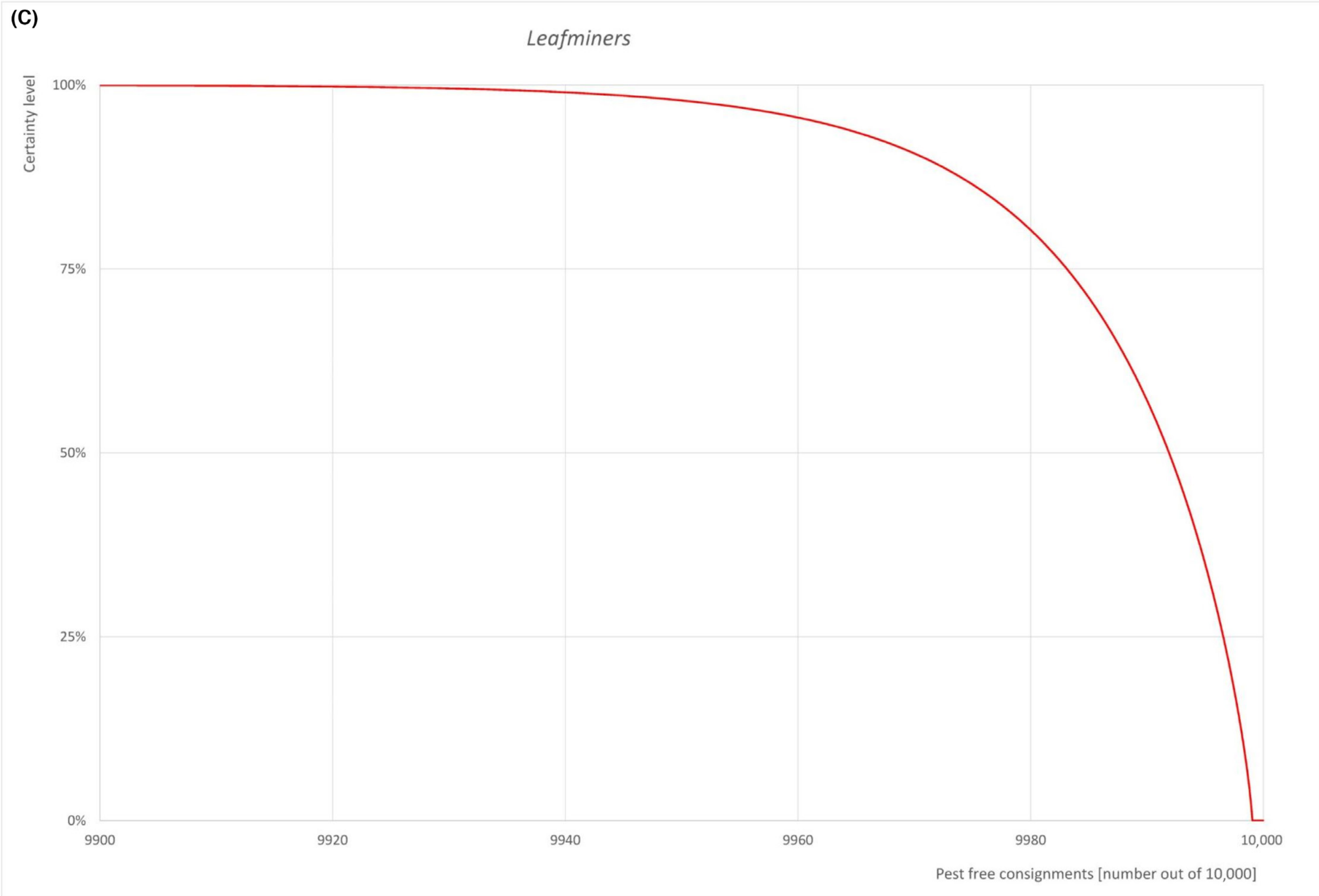


**FIGURE A.5** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Leafminers* complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags

### A.5.7 | Reference list

CABI (Centre for Agriculture and Bioscience International). (Online). Datasheet *Liriomyza trifolii* (American serpentine leafminer). https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.30965

EFSA (European Food Safety Authority). (2012). Scientific Opinion on the risks to plant health posed by *Liriomyza huidobrensis* (Blanchard) and *Liriomyza trifolii* (Burgess) to the EU territory with the identification and evaluation of risk reduction options. *EFSA Journal*, 10(12), 190. https://doi.org/10.2903/j.efsa.2012.3028

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., Jaques Miret, J. A., Justesen, A. F., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Potting, R., Reignault, P. L., Thulke, H.-H., Van der Werf, W., Vicent Civera, A., Yuen, J., Zappala, L., Czwienczek, E., Streissl, F., & MacLeod, A. (2020). Scientific Opinion on the pest categorization of *Liriomyza sativae*. *EFSA Journal*, 18(3), 6037, 37 pp. https://doi.org/10.2903/j.efsa.2020.6037

EPPO (European and Mediterranean Plant Protection Organization). (Online_a). *Liriomyza huidobrensis* (LIRIHU). https://gd.eppo.int/taxon/LIRIHU

EPPO (European and Mediterranean Plant Protection Organization). (Online_b). *Liriomyza sativae* (THAUPR). https://gd.eppo.int/taxon/LIRISA

EPPO (European and Mediterranean Plant Protection Organization). (Online_c). *Liriomyza trifolii* (LIRITR). https://gd.eppo.int/taxon/LIRITR

EPPO (European and Mediterranean Plant Protection Organization). (2022). EPPO Standard on diagnostics PM 7/53(2) *Liriomyza* spp. EPPO Bulletin, 52, 326–345. https://doi.org/10.1111/epp.12832

EUROPHYT. (Online). European Union Notification System for Plant Health Interceptions - EUROPHYT. http://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

Mujica, N., Sporleder, M., Carhuapoma, P., & Kroschel, J. (2017). A temperature-dependent phenology model for *Liriomyza huidobrensis* (Diptera: Agromyzidae). *Journal of Economic Entomology*, 110, 1333–1344. https://doi.org/10.1093/jee/tox067

Plant Health Australia Limited (Version 1, 2020). Contingency plan for serpentine leafminer (*Liriomyza huidobrensis*). https://www.planthealthaustralia.com.au/wp-content/uploads/2021/08/Liriomyza-huidobrensis-CP-2020-v1.02.pdf

Stegmaier, C. E. (1966). Host plants and parasites of *Liriomyza trifolii* in Florida (Diptera: Agromyzidae). *The Florida Entomologist*, 49(2), 75–80. https://doi.org/10.2307/3493532

Weintraub, P. G., & Horowitz, A. R. (1995). The newest leafminer pest in Israel, *Liriomyza huidobrensis*. *Phytoparasitica* 23(2), 177–184. https://doi.org/10.1007/BF02980977

Xu, X., Schmidt, T. L., Liang, J., Ridland, P. M., Chung, J., Yang, Q., Jasper, M. E., Umina, P. A., Liu, W., Hoffmann, A. A. (2022). Genome-wide SNPs of vegetable leafminer, *Liriomyza sativae*: Insights into the recent Australian invasion. *Evolutionary Applications*, 15(7), 1129–1140. https://doi.org/10.1111/eva.13430

## A.6 | *Phenacoccus solenopsis*

### A.6.1 | Organism information

| | |
|---|---|
| **Taxonomic information** | Current valid scientific name: *Phenacoccus solenopsis*<br>Synonyms: *Phenacoccus cevalliae*, *Phenacoccus gossypiphilous*<br>Name used in the EU legislation: –<br>Order: Hemiptera<br>Family: Pseudococcidae<br>Common name: Cotton mealybug, solenopsis mealybug<br>Name used in the dossier: *Phenacoccus solenopsis* |
| **Group** | Insects |
| **EPPO code** | PHENSO |
| **Regulated status** | *Phenacoccus solenopsis* is not regulated in the EU, neither listed by EPPO.<br>The insect is included in the list of pests that are regulated by the Commission Implementing Regulation (EU) 2022/490 amending Implementing Regulation (EU) 2018/2019 as regards certain plants for planting of *Juglans regia* L., *Nerium oleander* L. and *Robinia pseudoacacia* L. originating in Turkey, and amending Implementing Regulation (EU) 2020/1213 as regards the phytosanitary measures for the introduction of those plants for planting into the Union territory.<br>The insect is included in the list of pests that are regulated by the Commission Implementing Regulation (EU) 2021/1936 amending Implementing Regulation (EU) 2018/2019 as regards certain plants for planting of *Ficus carica* L. and *Persea americana* Mill. originating in Israel, amending Implementing Regulation (EU) 2020/1213 as regards the phytosanitary measures for the introduction of those plants for planting into the Union territory and correcting the latter Implementing Regulation. |
| **Pest status in Guatemala** | It is reported as present with no further details (CABI, EPPO, García Morales et al., 2016). |

(Continued)

| | | |
|---|---|---|
| **Pest status in the EU** | Present, restricted distribution (CABI, EPPO)<br>The pest is present in Cyprus (EPPO GD, online), in Greece only in island of Crete (EFSA PHL Panel 2021a), in Italy in Lazio region and Sicily (Sannino et al., 2019; Ricupero et al., 2021) and in France in the province of Brittany (Kreiter et al., 2020)<br>In Cyprus, the pest first reported in 2010 on *Hibiscus rosa-sinensis, Lantana* and *Chrysanthemum* plants, mainly in private gardens. It was also occasionally found on gombo (*Abelmoschus esculentus*) and Vitis spp. Measures will be taken to contain the pest (EPPO GD, online)<br>In Italy, it was first found in 2019 in Lazio (Latina province) in a glasshouse on ornamentals (hibiscus, dipladenias and poinsettias), as well as outdoors on weeds (*Portulaca* sp. and *Solanum nigrum*). In 2019, a small infestation was also found in Sicilia near Ragusa on glasshouse with chrysanthemums plants and 2020 recorded as damaging in tomato production in Sicilia (Sannino et al., 2019; Ricupero et al., 2021)<br>In Greece, it was found in summer 2020 on Crete Island on tomato plants (FSA PHL Panel, 2021)<br>In France, it was found in the French province of Brittany (Kreiter et al., 2020) | |
| **Host status on *Petunia* spp. *and* *Calibrachoa* spp.** | *Petunia* sp. and *P. integrifolia* are reported as host plants for *P. solenopsis* (Fallahzadeh et al., 2014; Malumphy et al., 2013)<br>There is no information on whether *P. solenopsis* can also attack *Calibrachoa* species. | |
| **PRA information** | – Rapid pest risk analysis for *Phenacoccus solenopsis* (Cotton mealybug) and the closely related *P. defectus* and *P. solani* (Malumphy et al., 2013).<br>– Pest risk analysis (PRA) of Mealybug Spp. in Bangladesh (Islam et al., 2017).<br>– Scientific Opinion on the commodity risk assessment of *Ficus carica* plants from Israel (EFSA PLH Panel, 2021a).<br>– Scientific Opinion on the pest categorisation of *Phenacoccus solenopsis* (EFSA PLH Panel, 2021b). | |
| **Other relevant information for the assessment** | | |
| **Biology** | *Phenacoccus solenopsis* originates from southern California and Nevada (Spodek et al., 2018).<br>Female of *P. solenopsis* develops through an egg, three nymphal instars to an adult. The male has additional nymphal stage, the last two are called prepupa and pupa. Reproduction is sexual and ovoviviparous. Facultative parthenogenesis was observed under laboratory conditions of mealybugs collected from Nagpur, India (Vennila et al., 2010). Males have wings and females are wingless. Adult females are pale yellow to orange covered by powdery, wax secretion (Hodgson et al., 2008).<br>Females lay ~150–600 eggs in a white, waxy ovisac (Fand and Suroshe, 2015). The life cycle of *P. solenopsis* ranges between 28 and 35 days and can complete about 8–12 generations in a year (Fand and Suroshe, 2015).<br>The first nymphs are crawlers, which disperse to other parts of the same plant or get carried by the wind or other means (machinery, workers, animals) to other areas (Hodgson et al., 2008). The adult males live from few hours up to 3 days, depending on the temperature (Hodgson et al., 2008). Adult females can live for up to 3 months (Gerson and Aplebaum, online).<br>In Israel, the pest was observed on roots and root collars of weeds. In winter, *P. solenopsis* populations were found on the stems, branches and root collar of hibiscus plants (Spodek et al., 2018). It overwinters as an adult female, on the bark, the stem and branches of woody plants. It seems that it may develop in the ground on roots of non-woody plants (Spodek et al., 2018). This mealybug has been reported to be capable of surviving temperatures ranging from 0 to 45°C, throughout the year (CABI, online). The crawlers of *P. solenopsis* have been reported be commonly dispersed by wind for distances ranging from a few meters to several kilometres (Islam et al., 2017). | |
| **Symptoms** | Main type of symptoms | *Phenacoccus solenopsis* prefers the upper parts of the plants, young shoots or branches carrying fruitlets (Spodek et al., 2018). Large populations of mealybugs cause general weakening, distortion, defoliation, dieback and death of susceptible plants (Malumphy et al., 2013). Plants become covered in sooty moulds that grow on the honeydew produced by mealybugs. The honeydew also attracts ants that protect the mealybugs from natural enemies (Hodgson et al., 2008). The infested plants of cotton become stunted, growth appears to stop and most plants look dehydrated. In severe outbreaks, the cotton bolls fail to open and defoliation occurs (including the loss of flower buds, flowers and immature bolls) (Hodgson et al., 2008). On tomatoes the pest causes foliar yellowing, leaf wrinkling, puckering and severe damage, resulting in death (Ibrahim et al., 2015). |
| | Presence of asymptomatic plants | No asymptomatic period is known to occur in the infested plants. Plant damage might not be obvious in early infestation or during dormancy (due to absence of leaves), but the presence of mealybugs on the plants could be observed. During the crawler stage, infestation is difficult to be noted (Ben-Dov, 1994). |
| | Confusion with other pathogens/pests | *Although it may be confused with other* species of *Phenacoccus, a slide mounted female can be distinguished* using taxonomic keys (Hodgson et al., 2008). |
| **Host plant range** | *Phenacoccus solenopsis* is highly invasive and polyphagous, feeding on approximately 300 plant species in 65 botanical families. The plant families containing most hosts are Amaranthaceae, Asteraceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Malvaceae and Solanaceae. (Arif et al., 2009; Fallahzadeh et al., 2014; Fand and Suroshe, 2015; Garcsıa Morales et al., online; Vennila et al., 2013). | |
| **What life stages could be expected on the commodity** | Possible pathways of entry for mealybugs are plant materials of any kind (hiding in a protected site – on the bark, roots, stems, leaves), human transportation, irrigation water, wind, animals and ants (Mani and Shivaraju, 2016). | |
| **Surveillance information** | Dossier | |

### A.6.2 | Possibility of pest presence in the nursery

#### A.6.2.1 | Possibility of entry from the surrounding environment

*P. solenopsis* is polyphagous species that is reported to be present in Guatemala. Given the wide host range of this pest it is possible that local populations of *P. solenopsis* are present in the neighbouring environment.

Possible pathways of entry into the nursery can be by movement of infested plants, wind, human and animal dispersal and irrigation water (Mani and Shivaraju, 2016). The first nymph instars (crawlers) can disperse by walking and by wind and by hitchhiking (Mani and Shivaraju, 2016).

Uncertainties:

- It is not known what the *P. solenopsis* population pressure is in the surrounding environment of the nursery.
- Presence and distribution of host plants in the surroundings.
- The presence of defects in the greenhouse structure.

#### A.6.2.2 | Possibility of entry with new plants/seeds

Mother plants used for the production of unrooted cuttings originate from the Netherlands, Germany, El Salvador and Israel. There is a possibility that *P. solenopsis* could enter the nursery with infested propagation material of host plants species.

Uncertainties:

– The origin of the propagation material in relation to the infested areas;
– The presence and the numbers of other host plants in the export nursery.

#### A.6.2.3 | Possibility of spread within the nursery

Nymphs and adults could spread from other host plants present in the nursery by hitchhiking on clothing of nursery staff.

Uncertainties:

- There are no uncertainties.

### A.6.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions of *P. solenopsis* on *Petunia* sp. and on *Calibrachoa* sp. from third countries or on any other plant from Guatemala.

### A.6.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing *Phenacoccus solenopsis* adults that may enter from the surrounding environment. *Phenacoccus solenopsis adults* may be introduced through defects in the greenhouse. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>– Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* and *Calibrachoa* are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of mealybug.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/ Calibrachoa* production units. |

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Soil treatment | N | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2).<br>Evaluation:<br>*Phenacoccus solenopsis* is present in El Salvador and adults could be associated with mother plants.<br>Uncertainties:<br>The abundance of the species in El Salvador. |
| Crop rotation | N | Description:<br>The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfection of irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whitefly, shoreflies and other flying insects.<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of *Phenacoccus solenopsis* adults.<br>Uncertainties:<br>– The efficiency of monitoring and inspection. |
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 9.0).<br>Evaluation:<br>The applied insecticides are effective against *Phenacoccus solenopsis* adults.<br>Uncertainties:<br>– The efficacy of the applied insecticide and its timing is not known. |
| Sampling and testing | N | Description:<br>*Petunia* and *Calibrachoa* plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>The monitoring can detect the presence of *Phenacoccus solenopsis*.<br>Uncertainties:<br>– The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of *Phenacoccus solenopsis*. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of surveillance scheme. |

### A.6.5 | Overall likelihood of pest freedom

A.6.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Calibrachoa* spp. is not a preferred host.
- Mealybug spp. has never been intercepted on produce from Guatemala.
- Dispersal capacity of Mealybug adults is limited.
- Low population pressure of Mealybug species in the surrounding environment, due to the limited presence of preferred host plants.
- Greenhouse structure is insect-proof and entrance is thus unlikely.
- Rotation of compartments (Solanaceae, other), break of 1 month, dedicated compartments for petunia/calibrachoa
- The scouting monitoring regime is effective, insects are expected to be easily detected.
- Application of the insecticides have a good efficacy against Mealybug adults.
- Sorting may reduce the infestation.
- At harvest and packing, cuttings with symptoms will be detected.
- 25 cuttings per bag.

A.6.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *P.* solenopsis is present throughout Guatemala and has a wide host range, mainly solanaceous plant, including *Petunia* and it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *P. solenopsis* is present and abundant (e.g. potato, tomato).
- Presence of *P. solenopsis* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *P. solenopsis*.
- Hitch hiking is possible.
- 80 cuttings per bag.

A.6.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- High uncertainty in the lower part.
- Low possibility of introduction from outside.
- Early stages difficult to detect.

A.6.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/ interquartile range)

- The main uncertainty is the population pressure of *P. solenopsis* in the surrounding environment.
- High uncertainty for values below median.
- Less uncertainty for higher values.

### A.6.6 | Elicitation outcomes of the assessment of the pest freedom for Mealybug

The following Tables show the elicited and fitted values for pest infestation (Table A.11) and pest freedom (Table A.12).

**TABLE A.11** Elicited and fitted values of the uncertainty distribution of pest infestation by *Phenacoccus solenopsis* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 1 | | | | | 5 | | 10 | | 20 | | | | | 80 |
| EKE | 0.942 | 1.37 | 1.88 | 2.72 | 3.75 | 5.04 | 6.44 | 9.99 | 15.5 | 19.8 | 26.6 | 36.7 | 53.0 | 73.0 | 105.9 |

*Note*: The EKE results is the Lognorm (16.72, 22.448) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.12.

**TABLE A.12** The uncertainty distribution of plants free of *Phenacoccus solenopsis* per 10,000 bugs of unrooted cuttings calculated by Table A.11.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9920 | | | | | 9980 | | 9990 | | 9995 | | | | | 9999 |
| EKE results | 9894 | 9927 | 9947 | 9963 | 9973 | 9980 | 9985 | 9990 | 9994 | 9995 | 9996 | 9997 | 9998.1 | 9998.6 | 9999.1 |

*Note*: The EKE results are the fitted values.

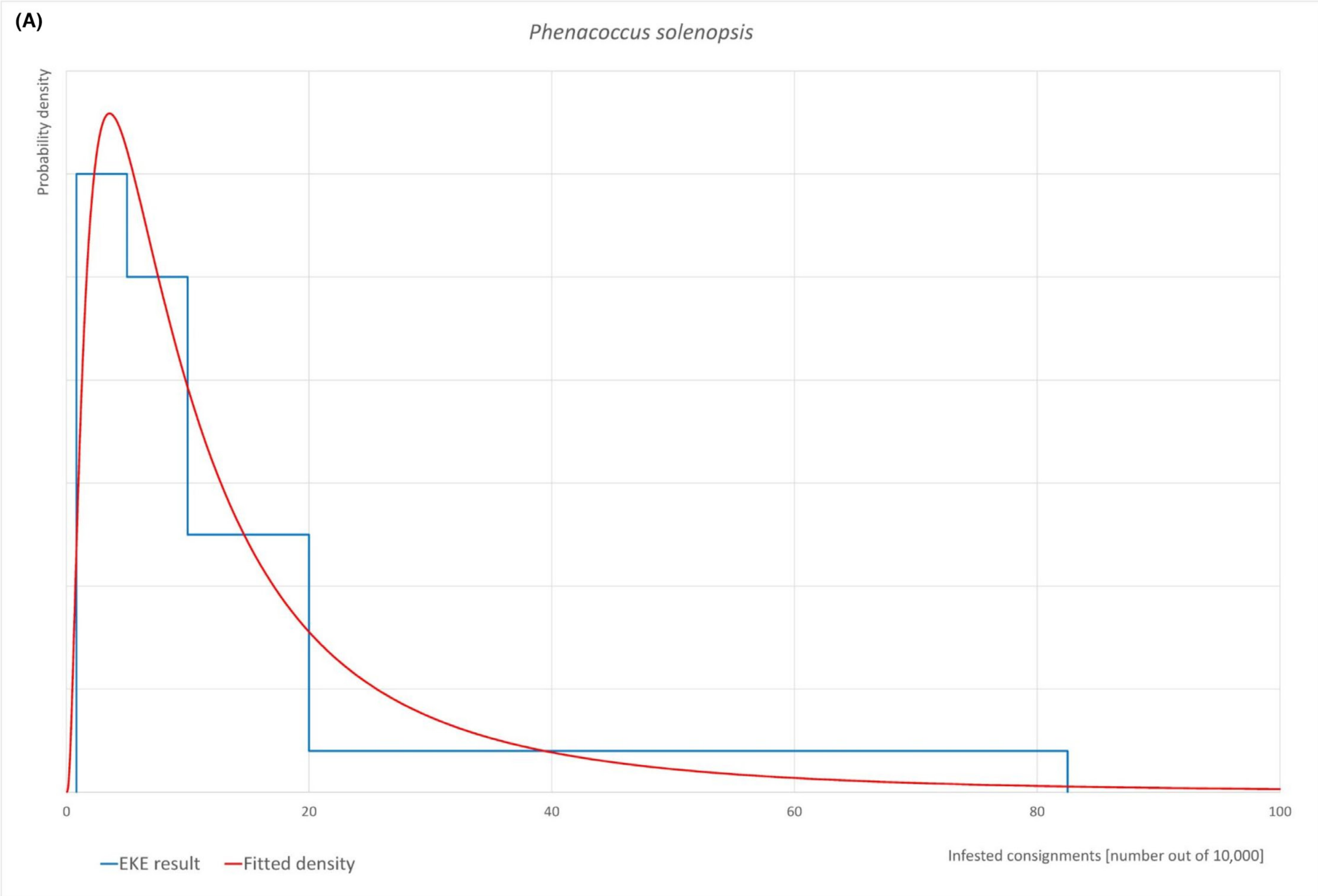


**FIGURE A.6** (Continued)

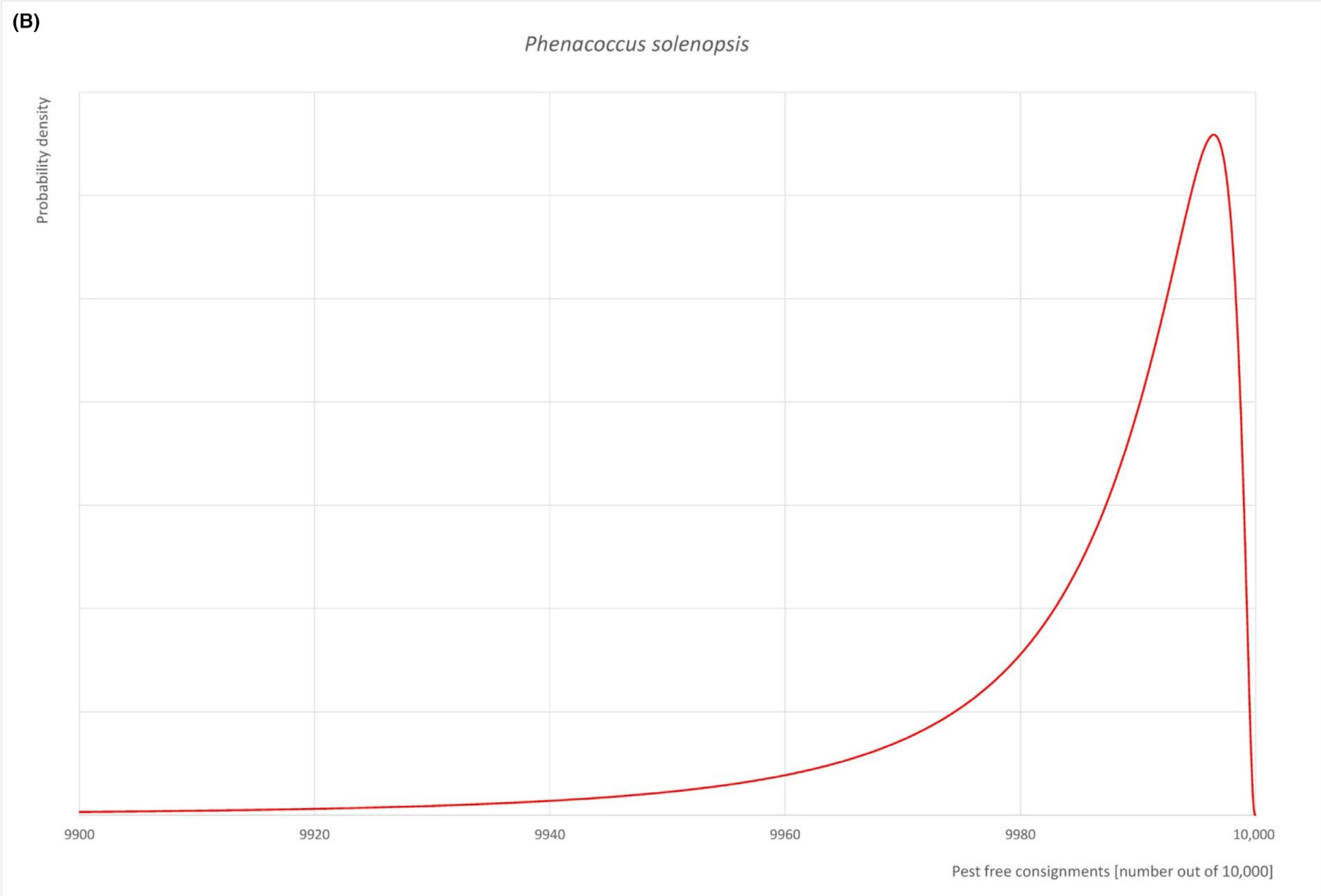


**FIGURE A.6** (Continued)

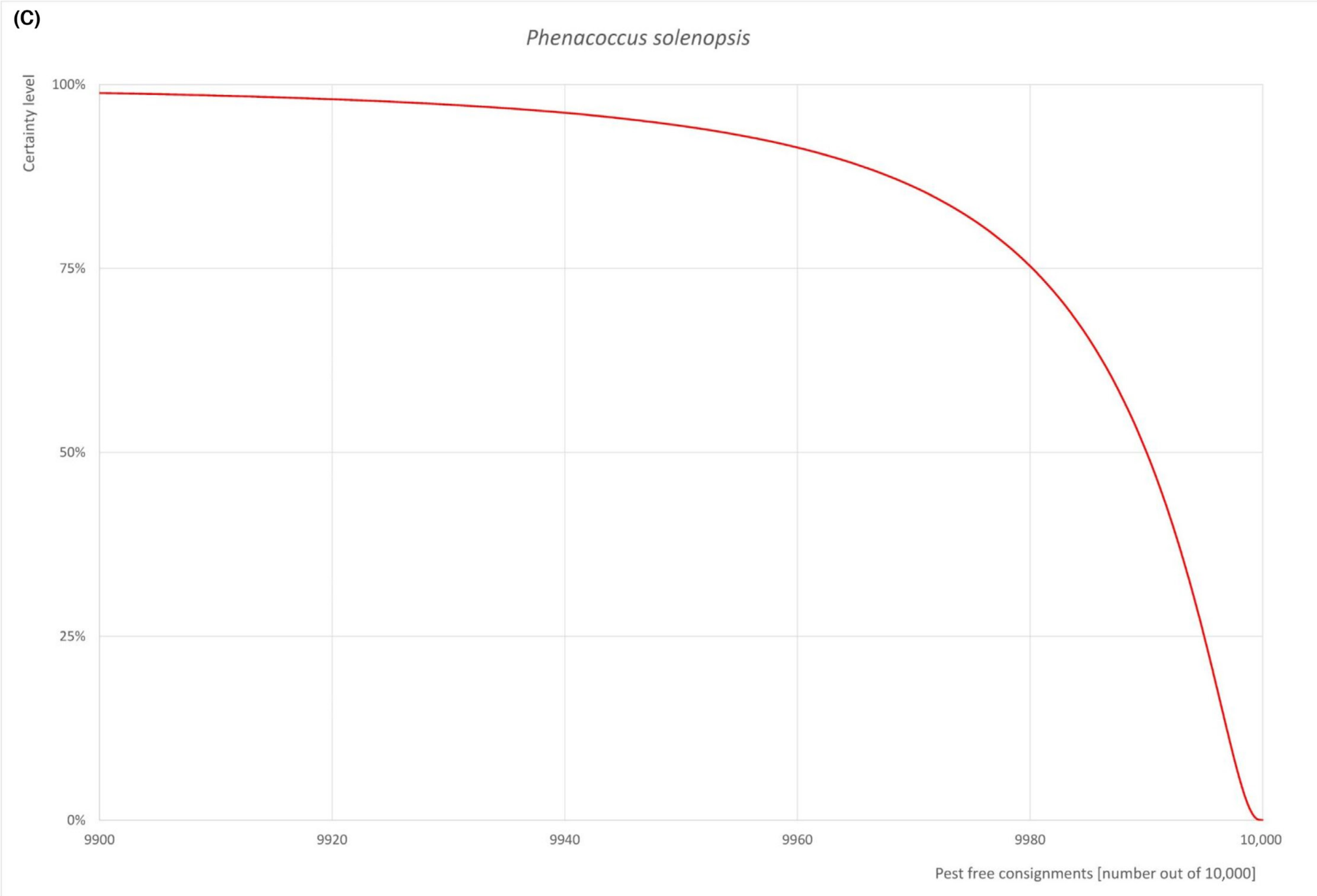


**FIGURE A.6** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Phenacoccus solenopsis* complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags.

## A.6.7 | Reference list


Arif, M. I., Rafiq, M., & Ghaffar, A. (2009). Host plants of cotton mealybug (*Phenacoccus solenopsis*): A new menace to cotton agroecosystem of Punjab, Pakistan. *International Journal of Agriculture and Biology*, 11, 163–167.

Ben-Dov, Y. (1994). A systematic catalogue of the mealybugs of the world (Insecta: Homoptera: Coccoidea: Pseudococcidae and Putoidae) with data on geographical distribution, host plants, biology and economic importance. 100th Intercept Limited Andover, UK. 686 pp.

CABI (Centre for Agriculture and Bioscience International). (online). Datasheet *Phenacoccus solenopsis* (cotton mealybug). https://www.cabi.org/isc/datasheet/109097

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Jacques, M.-A., Jaques Miret, J. A., Justesen, A. F., MacLeod, A., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Potting, R., Reignault, P. L., Thulke, H.-H., van der Werf, W., Civera, A. V., … Gonthier, P. (2021a). Scientific Opinion on the commodity risk assessment of *Ficus carica* plants from Israel. *EFSA Journal*, 19(1), 6353. https://doi.org/10.2903/j.efsa.2021.6353

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Di Serio, F., Gonthier, P., Jaques Miret, J. A., Justesen, A. F., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Potting, R., Reignault, P. L., Thulke, H.-H., Van der Werf, W., Civera, A. V., Yuen, J., Zappal_a, L., Gregoire, J.-C., … MacLeod, A. (2021b). Scientific Opinion on the pest categorisation of *Phenacoccus solenopsis*. *EFSA Journal*, 19(8), 6801. https://doi.org/10.2903/j.efsa.2021.6801

EPPO (European and Mediterranean Plant Protection Organization). (online). *Phenacoccus solenopsis* (PHENSO). https://gd.eppo.int/taxon/PHENSO

EUROPHYT (online). European Union Notification System for Plant Health Interceptions – EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

Fallahzadeh, M., Abdimaleki, R., & Saghaei, N. (2014). Host Plants of the Newly Invasive Mealybug Species, *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae), in Hormozgan Province, Southern Iran. *Zeitschrift fur Entomologie Entomofauna*, 35, 169–176.

Fand, B., & Suroshe, S. (2015). The invasive mealybug *Phenacoccus s*olenopsis Tinsley, a threat to tropical and subtropical agricultural and horticultural production systems - a review. *Crop Protection*, 69, 34–43. https://doi.org/10.1016/j.cropro.2014.12.001

Garc_ıa Morales, M., Denno, B. D., Miller, D. R., Miller, G. L., Ben-Dov, Y., & Hardy, N. B. (online). ScaleNet: A literature-based model of scale insect biology and systematics, *Phenacoccus solenopsis*. https://scalenet.info/catalogue/Phenacoccus%20solenopsis/

Gerson, U., & Aplebaum, S. (online). Plant Pests of the Middle East, *Phenacoccus solenopsis* Tinsley. https://www.agri.huji.ac.il/mepests/pest/Phenacoccus_solenopsis/

Hodgson, C., Abbas, G., Arif, M. J., Saeed, S., & Karar, H. (2008). *Phenacoccus solenopsis* Tinsley (Sternorrhyncha:Coccoidea: Pseudococcidae), an invasive mealybug damaging cotton in Pakistan and India, with a discussion on seasonal morphological variation. *Zootaxa*, 1913, 1–35. https://doi.org/10.11646/zootaxa.1913.1.1

Ibrahim, S. S., Moharum, F. A., El-Ghany, N. M. A. (2015). The cotton mealybug *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) as a new insect pest on tomato plants in Egypt. *Journal of Plant Protection Research*, 55, 48–51. https://doi.org/10.1515/jppr-2015-0007

Islam, K. S., Ali, R., Hossain, A., Aminuzzaman, F. M., Ullah, J., Alam, F., Saha, S., & Abdullah-Al-Mahamud, K. M. (2017). Pest Risk Analysis (PRA) of Mealybug Spp. in Bangladesh. Strengthening Phytosanitary Capacity in Bangladesh Project.

Malumphy, C., Baker, R., & Anderson, H. (2013). Rapid pest risk analysis for *Phenacoccus solenopsis* (cotton mealybug) and the closely related *P. defectus* and *P. solani*. FERA (The Food and Environment Research Agency), UK. https://pra.eppo.int/pra/39656db7-d832-415c-83b7-49ff596393e8

Mani, M., & Shivaraju, C. (2016). Mealybugs and their management in agricultural and horticultural crops. Berlin, Germany, Springer. 655 pp.

Plant Quarantine Wing Department of Agricultural Extension Khamarbari, Farmgate, Dhaka-1205. 128 pp.

Sannino, L., Espinosa, B., Piccirillo, G., Pallino, R., & Fondacaro, S. (2019). *Phenacoccus solenopsis* nuova minaccia sulle solanacee. L'informatore Agrario no. 47, 51–55.

Ricupero, M., Biondi, A., Russo, A., Zappalà, L., & Mazzeo, G. (2021). The cotton mealybug is spreading along the Mediterranean: first pest detection in Italian tomatoes. *Insects*, 12(8), 675. https://doi.org/10.3390/insects12080675

Spodek, M., Ben-Dov, Y., Mondaca, L., Protasov, A., Erel, E., & Mendel, Z. (2018). The cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) in Israel: pest status, host plants and natural enemies. *Phytoparasitica*, 46, 45–55. https://doi.org/10.1007/s12600-018-0642-1

TRACES-NT (online). TRAde Control and Expert System. https://webgate.ec.europa.eu/tracesnt

Vennila, S., Deshmukh, A. J., Pinjarkar, D., Agarwal, M., Ramamurthy, V. V., Joshi, S., Kranthi, K. R., & Bambawale, O. M. (2010). Biology of the mealybug, *Phenacoccus solenopsis* on cotton in the laboratory. *Journal of Insect Science*, 10, 115.

Vennila, S., Prasad, Y. G., Prabhakar, M., Agarwal, M., Sreedevi, G., & Bambawale, O. M. (2013). Weed hosts of cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae). *Journal of Environmental Biology*, 34.


## A.7 | Moths

### A.7.1 | Organism information

| | | | |
|---|---|---|---|
| **Name of the organisms in the cluster** | *Helicoverpa zea* (Boddie) (HELIZE)<br>*Chloridea virescens* (Fabricius) (HELIVI)<br>*Spodoptera ornithogalli* (Guenée) (PRODOR)<br>Reasons for clustering:<br>The three moth species have a very similar biology and are therefore evaluated as a group. | | |
| **Group** | Order: Lepidoptera<br>Family: Noctuidae | | |
| **Regulated status** | *Helicoverpa zea*: Commission Implementing Regulation (EU) 2019/2072, Annex II, Part A.<br>*Chloridea virescens, Spodoptera ornithogalli*: Emergency measures. | | |
| **Host status on *Petunia* sp./*Calibrachoa* sp.** | **Pest name** | **Petunia/Calibrachoa host status** | **Solanaceae host plants** |
| | *H. zea* | No evidence | Eggplant, Pepper, Potato, Tobacco, Tomato |
| | *C. virescens* | *Petunia* spp., Calibrachoa spp | Tobacco, Tomato |
| | *S. ornithogalli* | *Petunia* spp. | Eggplant, Potato, Tobacco, Tomato |
| | For *H. zea* there are no records for *Petunia/Calibrachoa*. However, *H. zea* is highly polyphagous (see biology section) and among the host plats there are several solanaceous host plants. Therefore, the panel assumes that *Petunia/Calibrachoa* are likely as a host plant species.<br>Uncertainties: the host status of *Petunia* spp. and *Calibrachoa* spp. to *Helicoverpa zea*. | | |

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| | |
|---|---|
| **Pest status in Guatemala** | *H. zea, C. virescens* and *S. ornithogalli* according to EPPO GD online are present in Guatemala. |
| **Pest status in EU** | No relevant as EU quarantine or emergency risk pests. |
| **PRA information** | Available Pest Risk Assessments:<br>Scientific Opinion on the pest categorisation of *Helicoverpa zea* (EFSA PLH Panel, 2020). |
| **Other relevant information for the assessment** | |
| **Biology** | **Host range and distribution of host plants in the environment:**<br>*Helicoverpa zea* is a highly polyphagous pest. Most hosts are recorded from the family Poaceae, Malvaceae, Fabaceae and Solanaceae; in total more than 100 plant species are recorded as hosts. The crops most frequently recorded as host plants are maize, sorghum, cotton, beans, peas, chickpeas, tomatoes, aubergines, peppers and, to a lesser extent, clover, okra, cabbages, lettuces, strawberries, tobacco, sunflowers, cucurbits and many of the other legumes. Damage to fruits and to trees has also been recorded (EFSA, 2020; EPPO, online a).<br>*Chloridea virescens* is a highly polyphagous pest infesting more than 19 crops and has been reported to feed on at least 80 wild plants species (Blanco et al., 2007). *Glycine max* (soybean), *Gossypium hirsutum* (American upland cotton), *Cicer arietinum* (chickpea) and *Nicotiana tabacum* (large tobacco) are major hosts (EPPO, online b; Karpinski et al., 2014) for *C. virescens*. In general, preferred hosts are *Abelmoschus esculentus* (okra), *Cajanus cajan* (pigeon pea), *Capsicum annuum* (bell pepper), *Cicer arietinum* (chickpea), *Cucurbita pepo* (marrow), *Helianthus annuus* (sunflower), *Ipomoea batatas* (sweet potato), *Lactuca sativa* (lettuce), *Linum usitatissimum* (flax), *Phaseolus* (beans), *Phaseolus vulgaris* (common bean), *Solanum lycopersicum* (tomato) and *Zea mays* (maize) (EPPO, online).<br>*Spodoptera ornithogalli* is a highly polyphagous insect pest damaging a wide range of cultivated and wild plants. The larvae of S. *ornithogalli* can feed on at least 209 plant species belonging to 76 botanical families (Brito et al., 2019). Plant species of the Asteraceae presented the highest number of records (approximately 23% of the total records) followed by plants species belonging to Fabaceae, Solanaceae and Araceae families, with 19, 15 and 14% of the total records respectively (Brito et al., 2019). *Spodoptera ornithogalli* can damage many economically important horticultural crops such as alfalfa, banana, barley, begonia calathea, cabbage, carrot, cassava, Chinese banyan, corn, cotton, eggplant, flax, gladiolus, jasmine, lentil, lettuce, marigold, oat, okra, onion, orange, papaya, peach, peanut, Peperomia, pepper, potato, rose, soybean, spinach, strawberry, sunflower, vine grape, violet, watermelon and wheat. Weed species known to be suitable hosts include *Amaranthus retroflexus, Chenopodium album*, Datura sp., *Erigeron canadensis, Grindelia* sp., *Ipomoea* sp., *Lactuca scariola, Plantago lanceolata, Ricinus communis*; *Rumex* sp. and *Solanum carolinense*. In many cases, yellow striped armyworm develops first on weed or rangeland plants, with subsequent generations affecting crops (Brito et al., 2019; Capinera, 2008; EPPO, online c, 2021).<br>**Life cycle**:<br>The life span of moths ranges from 5 to 15 days on average. They are nocturnal and hide in vegetation during the day. Adult moths collect nectar or other plant exudates from a large number of plants and live for 12 to 16 days. Females can lay up to 2500 eggs in their lifetime.<br>**Symptoms and characteristic of the pest**:<br>*Helicoverpa Zea*<br>Vegetative stage maize plants can have holes in the leaves following whorl-feeding on the apical leaf, although this type of feeding is generally rare. On maize plants at the reproductive stage, eggs can be found stuck to the silks. Young larvae of *Helicoverpa zea* feed on the silks as they move down the silk channel to feed on the ear. As the ears develop, kernels in the top few centimetres of the cobs can be eaten in addition to the unpollinated tip of the ear; usually only one large larva per cob can be seen. Larvae feed on contents of seeds of sorghum heads after chewing holes. While feeding on leaves of legume plants can occur, more significant damage is caused by feeding on seeds in pods. Feeding holes can be seen in tomato fruits, cotton bolls, cabbage and lettuce hearts and flower heads (EPPO, 2023).<br>*Chloridea virescens*<br>The larvae of *Chloridea virescens* make holes in shoots and flower buds, although sometimes they can be found on the growing tips, the leaf petioles and the stems. In the absence of reproductive tissue, the larvae easily feed on leaf material. When the caterpillars move towards and penetrate the fruit, the risk of disease infection increases considerably (Capinera, 2018; EPPO, 2015).<br>*Spodoptera ornithogalli*<br>The larvae of *S. ornithogalli* feeding on the aerial parts of the host plants. Larvae damage plants mainly by consumption of foliage. The small gregarious larvae tend to skeletonize foliage and the later larval instars consume irregular patches of foliage or entire leaves. The larvae can also feed on the fruits and flowers of host plants such as tomato, pepper and cotton (Bessin ND; Capinera, 2008; EPPO, 2015; Fernández et al., 2004). |
| **What life stages could be expected on the commodity** | Eggs and larvae could be present on *Petunia/Calibrachoa* plants on harvested unrooted cuttings. |
| **Surveillance information** | There is no information on specific surveys for *S. ornithogalli, C. virescens* and *H. zea.* |

## A.7.2 | Possibility of pest presence in the nursery

### A.7.2.1 | Possibility of entry from the surrounding environment

The three moth species could be present on host plant crops cultivated in the area where the export nurseries are located. Moths are good flyers and it is possible that mated females are present near a greenhouse. Given the size of the adult moths (wingspan 3–5 cm) only the presence of large defects in the insect proof structure of the production greenhouses could enable a moth to enter. Hitchhiking moth on persons or material entering the greenhouse is unlikely.

<u>Uncertainties:</u>

- The presence of suitable hostplants/crops in the surrounding environment of the export nurseries.

#### A.7.2.2 | Possibility of entry with new plants/seeds

Eggs and larvae can be attached to plants or plant parts that are introduced in the greenhouse but they will be relatively easily detectable. It is unlikely that eggs or larvae are present on imported certified propagation material.

#### A.7.2.3 | Possibility of spread within the nursery

Other host plants than *Petunia/Calibrachoa* could be present in the nursery and if infested with one of the moth species these production lots could be a source of spreading moths within the nursery.

Uncertainties:

The probability that the moth species are able to complete development to an adult moth inside the greenhouse.

The probability that flying adults or larvae searching for food sources could spread from infested host plants within the nursery without being noticed.

### A.7.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are 3 records of interceptions of *H. zea* on *Pisum Sativum*. from Guatemala. There are no records of interceptions of *C. Virescens*, *S. ornithogalli* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala.

### A.7.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>The three moth species have a wingspan of 3–5 cm and cannot enter a greenhouse with thrips proof netting in place. Hitchhiking on clothing of greenhouse staff is unlikely<br>Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>− Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* and *Calibrachoa* are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of moths.<br>Uncertainties:<br>It Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| Soil treatment | N | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2).<br>Evaluation:<br>It is unlikely that eggs or larvae are present on certified *in vitro* material or cuttings of *Petunia/Calibrachoa.*<br>Uncertainties:<br>The abundance of the species in and the proportion of plant material coming from El Salvador. |
| Crop rotation | N | Description:<br>The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |

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| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Disinfection of irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects.<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>If one of the moth species would be present in the greenhouse, they should be monitored with pheromone traps. Moths can be caught by yellow sticky traps. Eggs and feeding damage are easy to detect. Uncertainties:<br>– The efficiency of monitoring and inspection. |
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0).<br>Evaluation:<br>The applied insecticides can be effective against Lepidoptera.<br>Uncertainties:<br>– The efficacy of the applied insecticide and its timing is not known. |
| Sampling and testing | N | Description:<br>*Petunia* and *Calibrachoa* plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus. There is an inventory of immune-strips to test different virus from AGDIA. |
| Packing and handling procedures | Y | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers.<br>Evaluation:<br>During this step feeding damages can be easily detected.<br>Uncertainties:<br>Eggs can go undetected. |
| Official supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>All three moth species have a quarantine status in the EU and plants exported to the EU should be free of these pests.<br>Uncertainties:<br>– The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of the insects. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of surveillance scheme. |

### A.7.5 | Overall likelihood of pest freedom

#### A.7.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* and *Calibrachoa* spp are not a preferred host for *H. zea.*
- None of the three species has been intercepted on produce from Guatemala.
- Low population pressure of the three species in the surrounding environment, due to the limited presence of preferred host plants.

- Greenhouse structure is insect-proof and entrance is thus unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected.
- Application of the insecticides have a good efficacy against the three species.

A.7.5.2 | At harvest and packing, cuttings with symptoms will be detected Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *H. zea, C. virescens* and *S. ornithogalli* are present throughout Guatemala and they have a wide host range, mainly Solanaceous plant, including *Petunia* spp. (*C. virescens*, *S. ornithogalli*) and *Calibrachoa* spp. (*C. virescens*).
- Greenhouses are located in areas where *H. zea, C. virescens* and *S. ornithogalli* are present and abundant (e.g. Eggplant, Pepper, Potato, Tobacco, Tomato).
- Presence of *H. zea, C. virescens and S. ornithogalli* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *H. zea, C. virescens* and *S. ornithogalli*.

A.7.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The protective effect of the greenhouse structure.
- The insecticides treatments are moderately effective.
- There are no records of interceptions from Guatemala.

A.7.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The main uncertainty is the population pressure of the selected moths species in the surrounding environment.
- High uncertainty for values below median.
- Less uncertainty for higher values.

### A.7.6 | Elicitation outcomes of the assessment of the pest freedom for Moths

The following Tables show the elicited and fitted values for pest infestation (Table A.13) and pest freedom (Table A.14).

**TABLE A.13** Elicited and fitted values of the uncertainty distribution of pest infestation by *Helicoverpa zea, Chloridea virescens* and *Spodoptera ornithogalli* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 0 | | | | | 2 | | 3 | | 5 | | | | | 10 |
| EKE | 0.303 | 0.492 | 0.718 | 1.06 | 1.45 | 1.88 | 2.30 | 3.18 | 4.21 | 4.86 | 5.69 | 6.64 | 7.79 | 8.82 | 10.0 |

*Note*: The EKE results is the *BetaGeneral (2.0038, 9.7777, 0, 21)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.14.

**TABLE A.14** The uncertainty distribution of plants free of *Helicoverpa zea, Chloridea virescens* and *Spodoptera ornithogalli* per 10,000 bugs of unrooted cuttings calculated by Table A.13.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9990 | | | | | 9995 | | 9997 | | 9998 | | | | | 10,000 |
| EKE results | 9990 | 9991 | 9992 | 9993 | 9994 | 9995.1 | 9995.8 | 9996.8 | 9997.7 | 9998.1 | 9998.6 | 9998.9 | 9999.3 | 9999.5 | 9999.7 |

*Note*: The EKE results are the fitted values.

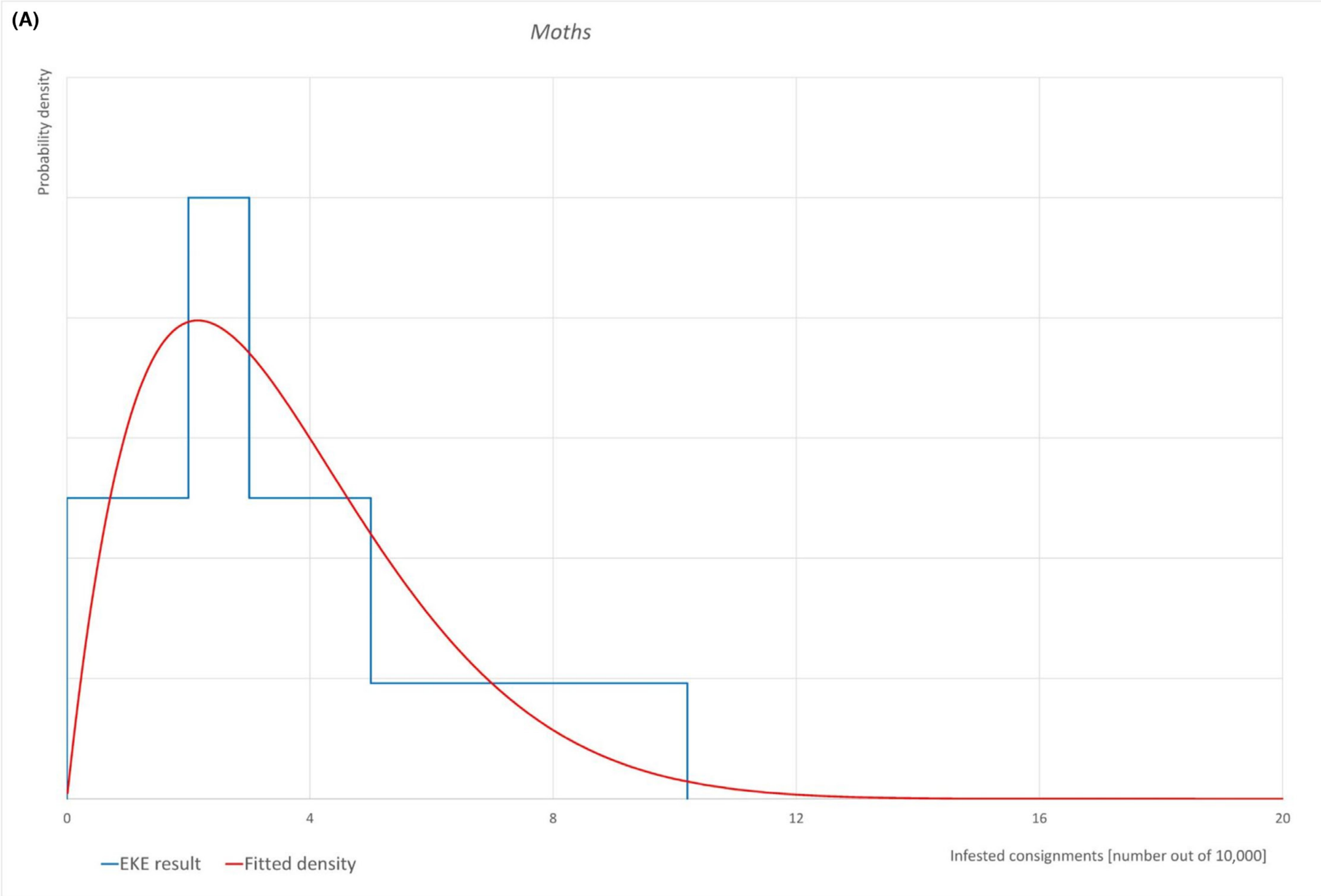


**FIGURE A.7** (Continued)

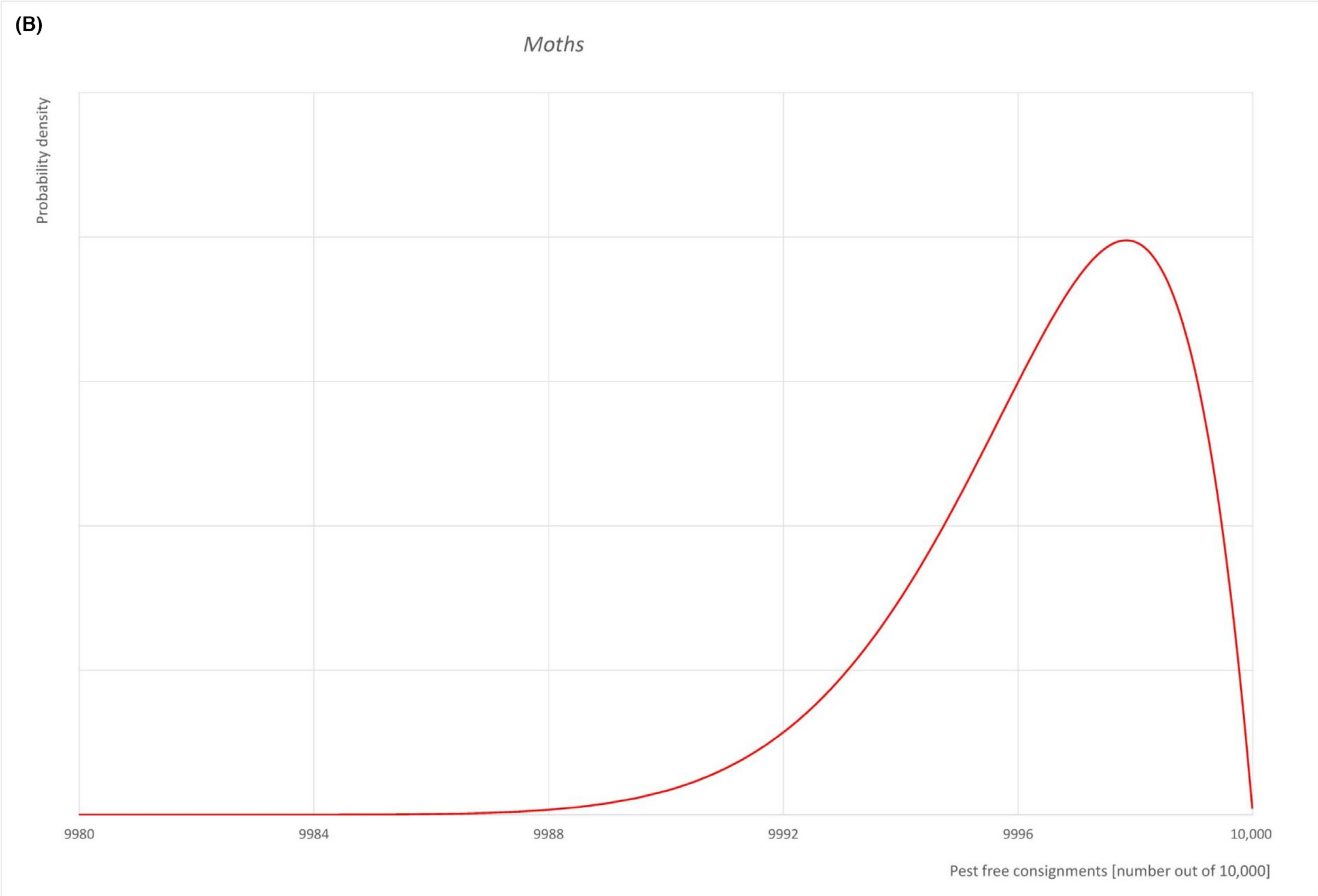


**FIGURE A.7** (Continued)

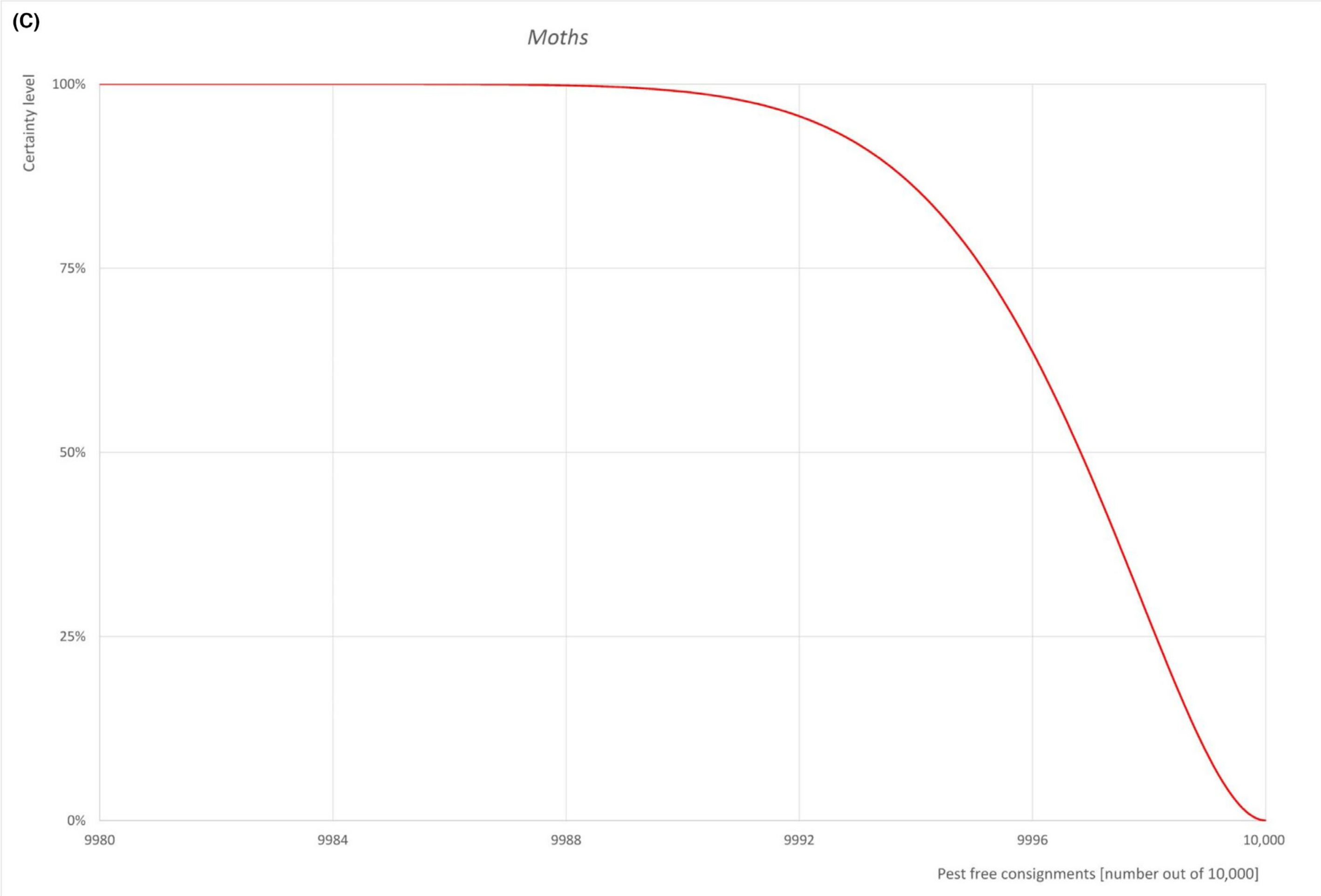


**FIGURE A.7** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for moths complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags.

### A.7.7 | Reference list


Bessin, R. N. D. Yellowstriped Armyworm, *Spodoptera ornithogalli* (Guenée). ENTFACT-321. Cooperative extension service, University of Kentucky. https://www2.ca.uky.edu/entomology/entfacts/entfactpdf/ef321.pdf

Blanco, C. A., Terán-Vargas, A. P., López Jr, J. D., Kauffman, J. V., & Wei, X. (2007). Densities of *Heliothis virescens* and *Helicoverpa zea* (Lepidoptera: Noctuidae) in three plant hosts. *Florida Entomologist*, 742–750. https://doi.org/10.1653/0015-4040(2007)90[742:DOHVAH]2.0.CO;2

Brito, R., Specht, A., Gonçalves, G. L., Moreira, G. R. P., Carneiro, E., Santos, F. L., Roque-Specht, V. F., Mielke, O. H. H., & Casagrande, M. M. (2019). *Spodoptera marima*: a New Synonym of *Spodoptera ornithogalli* (Lepidoptera: Noctuidae), with Notes on Adult Morphology, Host Plant Use and Genetic Variation Along Its Geographic Range. *Neotropical Entomology*, 48, 433–448. https://doi.org/10.1007/s13744-018-0654-z

CABI (Centre for Agriculture and Bioscience International). (online). Datasheet *Helicoverpa zea* (bollworm). https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.26776

CABI (Centre for Agriculture and Bioscience International). (online). Datasheet *Heliothis virescens* (tobacco budworm). https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.26774

Capinera, J. L. (2001). *Heliothis virescens*: Featured Creatures (ed. by JL Gillett-Kaufman) Entomology and Nematology Department, University of Florida. https://entnemdept.ufl.edu/creatures/field/tobacco_budworm.htm

Capinera, J. L. (2008). Yellowstriped armyworm, *Spodoptera ornithogalli* (Guenee) (Insecta: Lepidoptera: Noctuidae). IFAS Extension, University of Florida, EENY 216. https://entnemdept.ufl.edu/creatures/veg/leaf/yellowstriped_armyworm.htm

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M.-A., Jaques Miret, J. A., Justesen, A. F., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Potting, R., Reignault, P. L., Thulke, H.-H., Van der Werf, W., Civera, A. V., Yuen, J., Zappalà, L., Czwienczek, E., … MacLeod, A. (2020). Scientific Opinion on the pest categorisation of *Helicoverpa zea*. *EFSA Journal*, 18(7), 6177.

EPPO (European and Mediterranean Plant Protection Organization). (2015). EPPO Technical Document No. 1068, EPPO study on pest risks associated with the import of tomato fruit. EPPO Paris. https://pra.eppo.int/pra/66c82994-76ab-4780-9fd0-ea4f92e7c094

EPPO (European and Mediterranean Plant Protection Organization). online a. *Helicoverpa zea*. EPPO datasheets on pests recommended for regulation. https://gd.eppo.int/taxon/HELIZE/datasheet

EPPO (European and Mediterranean Plant Protection Organization). online b. *Chloridea virescens* (HELIVI). https://gd.eppo.int/taxon/HELIVI

EPPO (European and Mediterranean Plant Protection Organization). (2015). EPPO Technical Document No. 1068, EPPO Study on Pest Risks Associated with the Import of Tomato Fruit. EPPO Paris. /media/uploaded_images/RESOURCES/eppo_publications/td_1068_tomato_study.pdf

EPPO (European and Mediterranean Plant Protection Organization). (2021). EPPO Alert List – *Spodoptera ornithogalli* (Lepidoptera: Noctuidae) Yellow-striped armyworm. https://www.eppo.int/ACTIVITIES/plant_quarantine/alert_list_insects/spodoptera_ornithogalli

EPPO (European and Mediterranean Plant Protection Organization). online c. *Spodoptera ornithogalli* (PRODOR). https://gd.eppo.int/taxon/PRODOR

EPPO (European and Mediterranean Plant Protection Organization). 2015b. Diagnostic Protocol PM 7/124 (1) *Spodoptera littoralis, Spodoptera litura, Spodoptera frugiperda, Spodoptera eridania*. EPPO Bulletin, 45(3), 410–444. https://doi.org/10.1111/epp.12258

EUROPHYT. (online). European Union Notification System for Plant Health Interceptions – EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

Fernández, L. S., Fernández, C., & Mejía, J. E. (2004). Ciclo de vida de *Spodoptera ornithogalli* (Guenée) en el cultivo del algodonero en el Valle Medio del Sinú. *Temas agrarios*, *9*(1), 30–36.

Karpinski, A., Haenniger, S., Schofl, G., Heckel, D. G., & Groot, A. T. (2014). Host plant specialization in the generalist moth *Heliothis virescens* and the role of egg imprinting. *Evolutionary Ecology*, 28, 1075–1093. https://doi.org/10.1007/s10682-014-9723-x

TRACES-NT. (online). TRAde Control and Expert System. https://webgate.ec.europa.eu/tracesnt

University of California Integrated Pest Management. (2007). UC Statewide Integrated Pest Management Program. https://ipm.ucanr.edu/PHENOLOGY/ma-tobacco_budworm.html


## A.8 | Tomato spotted wilt virus (TSWV)

### A.8.1 | Organism information

| | |
|---|---|
| **Name of the organisms in the cluster** | Tomato spotted wilt virus (TSWV00), *Orthotospovirus tomatomaculae* (proposed binomial nomenclature by ICTV). |
| **Group** | Viruses and viroids<br>*Tospoviridae*<br>*Orthotospovirus* |
| **Regulated status** | Tomato spotted wilt virus is regulated as RNQPs in vegetable propagating and planting material of *Capsicum annuum* L., *Lactuca sativa* L., *Solanum lycopersicum* L., *Solanum melongena* L. in Commission Implementing Regulation (EU) 2019/2072, ANNEX IV, Part I.<br>TSWV is a regulated non-quarantine pest (RNQP) of *Begonia x hiemalis* Fotsch, *Capsicum annuum* L., *Chrysanthemum* L., *Gerbera* L., *Impatiens* L. New Guinea Hybrids, *Pelargonium* L. plants for planting for ornamental purposes in Commission Implementing Regulation (EU) 2019/2072, ANNEX IV, Part D |
| **Host status on *Petunia* sp./*Calibrachoa* sp.** | TSWV infects petunia, tomato, pepper and potato in nature (EPPO Bulletin 2020).<br>There are no records that *Calibrachoa* sp. is a host of TSWV. However, TSWV has a very large host range within the solanaceous family (Parrela et al., 2003; EPPO). Therefore, *Calibrachoa* sp. is expected to be host of TSWV.<br>Uncertainties:<br>The host status of *Calibrachoa* sp. to TSWV.<br>The ability of TSWV to systemically infect *Petunia* sp. and *Calibrachoa* sp. |
| **Pest status in Guatemala** | In Dossier section 5.0, the NPPO of Guatemala states that based of surveillance data there have been reports for the presence of TSWV in Guatemala, therefore TSWV is present in Guatemala. |
| **Pest status in EU** | No relevant as EU regulated pest. |
| **PRA information** | Available Pest Risk Assessments:<br>- Scientific Opinion on the risk to plant health posed by Tomato spotted wilt virus to the EU territory with identification and evaluation of risk reduction options (EFSA Panel on Plant Health, 2012). |

(Continued)

| **Other relevant information for the assessment** | |
|---|---|
| **Biology** | **Transmission:**<br>Tospoviruses are transmitted by thrips species (Thysanoptera: Thripidae) in a circulative, propagative manner by which the virus persists through the various developmental stages of the insect. *Frankliniella occidentalis* is the most efficient vector of tospoviruses for their spread in ornamental and vegetable crops. Other species may also transmit INSV (*F. fusca, F. intonsa F. bispinosa, F. cephalica, F. schultzei F. gemina*, *Thrips setosus* and *T. tabaci*); however, the transmission efficiencies vary significantly among different species and sometimes among different populations of the same species (Oliver and Whitfield, 2016; Rotemberg et al., 2015).<br>Transmission parameters of TSWV have been studied in details in the vector *F. occidentalis* a. Only thrips that acquire the virus as larvae (L1 and L2) are able to transmit TSWV. The first instar larval (L1) is the most efficient at acquiring the virus which it can be then transmitted by second instar larvae (L2) and adults after a latent period that is negatively correlated with temperature. The minimum acquisition access period and inoculation access period ranges from 5 min to 1 day with increasing frequency of transmission when the feeding period is extended. Following acquisition, TSWV is retained for the entire lifespan of the thrips, but it is not transovarially passed onto the insect progeny. TSWV is better spread by flying adults thrips than crawling larvae (Wijkamp and Peters, 1993; Wijkamp et al., 1993, 1995, 1996; Ullman et al., 1993).<br>As all plant viruses that may systemically infect their host, TSWV could be also transmitted via the vegetative propagation material and it is generally considered not to be seed-transmitted (EFSA, 2012).<br>**Uncertainly on biology**<br>The vector ability of additional thrips species for tospoviruses.<br>**Host range and distribution of host plants in the environment:**<br>**TSWV** is one of the most successful plant pathogens in terms of worldwide distribution and an ever-expanding host range (Rybicki, 2015; Scholthof et al., 2011). Its host range includes 1300 species dicotyledonous and monocotyledonous angiosperms belonging to at least 85 families but mainly infecting species in the Asteraceae and Solanaceae families (Parella et al., 2013). The natural crop-hosts of TSWV include most of the major horticultural crops such as tomato, pepper, tobacco, legumes and many ornamentals (Parella et al., 2013). TSWV also infect many weed species which may contribute significantly to its epidemiology as virus reservoirs (Chatzivassiliou et al., 2001).<br>**Uncertainly on host range**<br>The actual host range of TSWV is continuously growing therefore remains unknown.<br>**Ecology and biology of the vectors:**<br>*F. occidentalis* is present in Guatemala (EPPO GD) where it widespread in field-grown crops and weeds (CABI online; Porres, 2008).<br>*F. occidentalis* is a highly polyphagous invasive species and the most efficient vector of TSWV, and can reach high populations on ornamentals and vegetables belonging to the Solanaceae family especially during warm weather conditions. The entire life cycle from oviposition to adult emergence can take 8 days in hot weather to 44 days in cool weather (Rob et al., 1988).<br>**Uncertainly on ecology and biology of the vectors:**<br>The presence and distribution of other vector species.<br>**Symptoms on *Petunia/Calibrachoa*:**<br>TSWV infected petunia plants exhibit necrotic spots on the inoculated leaves with no systemic infection (Daughtrey et al., 1997; DPVnet). Symptoms usually appear within a few days after feeding of a viruliferous thrips. These spots are not easy to be detected by an inspector, especially in high densities of the plant canopy.<br>In addition, these symptoms might be confused in between the different tospoviruses but also with those caused by some fungal or bacterial diseases. Therefore, further testing is needed for confirmation of TSWV infection (Daughtrey et al., 1997).<br>Uncertainties:<br>The host status of *Calibrachoa* sp. to TSWV and the symptoms of the infected plants.<br>The ability of TSWV to systemically infect some *Petunia* sp. and *Calibrachoa* sp. varieties. |
| **Evidence that the commodity can be a pathway** | Unrooted cuttings of *Petunia/Calibrachoa* can be infected by TSWV and/or infested by viruliferous thrips. |
| **Surveillance information** | There are no targeted surveys for TSWV in Guatemala. |

### A.8.2 | Possibility of pest presence in the nursery

#### A.8.2.1 | Possibility of entry from the surrounding environment

TSWV is transmitted by thrips and *Frankliniella occidentalis*, its most efficient vector species (REF) is present in GA (EPPO GD; online) and widespread in field-grown crops and weeds (Porres, 2008). TSWV, although not reported in Guatemala, is present in all surrounding countries (EPPO GD, online) and worldwide, therefore it is highly impossible not to be present in Guatemala. Having a large host range, a high number of vegetables, ornamentals and weeds (also perennial) are hosts (EPPO GD, online).

Therefore, hosts and vectors are expected to be present and possibly widespread in Guatemala. The main pathway of entrance of TSWV from the surrounding environment in the nursery is through viruliferous thrips. Defect in the insect proof structure of the production greenhouses could enable whitefly to enter, as well as hitchhiking aphids on persons or materials entering the greenhouse.

Uncertainties:

- Presence of defects in the greenhouse structure.
- Infection (virus) and infestation (thrips vectors) pressure in the surroundings.
- Presence and distribution of host plants in the surroundings.

#### A.8.2.2 | Possibility of entry with new plants/seeds

Plant material (cuttings) for *Petunia* sp. and *Calibrachoa* sp. mother plants used for the production of unrooted cutting originate from the Netherlands, Germany, El Salvador and Israel. TSWV is present in the EU and in Israel (EPPO GD) and possibly in El Salvador (due to its worldwide distribution). In the EU countries a certification scheme is in place for *Petunia/Calibrachoa* which includes TSWV. Although the details for the certification systems in the non-EU countries are not known, a percentage of incoming mother plants are tested in the nursery for TSWV at the start of the production (Dossier, Section 4.0).

Other solanaceous and non-solanaceous plants are produced in the same nursery and their cultivation rotates within the nursery greenhouses/compartments. No data are provided for the identity, proportion, origin and phytosanitary status of other than *Petunia/Calibrachoa* plants produced in the same nursery.

Uncertainties:

- The detail of the *Petunia/Calibrachoa* certification schemes in the non-EU countries.
- The proportion of *Petunia/Calibrachoa* mother plants coming from non-EU countries.
- The origin and the host status for TSWV and the phytosanitary status of other plant species (solanaceous, non-solanaceous) entering the same nursery.
- The phytosanitary requirements for imports into Guatemala.

#### A.8.2.3 | Possibility of spread within the nursery

*Petunia* sp. and *Calibrachoa* sp. are cultivated in compartments dedicated for their cultivation with no other plant species. However, other plants (solanaceous and non-solanaceous) possible hosts of TSWV are cultivated and thrips could be present in other greenhouses/compartments of the nursery. *Frankliniella occidentalis* is the most efficient vector of TSWV and a major pest of ornamentals, practically feeding in almost any flower plant (Daughtrey et al., 1997; CABI). Viruliferous thrips could spread TSWV between the different or within the same greenhouse/compartment. TSWV may also spread by vegetative propagation of infected mother plants. There are strict hygiene conditions inside the nursery however, thrips due to their minute size are more difficult to observe and easier to escape these conditions than other insects.

Uncertainties:

- The presence and density of the TSWV and thrips in the nursery.
- The presence and the host status for TSWV of other plant species (solanaceous, non-solanaceous) growing in the same nursery.

### A.8.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions *of tomato spotted wilt virus* on different commodities from third countries or on any other plant from Guatemala.

### A.8.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| **Growing plants in isolation** | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from thrips that may enter from the surrounding environment. Thrips may be introduced through defects in the greenhouse or as hitchhikers on greenhouse staff. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>− Presence of unnoticed defects in the greenhouse structure. |
| **Dedicated hygiene measures** | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* and *Calibrachoa* are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of TSWV.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| **Soil treatment** | Y | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses.<br>Evaluation:<br>Metam-Sodium can kill (viruliferous) thrips pupating in the substrate. |
| **Quality of source plant material** | Y | Evaluation:<br>TSWV is included in the EU certification schemes therefore, the material originated from the EU is expected to be free of symptoms and tested negative for TSWV.<br>The material originated from non-EU countries (Israel and El Salvador) is certified, hence expected to comply with the respective phytosanitary legislation. If TSWV monitoring (inspections, testing) is included in the certification schemes, *Petunia* and *Calibrachoa* plants are expected to be free of symptoms and tested negative for TSWV.<br>Uncertainties:<br>The details of the certification schemes and if TSWV monitoring is included in the non-EU countries certification schemes.<br>The phytosanitary status of the imported material from the non-EU countries. |
| **Crop rotation** | N | The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| **Disinfection of irrigation water** | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of Sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| **Pest monitoring and inspections** | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects.<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of thrips and TSWV. However, TSWV infections are difficult to detect especially in low thrips infestation due to the local symptoms (necrotic local lesions) of *Petunia* (and possible of *Calibrachoa*) to TSWV infection. Especially in some varieties the developing local lesions are more difficult to visually detect than others. Traps can monitor flying thrips however, TSWV can be transmitted also by unnoticed nymphs that are also difficult to notice in low populations.<br>Uncertainties:<br>• The efficiency of monitoring and inspection especially for the detection of thrips nymphs.<br>• The visibility of the necrotic local lesions produced on *Petunia/Calibrachoa* by TSWV. |

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| **Pesticide treatment** | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0).<br>Evaluation:<br>The applied insecticides are effective against thrips. However, thrips are known for having developed resistance to some insecticides.<br>Uncertainties:<br>– The efficacy and timing of the applied insecticide are not known. |
| **Sampling and testing** | Y | Description:<br>*Petunia* and *Calibrachoa* plants are laboratory tested using serological based techniques for viruses, including TSWV and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus.<br>Evaluation: There are a lot of antibodies and/or serological techniques (immunostrips) available for the efficient TSWV detection. According to the dossier these viruses are included in the applied testing scheme, therefore most infections (if present) are expected to be detected. However, serological techniques may fail to detect low number of local lesions that may result in low virus concentration below the detection limit of the detection method.<br>Uncertainties:<br>The efficiency of serological techniques for the detection of TSWV in *Petunia/Calibrachoa* (local lesion host). |
| **Packing and handling procedures** | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| **Official supervision by NPPO** | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>The monitoring can detect the presence of thrips infestation however this may be difficult at low populations. However, once TSWV can be transmitted by a single thrips – even a nymph to more than one plant, some infections may occur before the development of a detectable thrips infesting population. Infected *Petunia* sp. and *Calibrachoa* sp. plants are expected to exhibit local symptoms difficult to be detected in some varieties and especially when low in numbers. This is especially important in large plants and high canopy densities that leaves with local lesions may be covered by the neighbouring healthy once and escape detection.<br>Uncertainties:<br>– The efficiency of monitoring and inspection |
| **Surveillance of production area** | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of TSWV and its thrips vectors. However, no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of the surveillance scheme. |

## A.8.5 | Overall likelihood of pest freedom

### A.8.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- TSWV has not been reported to infect *Calibrachoa*.
- TSWV has not been reported on *Petunia/Calibrachoa* in Guatemala.
- TSWV has never been intercepted on produce from Guatemala.
- Low infection pressure (prevalence of host plants) of TSWV in the surrounding environment.
- No infection pressure (prevalence of host plants) of TSWV in other greenhouses/compartments of the nursery.

- Transfer of infected thrips from virus-sources (infected host plants) in the surrounding environment to the greenhouse plants is very difficult because of insect proof structure and its efficient inspection of the greenhouse and the strict hygienic measure in place preventing the natural and human-assisted movement of thrips.
- The scouting monitoring regime is effective and TSWV infected plants and thrips present in the nurseries are expected to be easily detected.

  - Application of the insecticides have a good efficacy against thrips and TSWV spread.
  - At harvest and packing, cuttings with symptoms can be detected with careful observation.
  - The inspection regime is effective (detection and treatment).
  - Physical separation of different lots offers in case of infestation the restriction of the affected plants.

### A.8.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

Even if there is no evidence that *Calibrachoa* is a host plant for TSWV, given their polyphagous nature especially among ornamentals it is likely that *Calibrachoa* is also a suitable host plant.

- Solanaceous are very susceptible to TSWV infections.

  - *Petunia* and *Calibrachoa* are preferable hosts for thrips.
  - High population pressure in highly preferred host (e.g. abandoned infected field of highly preferable host close to the greenhouse).

- Presence of TSWV in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure or thrips hitchhike on greenhouse staff or materials.
- Transmission of TSWV via vegetative propagated material increases the probability of their entry and establishment in the nursery on *Petunia/Calibrachoa* or other host plant species.
- The major thrips species in ornamental nurseries is *Frankliniella occidentalis* that it is the most efficient vector of TSWV
- Other thrips species vectoring TSWV are also present and widely distributed in Guatemala.

  - The insecticides treatments are moderately effective against thrips (insecticide resistance).
  - Considering their wide host range it is likely that host plants are present in the surrounding environment.
  - Presence of TSWV in the environment is not monitored.
  - Symptoms are not easy to be visually detected especially in low thrips infestation.
  - In some varieties local lesions produced by TSWV are not easy to distinguish from thrips feeding symptoms

### A.8.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

The value of the median is estimated based on:

- TSWV infects many solanaceous species especially ornamentals therefore *Calibrachoa* is expected to be host also for TSWV.
- *Petunia* spp. and *Calibrachoa* spp. are a preferable host for thrips.

- The major thrips species in ornamental nurseries is *Frankliniella occidentalis* that it is the most efficient vector of TSWV.

  - The protective effect of the greenhouse structure.
  - The insecticides treatments are moderately effective against thrips (insecticide resistance).
  - The high 27density of the mother plants in the nurseries before cutting prevents the detection of infected plants/leaves.
  - Petunia plants when infected by TSWV exhibit local lesions difficult to visually detect especially in high canopy densities.

### A.8.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- There is a low uncertainty about the protective effect of the greenhouse structure.

### A.8.6 | Elicitation outcomes of the assessment of the pest freedom for tomato spotted wilt virus

The following Tables show the elicited and fitted values for pest infestation (Table A.15) and pest freedom (Table A.16).

**TABLE A.15** Elicited and fitted values of the uncertainty distribution of pest infestation by tomato spotted wilt virus per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 0 | | | | | 10 | | 20 | | 50 | | | | | 80 |
| EKE | 0.0438 | 0.191 | 0.582 | 1.77 | 4.05 | 7.78 | 12.4 | 24.1 | 39.0 | 47.7 | 57.3 | 66.0 | 73.2 | 77.2 | 79.9 |

*Note*: The EKE results is the *BetaGeneral (0.62241, 1.125, 0, 82)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.16.

**TABLE A.16** The uncertainty distribution of plants free of tomato spotted wilt virus per 10,000 bugs of unrooted cuttings calculated by Table A.15.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9920 | | | | | 9950 | | 9980 | | 9990 | | | | | 10,000 |
| EKE results | 9920 | 9923 | 9927 | 9934 | 9943 | 9952 | 9961 | 9976 | 9988 | 9992 | 9996 | 9998 | 9999.4 | 9999.8 | 10,000.0 |

*Note*: The EKE results are the fitted values.

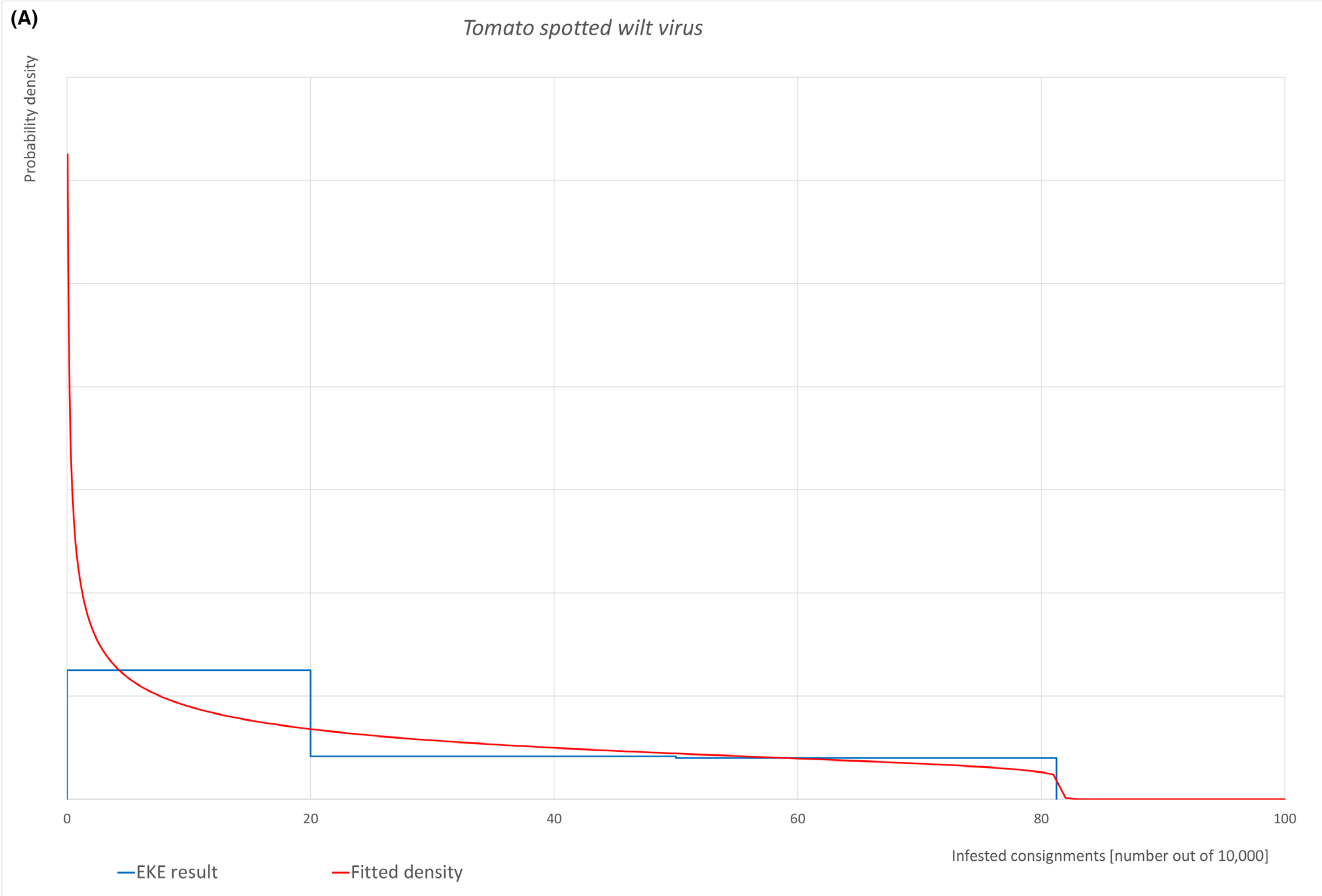


**FIGURE A.8** (Continued)

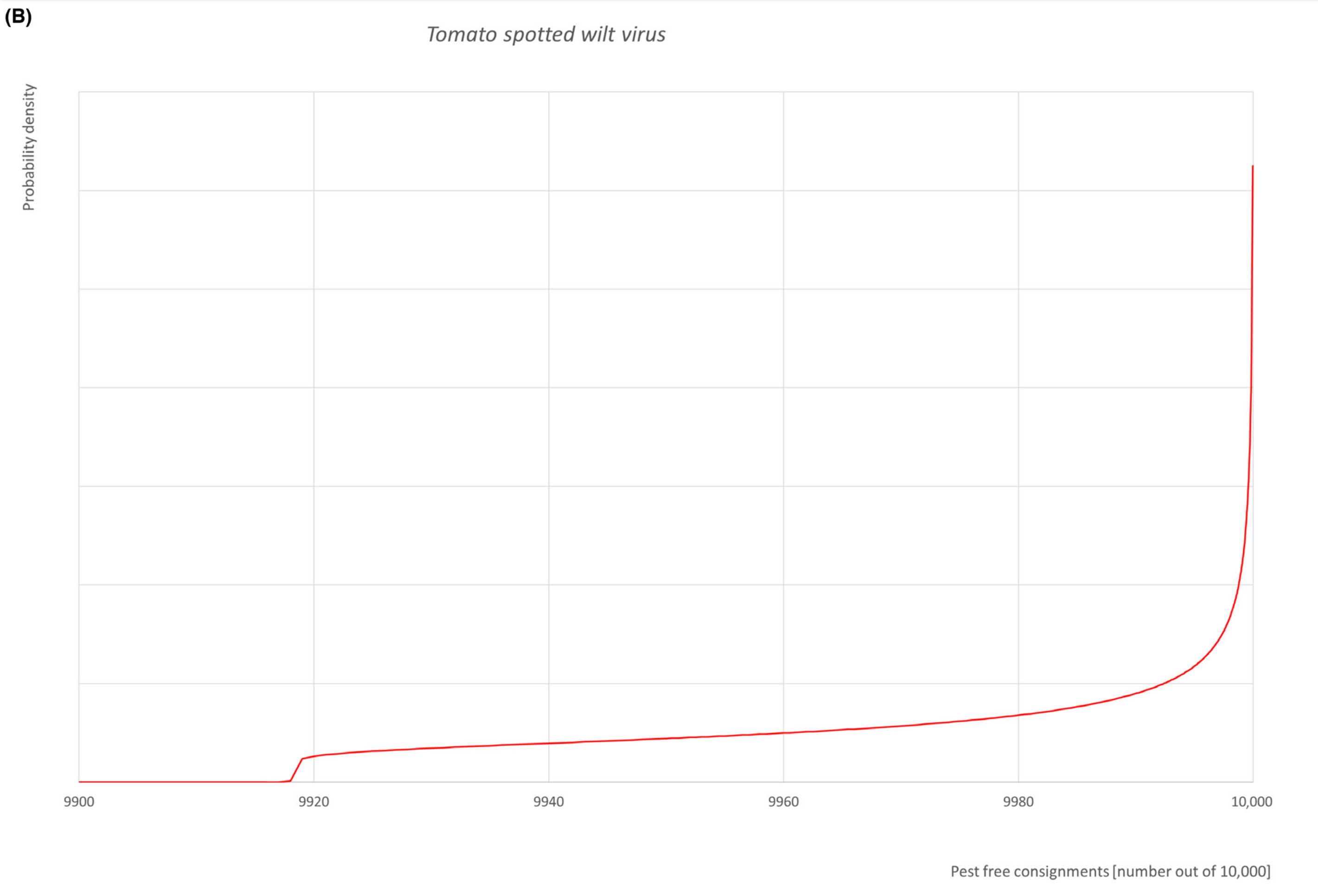


**FIGURE A.8** (Continued)

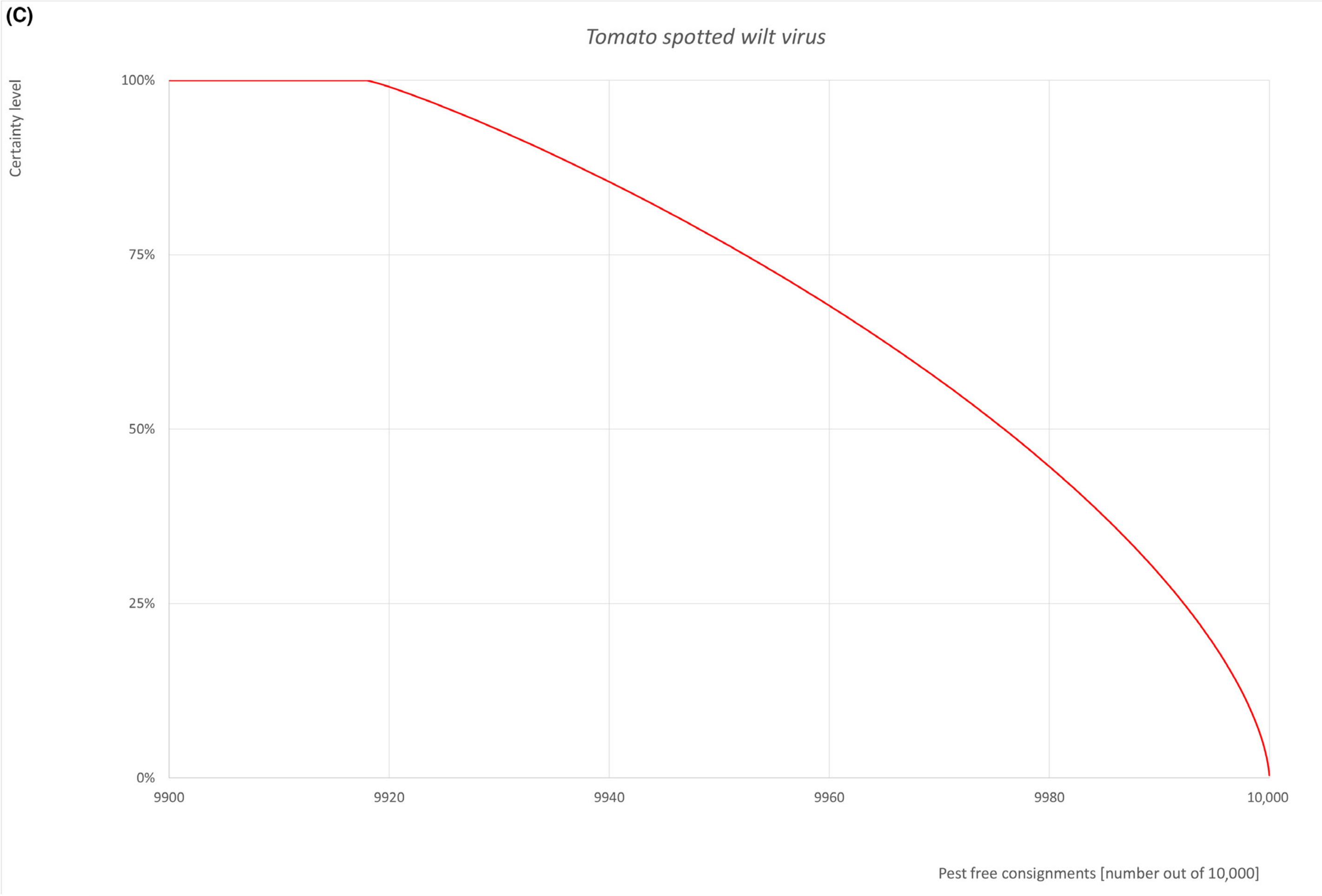


**FIGURE A.8** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for tomato spotted wilt virus (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (c) descending uncertainty distribution function of pest infestation per 10,000 bags.

## A.8.7 | Reference list


Chatzivassiliou, E. K., Boubourakas, I., Drossos, E., Eleftherohorinos, I., Jenser, G., Peters, D., & Katis, N. I. (2001). Weeds in greenhouses and tobacco fields are differentially infected by tomato spotted wilt virus and infested by its vector species. *Plant Disease*, 85(1), 40–46.

Daughtrey, M. L., Jones, R. K., Moyer, J. W., Daub, M. E., & Baker, J. R. (1997). Tospoviruses strike the greenhouse industry: INSV has become a major pathogen on flower crops. *Plant Disease*, 81, 1220–1230. https://doi.org/10.1094/PDIS.1997.81.11.1220

EUROPHYT. (online). European Union Notification System for Plant Health Interceptions - EUROPHYT. https://food.ec.europa.eu/plants/plant-health-and-biosecurity/europhyt/interceptions_en

Oliver, J. E., & Whitfield, A. E. (2016). The genus *Tospovirus*: Emerging bunyaviruses that threaten food security. *Annual Review of Virology*, 3(1), 101–124. https://doi.org/10.1146/annurev-virology-100114-055036

Robb, K., Parrella, M. P., & Neuman, J. P. (1988). The biology and control of the western flower thrips. Part 1. Ohio Florists' Association Bulletin, 699,2–5.

Rotenberg, D., Jacobson, A. L., Schneweis, D. J., & Whitfield, A. E. (2015). Thrips transmission of tospoviruses. *Current Opinion in Virology*, 15, 80–89.

Ruter, J., & Gitaitis, R. (1993). Impatiens necrotic spot virus in woody landscape plants in Georgia. *Plant Disease,*, 77, 318. https://doi.org/10.1094/PD-77-0318A

Sanchez-Cuevas, M.-C., & Nameth, S. G. P. (2002). Virus-associated diseases of double petunia: frequency and distribution in Ohio greenhouses. *HortScience*, 37, 543–546.

Wijkamp, I., van Lent, J., Kormelink, R., Goldbach, R., & Peters, D. (1993). Multiplication of tomato spotted wilt virus in its insect vector, *Frankliniella occidentalis*. *The Journal of General Virology*, 74, 341.

Wijkamp, I., & Peters, D. (1993). Determination of the median latent period of 2 Tospoviruses in *Frankliniella occidentalis*, using a novel leaf disk assay. Phytopathology, 83, 986–991.

Wijkamp, I., Almarza, N., Goldbach, R., & Peters, D. (1995). Distinct levels of specificity in thrips transmission of tospoviruses. *Phytopathology*, 85, 1069–1074.

Wijkamp, I., Goldbach, R., & Peters, D. (1996). Propagation of tomato spotted wilt virus in Frankliniella occidentalis does neither result in pathological effects nor in transovarial passage of the virus. *Entomologia Experimentalis et Applicata*, 81, 285–292.


## A.9 | *Bactericera cockerelli*

### A.9.1 | Organism information

| | |
|---|---|
| **Taxonomic information** | Current valid scientific name: *Bactericera cockerelli* (Šulc, 1909)<br>Synonyms: *Trioza cockerelli* (Šulc, 1909); *Paratrioza cockerelli* (Šulc, 1909)<br>Name used in the EU legislation: *Bactericera cockerelli*<br>Order: Hemiptera<br>Family: Triozidae<br>Common name: Tomato psyllid; potato psyllid<br>Name used in the dossier: *Bactericera cockerelli* |
| **Group** | Insects |
| **EPPO code** | PARZCO |
| **Regulated status** | Quarantine pest for the EU, Commission Implementing Regulation (EU) 2019/2072, ANNEX II PART A.<br>Special requirements for fruits of Solanaceae originating from third countries for their introduction into the Union territory. Commission Implementing Regulation (EU) 2019/2072, ANNEX VII.<br>EPPO A1 List |
| **Pest status in Guatemala** | Present, widespread (CABI, online; EPPO, online). |
| **Pest status in the EU** | No relevant as EU quarantine pest. |
| **Host status on *Petunia spp. and Calibrachoa spp*** | *Bactericera cockerelli* is a pest of many plants of Solanaceae family but it has not been reported to feed either in *Petunia* spp. or *Calibrachoa* spp. plants.<br><u>Uncertainties</u>: the host status of *Petunia* spp. and *Calibrachoa* spp to *Bactericera cockerelli.* |
| **PRA information** | Pest risk analysis on *Bactericera cockerelli*, the potato psyllid, has been prepared by EPPO. EPPO (2012) Final pest risk analysis for *Bactericera cockerelli*. EPPO, Paris. |
| **Other relevant information for the assessment** | |
| **Biology** | The potato psyllid is a small phloem-feeding insect (Horton et al., 2015). It is a polyphagous pest and its host range reaches the 40 plant species mainly from the Solanaceae family. It is polyvoltine, having more than one generation per year (CABI, online). Total adult longevity ranges from 21 to 97 days and females usually live more than males. Adult females lay from 200 to 400 eggs over their lifetime depending on the host plant (Abdullah, 2008; Yang and Liu, 2009). Larvae hatch after 5–8 days and nymphs undergo through five instars. The nymphal developmental time depends mainly on temperature and host plant and it is ranged from 19 to 24 days at 27°C (Abdullah, 2008; Yang and Liu, 2009). Females start laying their eggs 8–9 days after reaching adulthood and the oviposition periods is approximately 50 days (Yang and Liu, 2009). Potato psyllid is able to overwinter on natural vegetation as an adult (Jensen et al., 2012; Horton et al., 2015).<br>*Bactericera cockerelli* is a good flyer and migrates annually primarily with wind and in this way it can be transported over long distances (EPPO, 2013; EPPO, 2012). Adult migration is considered as the primary mechanism by which *B. cockerelli* arrives in agricultural crops (Glick, 1939; Papp and Johnson, 1979). The eggs are deposited singly mainly on the upper or lower surface of leaves, usually near the leaf edge while some eggs can be found in other parts of host plants. After larvae hatching the young nymphs search for a suitable place to feed. Nymphs are found mostly on the lower surface of leaves and usually remain sedentary during their development. The nymphs prefer sheltered and shaded locations. Adults are active in contrast to nymphs. Nymphs and adults produce characteristic and large quantities of whitish excrement particles which adhere to foliage and fruits (EPPO, 2013). *Bactericera cockerelli* transmits '*Candidatus Liberibacter solanacearum*' to solanaceous plants which is the causal agent of a serious disease called 'Zebra chip disease' (Nachappa et al., 2012).<br>The adults are quite small, measuring about 2.5–2.75 mm long. |

(Continued)

| | | |
|---|---|---|
| **Symptoms** | **Main type of symptoms** | The above ground symptoms of plant infestation of *B. cockerelli* in potatoes and tomatoes are retarded growth, erectness of new foliage, chlorosis and purpling of new foliage with basal cupping of leaves, upward rolling of leaves throughout the plant, shortened and thickened terminal internodes resulting in rosetting, enlarged nodes, axillary branches or aerial potato tubers, disruption of fruit set and production of numerous, small and poor-quality fruits. Below ground the psyllid may cause excessive number of tiny misshapen potato tubers, production of chain tubers and early breaking of dormancy of tubers. *Bactericera cockerelli* is also associated with psyllid yellows disease of potato and tomato which may be caused by a toxin which associated with the feeding of psyllid nymphs They comprise spiky, chlorotic apical growth, mottling of leaves, curling of mid-veins, stunting of plants and fruit deformation in some cultivars. (EPPO, 2013; EFSA, 2019). |
| | **Presence of asymptomatic plants** | No asymptomatic plants are known to occur. However, because eggs, nymphs and adults of the insect are very small their detection upon visual inspection may not be easy when low populations occur. |
| | **Confusion with other pathogens/pests** | *B. cockerelli* nymphs may be confused with other psyllids.<br>*Bactericera cockerelli* can be morphologically identified with the help of identification keys by Ossiannilsson (1992) and Carnegie et al. (2017). |
| **Host plant range** | *Bactericera* cockerelli is found mainly on plants within the family Solanaceae. The psyllid feeds and reproduces on a variety of cultivated and wild plant species including crop plants such as potato (*Solanum tuberosum*), tomato (*Lycopersicon esculentum*), pepper (*Capsicum annuum*) and eggplant (*Solanum melongena*), and non-crop species such as nightshade (*Solanum* spp.), groundcherry (*Physalis* spp.) and matrimony vine (*Lycium* spp.).<br>This species seems to feed on more species than those it can reproduce on. Adults have been collected from plants in numerous families, including Pinaceae, Salicaceae, Polygonaceae, Chenopodiaceae, Brassicaceae, Asteraceae, Fabaceae, Malvaceae, Amaranthaceae, Lamiaceae, Poaceae, Menthaceae and Convolvulaceae, but this is not an indication of the true host range of this psyllid (EPPO, 2013). | |
| **What life stages could be expected on the commodity** | Eggs nymphs and adults may be present on host plants.<br>No information for this pest on *Petunia* spp. or *Calibrachoa* spp. plants is available. | |
| **Surveillance information** | There are no targeted surveys for *B. cockerelli* in Guatemala. | |

## A.9.2 | Possibility of pest presence in the nursery

### A.9.2.1 | Possibility of entry from the surrounding environment

*B. cockerelli* is a pest of many species of Solanaceae and of other plant families and it is reported to be widespread in Guatemala. Given the wide host range of this pest it is possible that local populations of *B. cockerelli* may be present in the neighbouring environment. Flying adults of *B. cockerelli*, can enter the nursery from host plants that might be present in the surrounding environment. Defects in the insect proof structure of the production greenhouses could enable adults to enter.

Uncertainties:

- Presence of defect in the greenhouse structure.
- Abundance of *B. cockerelli* in the surroundings.
- Presence and distribution of host plants in the surroundings.

### A.9.2.2 | Possibility of entry with new plants/seeds

Mother plants used for the production of unrooted cutting originate from the Netherlands, Germany, El Salvador and Israel. *B. cockerelli* is present in El Salvador and adults could be associated with mother plants.

Uncertainties:

- The abundance of *B. cockerelli* in El Salvador.
- The host status of *B. cockerelli* on *Petunia* spp. and *Calibrachoa* spp.

### A.9.2.3 | Possibility of spread within the nursery

When present, flying adults searching for food sources can spread from infested host plants within the nursery.

Uncertainties:

- There are no uncertainties.

### A.9.3 | Information from interceptions

In the EUROPHYT database there are no records of interceptions of *B. cockerelli* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala.

### A.9.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| **Growing plants in isolation** | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing *Bactericera cockerelli* adults that may enter from the surrounding environment. *Bactericera cockerelli adults* may be introduced through defects in the greenhouse. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>– Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* and *Calibrachoa* are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of potato psyllid.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| Soil treatment | N | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2).<br>Evaluation:<br>*Bactericera cockerelli* is present in El Salvador and adults could be associated with mother plants.<br>Uncertainties:<br>The abundance of the species in El Salvador. |
| Crop rotation | N | Description:<br>The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfection of irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects.<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of *Bactericera* cockerelli adults.<br>Uncertainties:<br>– The efficiency of monitoring and inspection. |

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Pesticide treatment | Y | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0).<br>Evaluation:<br>The applied insecticides are effective against *Bactericera* cockerelli adults.<br>Uncertainties:<br>– The efficacy of the applied insecticide and its timing is not known. |
| Sampling and testing | N | Description:<br>*Petunia* and *Calibrachoa* plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber<br>The shipment of *Petunia* and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official Supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>The monitoring can detect the presence of *Bactericera* cockerelli adults.<br>Uncertainties:<br>– The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of *Bactericera* cockerelli. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of surveillance scheme. |

### A.9.5 | Overall likelihood of pest freedom

#### A.9.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* and *Calibrachoa* spp are not a preferred host.
- *B. cockerelli* has never been intercepted on produce from Guatemala.
- Dispersal capacity of *B. cockerelli* adults is limited.
- Low population pressure of *B. cockerelli* in the surrounding environment, due to the limited presence of preferred host plants.
- Greenhouse structure is insect-proof and entrance is thus unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected because of the typical symptoms on leaves.
- Application of the insecticides have a good efficacy against *B. cockerelli*.
- At harvest and packing, cuttings with symptoms will be detected.
- 25 cuttings per bag.

#### A.9.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *B. cockerelli* is present throughout Guatemala and they have a wide host range, mainly solanaceous plant, therefore it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *B. cockerelli* is present and abundant (e.g. eggplant, potato).
- Presence of *B. cockerelli* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.

- Insecticide treatments are not targeting *B. cockerelli*.
- 80 cuttings per bag.

A.9.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The protective effect of the greenhouse structure.
- The insecticides treatments are effective.
- There are no records of interceptions from Guatemala.

A.9.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The main uncertainty is the population pressure of *B. cockerelli* in the surrounding environment.

### A.9.6 | Elicitation outcomes of the assessment of the pest freedom for potato psyllid

The following Tables show the elicited and fitted values for pest infestation (Table A.17) and pest freedom (Table A.18).

**TABLE A.17** Elicited and fitted values of the uncertainty distribution of pest infestation by *Bactericera cockerelli* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 0 | | | | | 3 | | 6 | | 13 | | | | | 60 |
| EKE | 0.497 | 0.738 | 1.04 | 1.54 | 2.16 | 2.96 | 3.85 | 6.13 | 9.77 | 12.7 | 17.4 | 24.5 | 36.2 | 50.9 | 75.6 |

*Note*: The EKE results is the *Lognorm (10.984, 16.334)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.18.

**TABLE A.18** The uncertainty distribution of plants free of *Bactericera cockerelli* per 10,000 bugs of unrooted cuttings calculated by Table A.18.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9940 | | | | | 9987 | | 9994 | | 9997 | | | | | 10,000 |
| EKE results | 9924 | 9949 | 9964 | 9976 | 9983 | 9987 | 9990 | 9994 | 9996 | 9997.0 | 9997.8 | 9998.5 | 9999.0 | 9999.3 | 9999.5 |

*Note*: The EKE results are the fitted values.

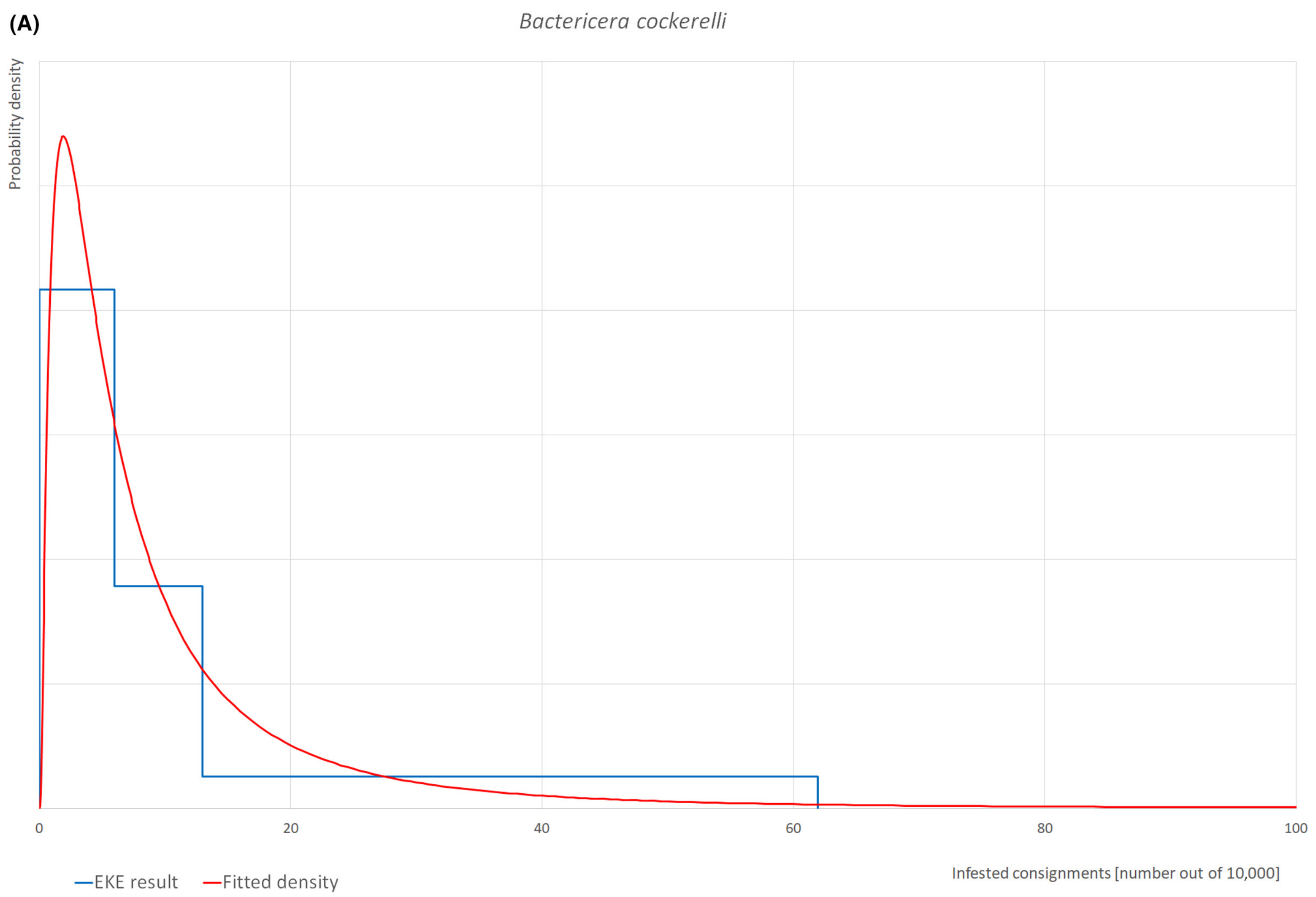


**FIGURE A.9** (Continued)

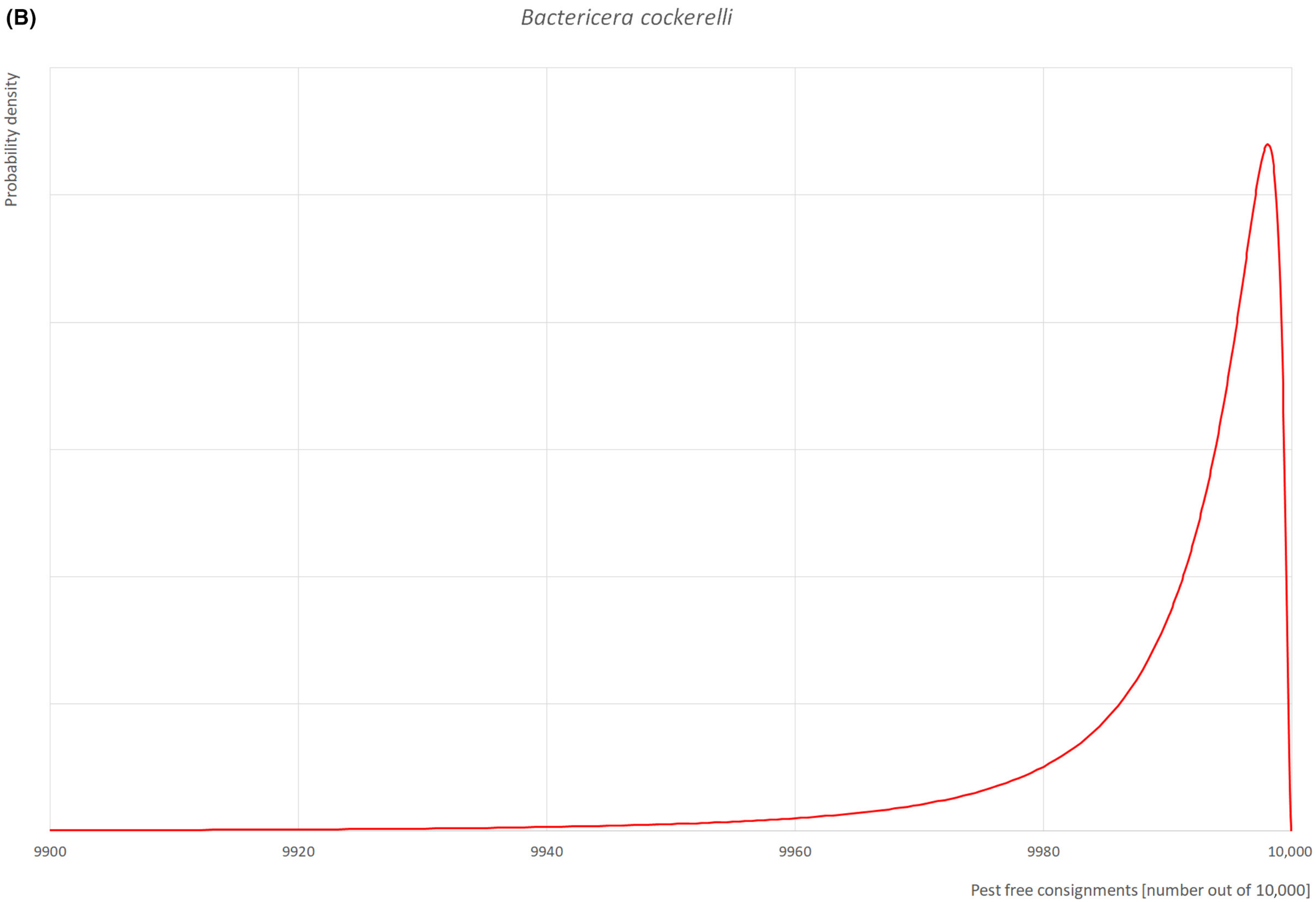


**FIGURE A.9** (Continued)

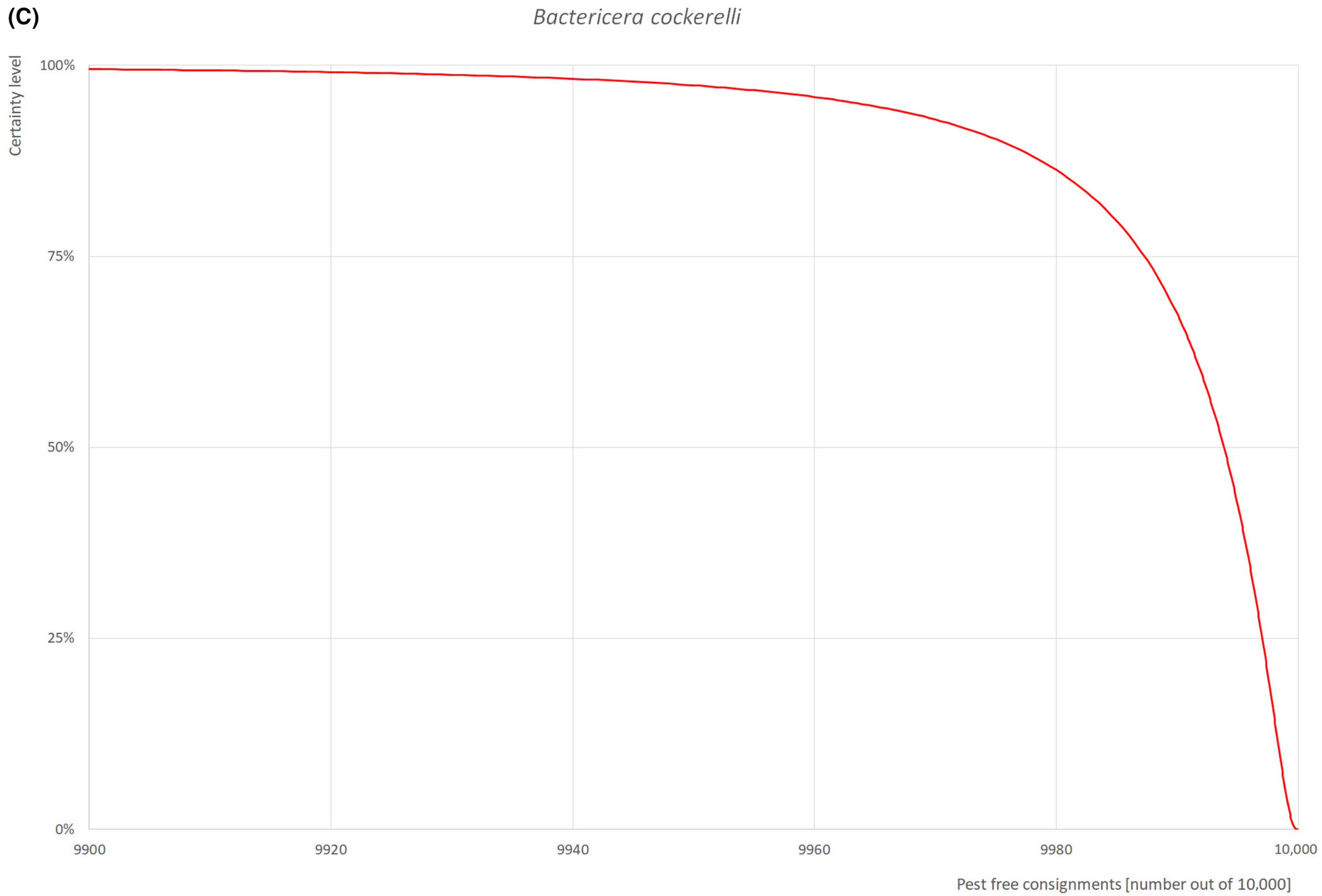


**FIGURE A.9** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Bactericera cockerelli* complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags.

### A.9.7 | Reference list

Abdullah, N. M. M. (2008). Life history of the potato psyllid *Bactericera cockerelli* (Homoptera: Psyllidae) in controlled environment agriculture in Arizona. *African Journal of Agricultural Research*, 3(1), 060–067.
CABI (Centre for Agriculture and Bioscience International). (online). Datasheet *Bactericera cockerelli* (tomato/potato psyllid). https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.45643
Carnegie, M., Greenslade, A., & Ouvard, D. (2017). A simple key to the potential vectors of caLsol. Pest Organisms Threatening Europe. www.ponteproject.eu/factsheets-calsol/simplekey-potential-vectors-calsol
EFSA (European Food Safety Authority), Loiseau, M., Schrader, G., Camilleri, M., Diakaki, M., & Vos, S. (2019). Pest survey card on *Candidatus Liberibacter solanacearum*. EFSA supporting publication, EN-1632.
EPPO (European and Mediterranean Plant Protection Organization), online. *Bactericera cockerelli* (PARZCO). https://gd.eppo.int/taxon/PARZCO
EPPO (European and Mediterranean Plant Protection Organization), 2012. Final pest risk analysis for *Bactericera cockerelli*. EPPO, Paris.
EPPO (European and Mediterranean Plant Protection Organization), 2013. *Bactericera cockerelli*. EPPO Bulletin, 43(2), 202–208.
EUROPHYT. (online). European Union Notification System for Plant Health Interceptio–s - EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm
Glick, P. A. (1939). The distribution of insects, spiders, and mites in the air. *USDA Technical Bulletin*, 673, 150.
Horton, D. R., Cooper, W. R., Munyaneza, J. E., Swisher, K. D., Echegaray, E. R., Murphy, A. F., Rondon, S. I., Wohleb, C. H., Waters, T. D., Jensen, A. S. (2015). A new problem and old questions: potato psyllid in the Pacific Northwest. *American Entomologist*, 61(4), 234–244.
Jensen, A. S., Rondon, S. I., Murphy, A. F., & Echegaray, E. (2012). Overwintering of the potato psyllid in the Northwest on *Solanum dulcamara*. In: Proceedings of the 12th annual zebra chip reporting session, 30 Octob–r - 2 November 2012, San Antonio, TX, USA. 63–64.
Nachappa, P., Shapiro, A. A., & Tamborindeguy, C. (2012). Effect 'f *'Candidatus Liberibacter solanacea'um'* on fitness of its insect vector, *Bactericera cockerelli* (Hemiptera: Triozidae), on tomato. *Phytopathology*, 102(1), 41–46.
Ossiannilsson, F. (1992). The Psylloidea (Homoptera) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica*, 26, Brill, Leiden, The Netherlands, 347 pp.
Papp, R. P., & Johnson, J. B. (1979). Origins of psyllid fallout in the Central Sierra Nevada of California (Homoptera). *Pan-Pacific Entomologist*, 55, 95–98.
TRACES-NT. (online). TRAde Control and Expert System. https://webgate.ec.europa.eu/tracesnt
Yang, X. B., & Liu, T. X. (2009). Life history and life tables of *Bactericera cockerelli* (Homoptera: Psyllidae) on eggplant and bell pepper. *Environmental Entomology*, 38(6), 1661–1667.

## A.10 | *Ralstonia solanacearum* species complex

### A.10.1 | Organism information

| | | | |
|---|---|---|---|
| **Name of the organisms in the cluster** | Current valid scientific name: *Ralstonia solanacearum*<br>Synonyms: *R. Solanacearum* phylotype II<br>Name used in the EU legislation: *Ralstonia solanacearum*, (smith) Yabuuchi et al. emend. Safni et al. (RALSSL)<br>Current valid scientific name: *Ralstonia pseudosolanacearum*<br>Synonyms: *R. Solanacearum* phylotypes I and III<br>Name used in the EU legislation: *Ralstonia pseudosolanacearum*, Safni et al. [RALSPS]<br>Reasons for clustering: These two species belong to the same species complex and share many biological traits | | |
| **Group** | Order: Burkholderiales<br>Family: Burkholderiaceae<br>Species of the *Ralstonia solananearum* species complex | | |
| **Regulated status** | *Ralstonia solanacearum (Smith)* Yabuuchi et al. emend. Safni et al. [RALSSL] is listed in Annex II/B of Commission Implementing Regulation (EU) 2019/2072.<br>*Ralstonia pseudosolanacearum*, Safni et al. [RALSPS] is listed in Annex II/A of Commission Implementing Regulation (EU) 2019/2072. | | |
| **Host status on *Petunia* sp./*Calibrachoa* sp.** | **Bacterium name** | ***Petunia/Calibrachoa* host status** | **Solanaceae host plants** |
| | *Ralstonia solanacearum* | *Petunia hybrida* and *Calibrachoa* sp. are listed as host plants (CABI 2020). | *Capsicum* spp., *Solanum* spp., *Datura stramonium.* |
| | *Ralstonia pseudosolanacearum* | Experimental host | *Capsicum* spp., *Solanum* spp. |
| | Uncertainties: *Although R. pseudosolanacearum* was not yet isolated from *Petunia/Calibrachoa*, it is probable that infection occurs in nature. | | |
| **Pest status in Guatemala** | *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* according to EPPO/CABI/Guatemala NPPO are present and widespread in Guatemala.<br>The pest has been found in ornamental flower production facilities (EPPO, 2010), and intercepted in geranium imported from Guatemala into USA. | | |
| **Pest status in EU** | No relevant as EU quarantine pests. | | |
| **PRA information** | Available Pest Risk Assessments:<br>– Scientific Opinion on the pest categorisation of *Ralstonia solanacearum* species complex (EFSA PLH Panel, 2019). | | |

(Continues)

(Continued)

| **Other relevant information for the assessment** | |
|---|---|
| **Biology** | Transmission:<br>*R. solanacearum* and *R. pseudosolanacearum* are soilborne and waterborne bacteria. They are transmitted by contaminated soil, irrigation water, tools and infected plant materials. Bacteria enter the plants usually by root injuries. They can also infect plants via stem injuries.<br>Host range and distribution of host plants in the environment:<br>*R. solanacearum* and *R. pseudosolanacearum* infect numerous cultivated solanaceous plants and are present on numerous wild host plants species.<br>Ecology and biology of the vectors:<br>Transmission does not involve any vector. Entry into plants is usually through root and stem injuries from where the bacteria move by colonisation of the xylem. Blocking of the vessels by bacterial biofilm is the major cause of wilting.<br>Symptoms on *Petunia/Calibrachoa:*<br>Bacteria cause wilting of the whole plant when the infection occurs at the root level. It can cause a hypersensitive reaction on resistant cultivar. Plants can also be infected without (evident) external signs or symptoms. Laboratory tests are necessary and available to detect infected plants. |
| **Evidence that the commodity can be a pathway** | Unrooted cuttings of *Petunia* and *Calibrachoa* can be systemically infected. The bacteria colonise the xylem vessels. |
| **Surveillance information** | There is no knowledge of a surveillance programme taking place in relation to outbreak management of *R. pseudosolanacearum* and *R. solanacearum* as well in Guatemala. |

## A.10.2 | Possibility of pest presence in the nursery

### A.10.2.1 | Possibility of entry from the surrounding environment

There are genetically variable strains within each species, which collectively affect a very wide range of hosts (over 250 species), including many tropical and subtropical crops, in 54 botanical families. The natural host range of *R. solanacearum* and *R. pseudosolanacearum* includes members of the Solanaceae including cultivated species and weeds. Bacteria are naturally transmitted by infected soil, water and runoff water. Many host plants are present in Guatemala (CABI, EPPO; online). *R. solanacearum* (formerly referred to as race 3 biovar 2) has spread worldwide through trade in infected potatoes and has been introduced in to the EPPO region. This strain has established within some river catchments in wild riparian plants (mainly *Solanum dulcamara*) and further spread occasionally to potato (*S. tuberosum*) crops and to a limited extent to tomato (*S. lycopersicum*) has been observed. Some strains of *R. pseudosolanacearum* have also occasionally been introduced into the EPPO region with ornamental/herbal plants or plant parts of tropical origin and have caused bacterial wilt disease under heated greenhouse conditions in temperate climates. Solanaceous weeds can act as a reservoir for the bacteria. The main pathway of entrance of the bacteria from the surrounding environment in the nursery is through infested soil and irrigation water. Defect in the water disinfection system of the production greenhouses could enable bacteria to enter, as well as hitchhiking bacteria on persons or material entering the greenhouse.

Uncertainties:

- Presence of defects in the water disinfection system of the facilities.
- Infected plants and infested soil pressure in the surroundings.
- Presence and distribution of host plants in the surroundings.

### A.10.2.2 | Possibility of entry with new plants/seeds

Mother plants used to produce unrooted cutting originate from the Netherlands, Germany, El Salvador and Israel. *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* are present in a few occurrences in El Salvador, in the Netherlands, in Germany and are not present in Israel. In all countries a certification scheme is in place for Petunia/Calibrachoa. Only 10% of imported cuttings used for mother plant production are tested for *Ralstonia*.

Uncertainties:

- The details of certification schemes are not known. The proportion of mother plants coming from non-EU countries is not known.

### A.10.2.3 | Possibility of spread within the nursery

Bacteria are efficiently transmitted by tools during pruning and cutting production. Strict hygiene conditions are in place in the production site (disinfection of tools, gloves, etc).

Uncertainties:

- There is no information on the eventual previous observations of *R. solanacearum* and *R. pseudosolanacearum in the greenhouse.*
- There is no information on the presence of other host plants of *R. solanacearum* and *R. pseudosolanacearum* in the nurseries.

### A.10.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions of *R. pseudosolanacearum* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala.

### A.10.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination. Substrate disinfection is performed by Metam-Sodium treatment after crop changes inside the greenhouses in order to eliminate insects, nematodes, fungi, bacteria and weed seeds that may be present in the medium.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing of *R. solanacearum* and *R. pseudosolanacearum* that may enter from the surrounding environment. *R. solanacearum* and *R. pseudosolanacearum* may be introduced by irrigation water, contaminated soil and as hitchhikers on clothing of greenhouse staff.<br>Uncertainties: |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* and *Calibrachoa* are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of *Ralstonia solanacearum.*<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units.<br>Contamination of shoes in the internal tunnel. |
| Soil treatment | Y | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses.<br>Evaluation:<br>Plants in the greenhouse are protected from infection by *R. solanacearum* and *R. pseudosolanacearum* through contaminated soil by disinfecting the grown media with Metam-Sodium treatment.<br>Uncertainties: How often the substrates are renewed. |
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified.<br>Evaluation:<br>The material originated from Israel and El Salvador is certified by a private company.<br>Uncertainties:<br>The certification body is internal to the company which manages the various production sites in Israel and Guatemala. |
| Crop rotation | Y | Description:<br>The production plots for Solanaceae crops destined to the export are changing each season in the greenhouses to reduce the risk of infection with pathogens. Within the nursery there is a rotation scheme in place for Solanaceae plants.<br>Evaluation: No information is provided on the crops used in the rotation scheme.<br>Uncertainties:<br>Are the rotation crops host for *Ralstonia solanacearum* or *Ralstonia pseudosolanacearum.* |

(Continues)

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Disinfection of irrigation water | Y | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$).<br>Evaluation:<br>*R. solanacearum* and *R. pseudosolanacearum* may enter from the surrounding environment. Irrigation water is one the main pathways for the introduction of *R. solanacearum* and *R. pseudosolanacearum* in the facilities. Irrigation water is treated with Chlorine dioxide.<br>Uncertainties:<br>– Presence of unnoticed defects in the water treatment. |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects.<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>Monitoring tests for the presence of *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* are only performed on the arrival of plant material. No monitoring is performed during the propagation and production steps except visual inspections.<br>Uncertainties:<br>– The efficiency of monitoring and inspection.<br>– The length of the latent period necessary to the expression of symptoms. |
| Pesticide treatment | N | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0)<br>Evaluation:<br>No bactericidal treatments are applied during the process. |
| Sampling and testing | Y | Description:<br>*Petunia* and *Calibrachoa* plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). No monitoring is performed along the propagation and production steps for *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum*. Ten percent (10%) of plants are tested at arrival on the site. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate.<br>Evaluation:<br>No sampling and testing targeting *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* are reported to be done during production process and at the exporting step.<br>Uncertainties:<br>If *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* are included in the testing of the issue for the Export certificate. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. No inspection targeting *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* are reported to be done during production process and at the exporting step.<br>An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>No tests specific to *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* are reported to be done during production process and at the exporting step.<br>Uncertainties:<br>The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>Surveillance in the area surrounding the nurseries, including rivers and water tanks where water is collected for irrigation system could provide data on the presence and abundance of *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum*. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>The intensity and the design of surveillance scheme. |

### A.10.5 | Overall likelihood of pest freedom

A.10.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* and *Calibrachoa* spp. are not a preferred host.
- *R. solanacearum* and *R. pseudosolanacearum* have never been intercepted on plant products from Guatemala.
- Low population pressure of *Ralstonia* species in the surrounding environment, due to the limited presence of preferred host plants.
- Greenhouse structure is insect-proof and hygiene measures in place are numerous and prevent the introduction of bacteria by employers and entrance is thus unlikely.
- A water disinfection system based on chlorine dioxide ($ClO_2$) is in place to make the irrigation water potable and prevents the introduction of the bacteria by irrigation water.
- No natural soil is used for the production of cuttings. The production site is disinfected between each production cycle and new substrates are used.
- The scouting monitoring regime is effective, wilting plants are expected to be easily detected.
- At harvest and packing, cuttings with symptoms will be detected.

A.10.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *R. solanacearum* and *R. pseudosolanacearum* are present throughout Guatemala and there are numerous potential host plants, including Solanaceous plants (e.g. pepper, tomato).
- Greenhouses are located in areas where *R. solanacearum* and *R. pseudosolanacearum* are present and abundant.
- Presence of *R. solanacearum* and *R. pseudosolanacearum* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure including the water treatment.
- Chemical treatments (insecticide, fungicide) are not targeting *R. solanacearum* and *R. pseudosolanacearum*.
- Susceptibility of cultivars of *Petunia* and *Calibrachoa* to *R. solanacearum* and *R. pseudosolanacearum* is not known. Some of these could be infected but asymptomatic.

A.10.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The production system in place includes the control of inputs and the containment of the multiplication and packaging areas.

A.10.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The high scenario is considered unlikely and the 3rd quartile is closer to the median.

### A.10.6 | Elicitation outcomes of the assessment of the pest freedom for *Ralstonia* spp.

The following Tables show the elicited and fitted values for pest infestation (Table A.19) and pest freedom (Table A.20).

**TABLE A.19** Elicited and fitted values of the uncertainty distribution of pest infestation by *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 1 | | | | | 10 | | 20 | | 30 | | | | | 350 |
| EKE | 1.76 | 2.84 | 4.10 | 6.01 | 8.13 | 10.5 | 13.0 | 18.5 | 26.4 | 32.5 | 42.1 | 57.0 | 83.5 | 120.7 | 194.4 |

*Note*: The EKE results is the *Loglogistic (0, 18.504, 1.9539)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.20.

**TABLE A.20** The uncertainty distribution of plants free of *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* per 10,000 bugs of unrooted cuttings calculated by Table A.19.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9650 | | | | | 9970 | | 9980 | | 9990 | | | | | 9999 |
| EKE results | 9806 | 9879 | 9916 | 9943 | 9958 | 9968 | 9974 | 9981 | 9987 | 9989 | 9992 | 9994 | 9996 | 9997 | 9998 |

*Note*: The EKE results are the fitted values.

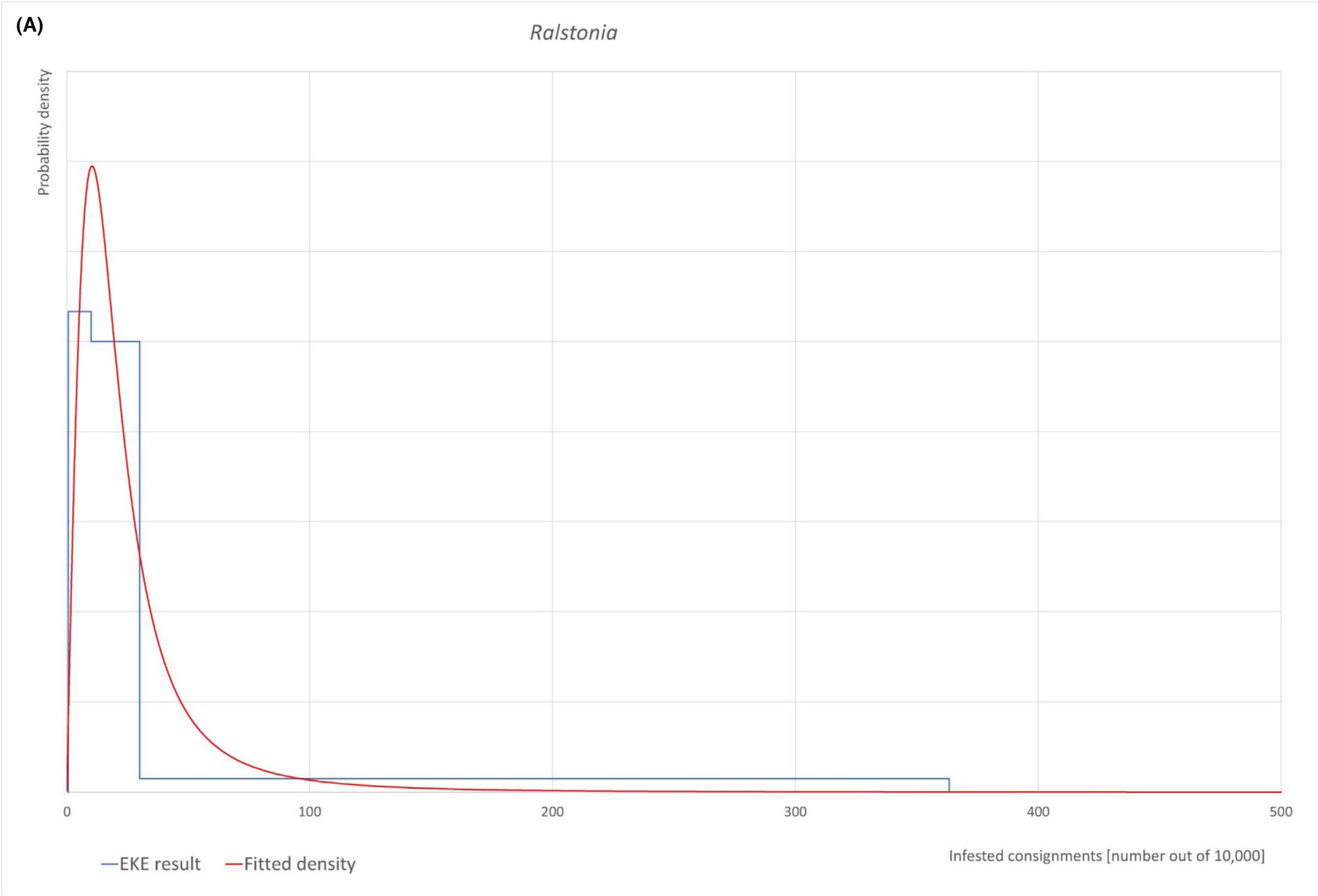


**FIGURE A.10** (Continued)

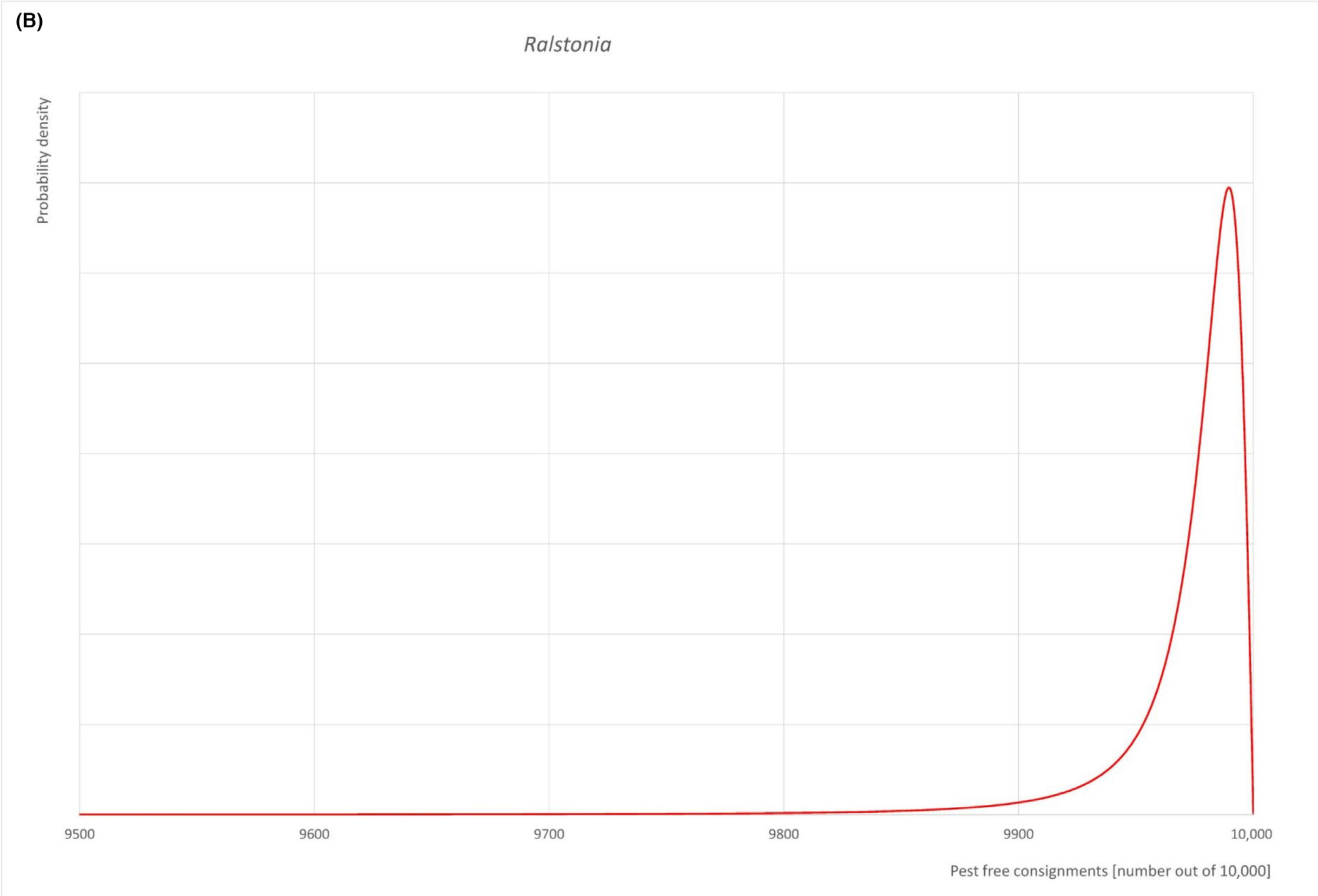


**FIGURE A.10** (Continued)

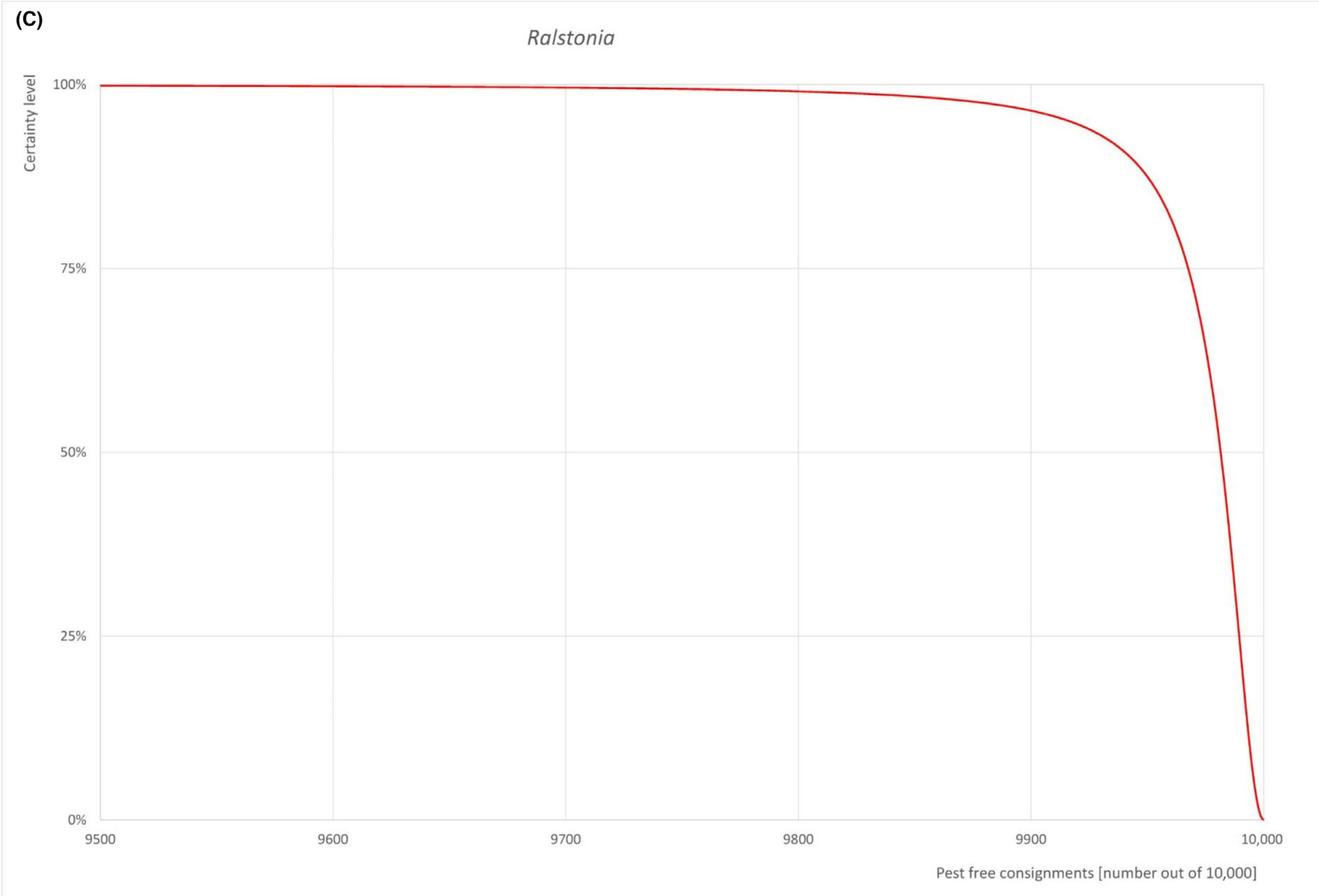


**FIGURE A.10** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Ralstonia* complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags

### A.10.7 | Reference list


EFSA PLH Panel (EFSA Panel on Plant Health), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jaques Miret, J. A., Justesen, A. F., MacLeod, A., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Potting, R., Reignault, P. L., Thulke, H.-H., Van der Werf, W., Vicent Civera, A., Yuen, J., Zappala, L., Van der Wolf, J., Kaluski, T., Pautasso, M., & Jacques, M.-A. (2019). Scientific Opinion on the pest categorisation of the *Ralstonia solanacearum* species complex. *EFSA Journal*, 17(2), 5618, 28 pp. https://doi.org/10.2903/j.efsa.2019.5618

EPPO (European and Mediterranean Plant Protection Organization). (2010). EPPO Reporting Service no. 05 - 2010. Situation of *Ralstonia solanacearum* in Guatemala. https://gd.eppo.int/reporting/article-523


## A.11 | *Xanthomonas vesicatoria*

### A.11.1 | Organism information

| | |
|---|---|
| **Taxonomic information** | Current valid scientific name: *Xanthomonas vesicatoria*<br>Synonyms: *Pseudomonas exitiosa, Pseudomonas vesicatoria*<br>Name used in the EU legislation: *Xanthomonas vesicatoria* (ex Doidge) Vauterin et al [XANTVE]<br>Order: Lysobacterales<br>Family: Lysobacteraceae<br>Common names: Bacterial leaf spot of tomato, bacterial scab of tomato, black spot of tomato<br>Leaf spot of tomato, stem canker of tomato<br>Name used in the dossier: *Xanthomonas vesicatoria* |
| **Group** | Bacteria |
| **Regulated status** | The pest is listed in Annex IV of Commission Implementing Directive (EU) 2019/2072, as *Xanthomonas vesicatoria* (ex Doidge) Vauterin et al [XANTVE]. |
| **Pest status in Guatemala** | Present, no details (EPPO GD, online). |
| **Pest status in the EU** | No relevant as EU regulated pest. |
| **Host status on *Petunia* sp. *and Calibrachoa* sp.** | *Petunia* sp. and *Calibrachoa* sp. are not listed as host plants for *Xanthomonas vesicatoria* (EPPO GD, online). |
| **PRA information** | Scientific Opinion on the pest categorisation of *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye; EFSA Panel on Plant Health (PLH). European Food Safety Authority (EFSA), Parma, Italy. EFSA Journal 2014;12(6):3720 https://doi.org/10.2903/j.efsa.2014.3720<br>California Pest Rating Proposal for *Xanthomonas vesicatoria* (Doidge) Dowson 1939 (Bacterial spot of tomato and pepper) https://blogs.cdfa.ca.gov/Section3162/wp-content/uploads/2020/10/Xanthomonas-vesicatoria-_ADA_PRP.pdf |
| **Other relevant information for the assessment** | |
| **Biology** | **Biology:**<br>Bacteria that cause bacterial spot diseases are seed borne, representing the primary inoculum, may be present and viable both on the tegument, if no sanitation or disinfection has been done during seed production and under the tegument. Less frequently, primary infections may be caused by the presence of infected plant debris or volunteers from a previous crop. Secondary inocula released from lesions on leaves and stems are spread via splashing water and wind driven rain. Bacteria may penetrate the host through natural openings such as hydathodes, stomata and lenticels. Additionally, wounds, caused by agronomic operations (grafting, topping, clipping, tying, staking and harvesting, during spraying with pesticides and on clothes during crop handlings), are important penetration sites for the pathogens, especially for table tomato. In open-field cultivation systems, bacteria-supporting plant particles are produced during cultural practices and are exported from the field by ascendant air flux. The period between infection and symptom expression varies, ranging from 8 to 21 days, and is determined by temperature, plant age and soil characteristics, including the nutrient status of the plants. Conditions decreasing incubation periods also favour disease severity. The optimal growth temperature for xanthomonads is between 25°C and 30°C (EFSA, 2014).<br>**Transmission:** The pathogen moves principally on seeds of *Capsicum* or tomato, and possibly also on young seedlings of these crops. According to Bashan (1986), 'nearly all accidental agents passing through the infested field may act as vectors' (including insects, tools, soil). |
| **Host plant range** | According to EPPO GD (2021), the host list of the bacterium includes *Capsicum annuum, Datura, Hyoscyamus niger, Lycium barbarum, Nicotiana rustica, Physalis, Solanum, Solanum lycopersicum and Solanum tuberosum*. Its major hosts however, are *Capsicum annuum* and *Solanum lycopersicum*. |
| **Evidence that the commodity can be a pathway** | The bacteria could be present on the harvested cuttings from infested mother plants. |
| **Surveillance information** | There are no targeted surveys for *Xanthomonas vesicatoria* in Guatemala. |

## A.11.2 | Possibility of pest presence in the nursery

### A.11.2.1 | Possibility of entry from the surrounding environment

The main hosts of *X. vesicatoria* are tomatoes and peppers. The disease has mainly been observed in field crops but can occur in greenhouses as well. A few infected plants can lead to outbreaks. At production sites, tomato volunteer plants and crop debris, in which xanthomonads can survive, are recognised as playing a key role as a source of inoculum. The bacteria can be present on infected footwear (attached soil) and clothes. Heavy rain, irrigation and wind, largely contribute to spread of the pathogen.

### A.11.2.2 | Possibility of entry with new plants/seeds

*X. vesicatoria* is a seed-borne bacterium and can be present in plants for planting (seeds and transplants) (EFSA 2014). Imported mother plants of *Petunia* and *Calibrachoa* can be a primary infection source where xanthomonads can survive epiphytically and endophytically.

Uncertainties:

The host plant status of *Petunia* and *Calibrachoa*.

### A.11.2.3 | Possibility of spread within the nursery

Cultivation practices may largely contribute to the spread of the disease by disseminating the bacteria, via wounding of the plants. In greenhouses and open fields, the handling of transplants, clipping and pruning, de-leafing, suckering are practices that allow bacterial infection. *Xanthomonas* released from infected plants or present as epiphytes can be spread by overhead irrigation or chemical sprays (EFSA, 2014).

## A.11.3 | Information from interceptions

In the EUROPHYT/TRACES-NT database there are no records of interceptions of *X. vesicatoria* on *Petunia* spp. and *Calibrachoa* spp. from third countries or on any other plant from Guatemala.

## A.11.4 | Risk Mitigation Measure applied in the nurseries

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Growing plants in isolation | Y | Description:<br>The unrooted cuttings are produced in greenhouses. Greenhouses have double doors ('sluice') at entry, side walls and roof ventilation closed off with thrips proof netting (Ludvig Svensson Econet 1535), and internal physical separation between the different vaults of the greenhouses to limit the possible dispersion of pests. There are regular inspections of greenhouses to assure that all netting is in good shape. An internal tunnel connects all the buildings in the greenhouse to reduce the risk of external contamination.<br>Evaluation:<br>Plants in the greenhouse are protected from dispersing of *X. vesicatoria* that may enter from the surrounding environment. *X. vesicatoria* may be introduced through defects in the greenhouse or as hitchhikers on clothing of greenhouse staff. Greenhouse staff is regularly checking the integrity of the netting.<br>Uncertainties:<br>− Presence of unnoticed defects in the greenhouse structure. |
| Dedicated hygiene measures | Y | For accessing the greenhouse there is a double door system. Changing rooms and disinfection facility allow the personnel to wear dedicated boots and clothes before entering the greenhouse. There are dedicated tools used for each greenhouse unit. Same unit have a specific change a disinfection area.<br>*Petunia* and *Calibrachoa* are produced in separate units.<br>Evaluation:<br>These measures could be effective in reducing the risk of introduction and/or spread of *Xanthomonas vesicatoria*.<br>Uncertainties:<br>Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units. |
| Soil treatment | N | Description:<br>The substrates are composed by pumice and peat, mixed in a ratio of 85/15 (85% pumice and 15% peat). Metam-Sodium is used for the substrate disinfection between two cycles of production of the cuttings inside the greenhouses. |

(Continued)

| Risk reduction option | Effect Y/N | Evaluation and uncertainties |
|---|---|---|
| Quality of source plant material | Y | Description:<br>The plant material (*in vitro* tissue cultures and cuttings) used for mother plants, is imported from Germany, the Netherlands, El Salvador and Israel and are reported to be certified (See Section 3.3.2).<br>Evaluation:<br>The material originated from Israel and El Salvador is certified by a private company.<br>Uncertainties:<br>The certification body is internal to the company which manages the various production sites in Israel and Guatemala. |
| Crop rotation | N | Description:<br>Solanaceae crops for export are changing each season the greenhouses to reduce the risk about the infection with pathogens or virus. Within the nursery there is a rotation scheme in place for Solanaceae plants. |
| Disinfection of irrigation water | N | Description:<br>A water disinfection system is in place to make the water free of pathogens, using a mixture of Sodium chlorite ($NaClO_2$) and Hydrochloric acid (HCl) to produce Chlorine Dioxide ($ClO_2$). |
| Pest monitoring and inspections | Y | Description:<br>Yellow sticky traps are used to monitor thrips, whiteflies, shoreflies and other flying insects.<br>Every week a scouting process takes place for abnormal growing symptoms in the crops. The scouting results are used to schedule the spray programme for the following weeks.<br>Evaluation:<br>The monitoring can detect the presence of *B. tabaci* and of *Xanthomonas vesicatoria*. Early infections cannot be detected due to the lack of symptoms.<br>Uncertainties:<br>– The efficiency of monitoring and inspection.<br>– The length of the latent period necessary to the expression of symptoms. |
| Pesticide treatment | N | Description:<br>Fungicides, insecticides and acaricides are applied on weekly basis, following scouting inspections. Rotation among active substances (a.s.) is adopted to prevent the development of insecticide resistance.<br>Details on the a.s. are reported in Table 9 (Section 3.0) |
| Sampling and testing | Y | Description:<br>*Petunia* and *Calibrachoa* plants are laboratory tested using serological based techniques for viruses and bacteria in different plant production stages (arrival, propagation, production). Percentages of plants tested ranges from 0.5% to 10% according to the production stage. Before exports, around 25% of the bags containing unrooted cuttings are sampled as indicated in the digital export certificate. The samples are sent to the lab each 6–8 weeks to test the virus.<br>Evaluation: There is no sampling and testing in place for *X. vesicatoria*. |
| Packing and handling procedures | N | Description:<br>The unrooted cuttings are placed in plastic bags and stored in a cold chamber.<br>The shipment of *Petunia* and *Calibrachoa* cuttings from the company to the La Aurora International Airport is carried out in refrigerated containers. |
| Official Supervision by NPPO | Y | Description:<br>Inspectors from the Ministry of Agriculture perform inspections on a monthly basis using a random scouting procedure, looking for signs of pest and diseases. An inspection certificate is issued and stored at the nursery as a proof of hygiene status. Tests on collected samples are performed by official NPPO laboratories or laboratories approved by the NPPO.<br>Evaluation:<br>No tests specific to *X. vesicatoria* are reported to be done during production process and at the exporting step.<br>Uncertainties:<br>– The efficiency of monitoring and inspection is not known. |
| Surveillance of production area | Y | Description:<br>The NPPO includes the surrounding area of the production facility in its surveillance. No further details are provided.<br>Evaluation:<br>The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of the viruses and its vector. However no specific data are available for the evaluation of the efficacy of the surveillance.<br>Uncertainties:<br>– The intensity and the design of surveillance scheme. |

A.11.4.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* spp. and *Calibrachoa* spp. are not preferred hosts.
- *X. vesicatoria* has never been intercepted on produce from Guatemala.
- Low population pressure of *X. vesicatoria* in the surrounding environment, because of active natural enemies or absence of preferred host plants.
- Transfer of *X. vesicatoria* from sources in the surrounding environment to the greenhouse plants is very difficult because dispersal is mainly dependent on human-assisted movement of the first instar stage (crawler) and hygienic measures are in place to prevent this.
- At harvest and packing, cuttings with symptoms will be detected.

A.11.4.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *X. vesicatoria* is present throughout Guatemala. It is likely that host plants are present in the surrounding. Windy storms occur under tropical climate.

A.11.4.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- There are no records of interceptions from Guatemala.

A.11.4.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The main uncertainty is the population pressure of the pest in the surrounding environment.
- High uncertainty for values below median.
- Less uncertainty for higher values.

### A.11.5 | Elicitation outcomes of the assessment of the pest freedom for *Xanthomonas vesicatoria*

The following Tables show the elicited and fitted values for pest infestation (Table A.21) and pest freedom (Table A.22).

**TABLE A.21** Elicited and fitted values of the uncertainty distribution of pest infestation by *Xanthomonas vesicatoria* per 10,000 bags of unrooted cuttings.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elicited values | 0 | | | | | 2 | | 5 | | 8 | | | | | 30 |
| EKE | 0.130 | 0.278 | 0.500 | 0.912 | 1.45 | 2.14 | 2.87 | 4.60 | 6.92 | 8.52 | 10.7 | 13.5 | 17.2 | 20.9 | 25.7 |

*Note*: The EKE results is the *BetaGeneral (1.225, 1984.4, 0, 10000)* distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infested bags per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table A.22.

**TABLE A.22** The uncertainty distribution of plants free of *Xanthomonas vesicatoria* per 10,000 bugs of unrooted cuttings calculated by Table A.21.

| Percentile | 1% | 2.5% | 5% | 10% | 17% | 25% | 33% | 50% | 67% | 75% | 83% | 90% | 95% | 97.5% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | 9970 | | | | | 9992 | | 9995 | | 9998 | | | | | 10,000 |
| EKE results | 9974 | 9979 | 9983 | 9986 | 9989 | 9991 | 9993 | 9995 | 9997.1 | 9997.9 | 9998.5 | 9999.1 | 9999.5 | 9999.7 | 9999.9 |

*Note*: The EKE results are the fitted values.

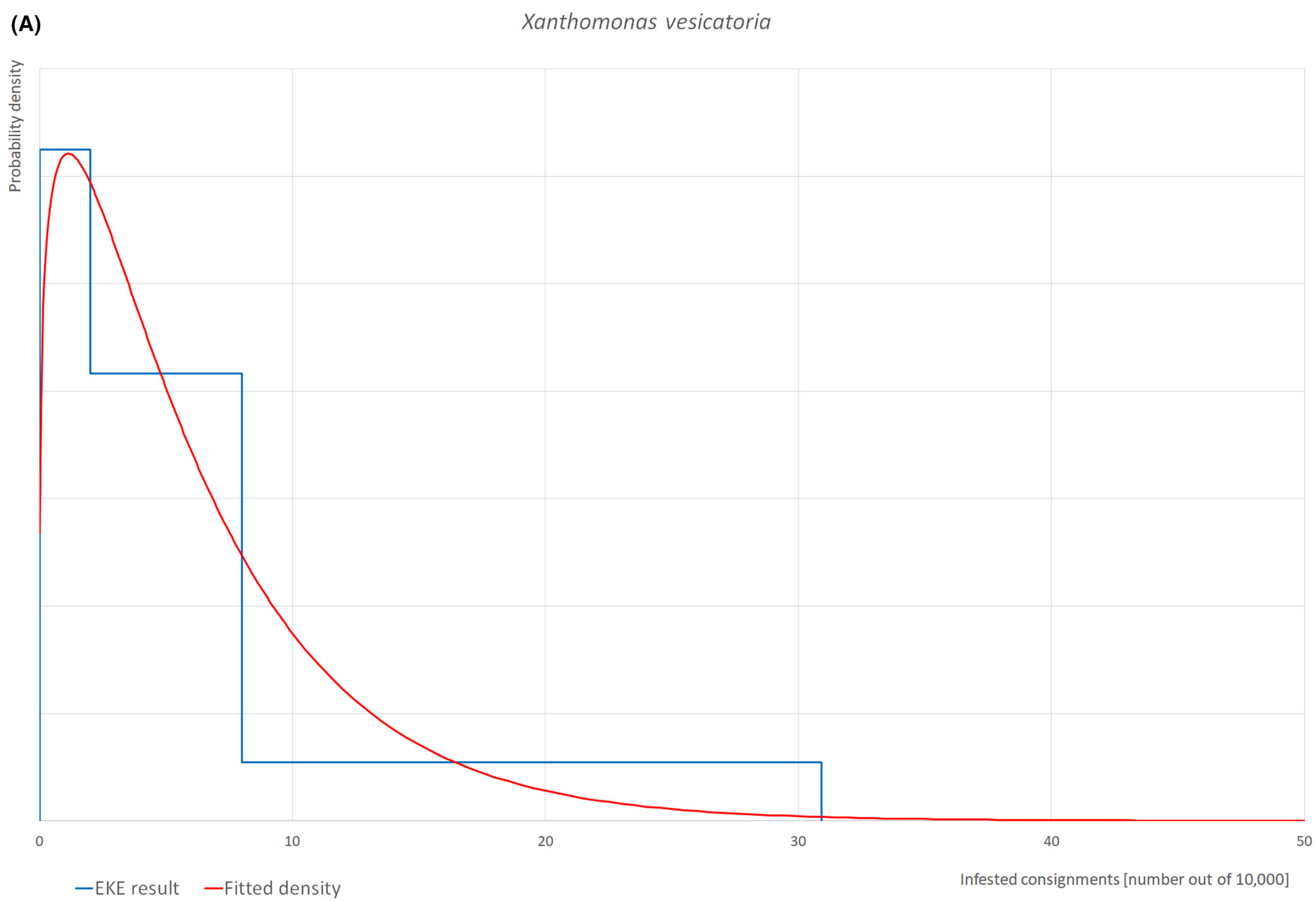


**FIGURE A.11** (Continued)

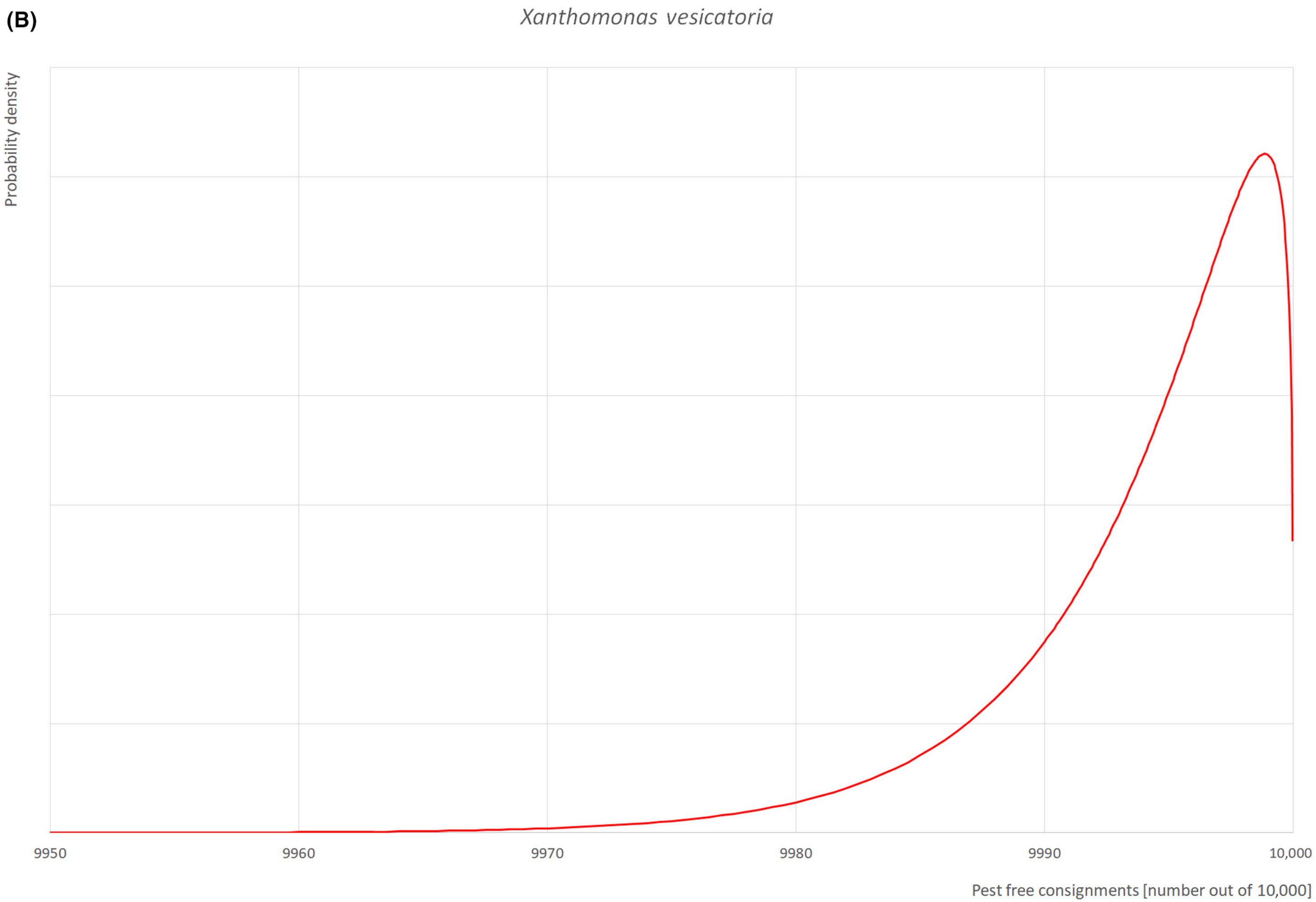


**FIGURE A.11** (Continued)

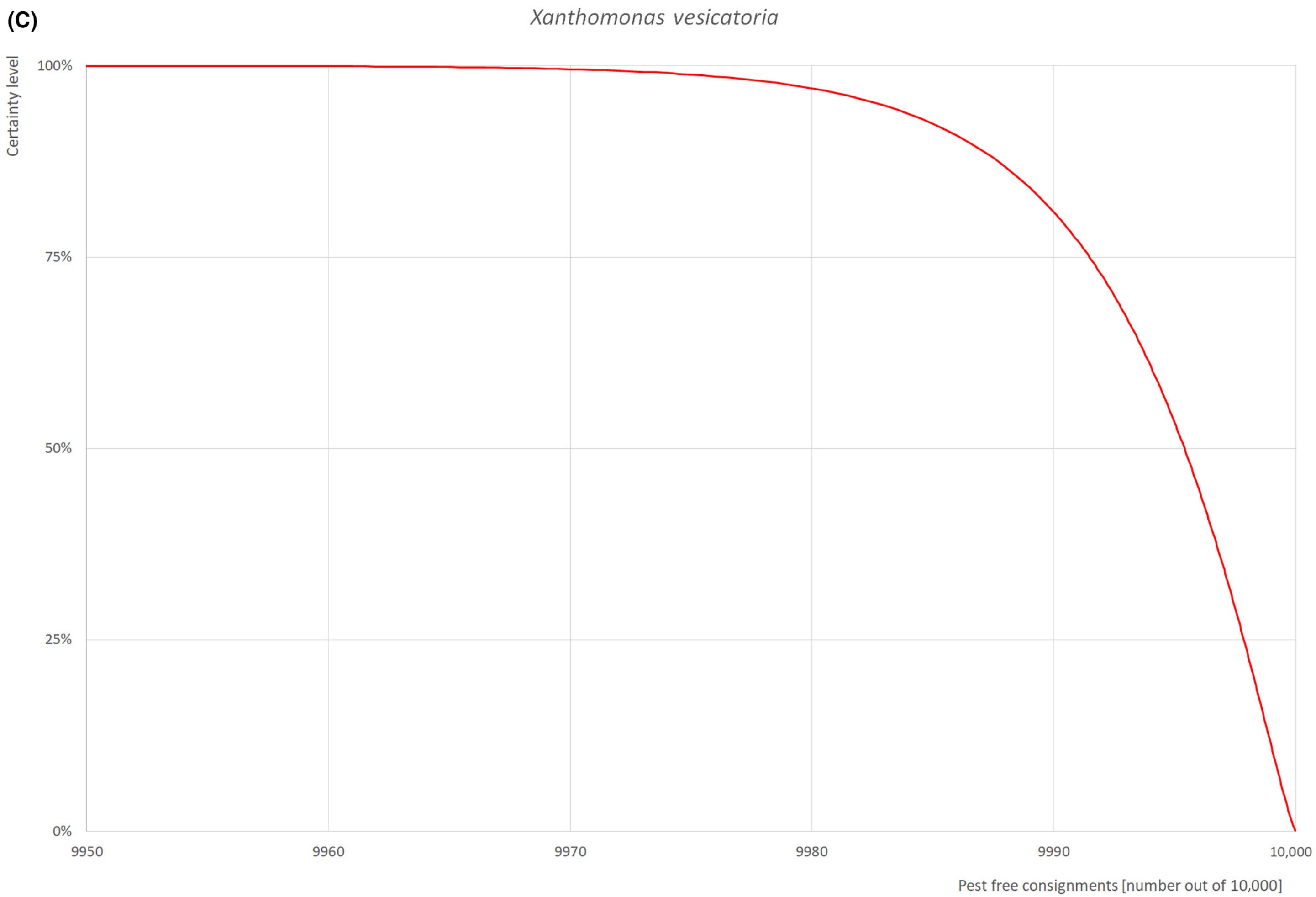


**FIGURE A.11** (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 50 unrooted cuttings per bag) for *Xanthomonas vesicatoria* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags.

## A.11.6 | Reference list

Bashan, Y. (1986). Inhibition of seed germination and root development caused by *Xanthomonas campestris* pv. vesicatoria in pepper and tomato. *Journal of Phytopathology*, 116(3), 228–237.

EFSA PLH Panel (EFSA Panel on Plant Health). (2014). Scientific Opinion on the pest categorisation of *Xanthomonas campestris pv. vesicatoria* (Doidge) Dye; *EFSA Journal*, 12(6), 3720. https://doi.org/10.2903/j.efsa.2014.3720

EPPO Bulletin. (2021). PM3/093(1). Management of phytosanitary risks for potato crops resulting from movement of soil associated with root crops and potatoes. EPPO Bulletin, 51, 418–435

EPPO Global. (online). EPPO Data Sheet on *Xanthomonas vesicatoria*. https://gd.eppo.int

EUROPHYT. (online). European Union Notification System for Plant Health Interceptions - EUROPHYT. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm

## APPENDIX B

### Web of Science All Databases Search String

In the table below the search string used in Web of Science is reported. In total, 43 papers were retrieved. Titles and abstracts were screened, and three pests were added to the list of pests (see Appendix D).

| | |
|---|---|
| Web of Science All databases | TOPIC:<br>"*Calibrachoa*" OR "million bells"<br>AND<br>TOPIC:<br>"pathogen*" OR "pathogenic bacteria" OR fung* OR oomycet* OR myce* OR bacteri* OR virus* OR viroid* OR insect$ OR mite$ OR phytoplasm* OR arthropod* OR nematod* OR disease$ OR infecti* OR damag* OR symptom* OR pest$ OR vector OR hostplant$ OR "host plant$" OR host OR "root lesion$" OR decline$ OR infestation$ OR damage$ OR symptom$ OR dieback* OR "die back*" OR malaise OR aphid$ OR curculio OR thrip$ OR cicad$ OR miner$ OR borer$ OR weevil$ OR "plant bug$" OR spittlebug$ OR moth$ OR mealybug$ OR cutworm$ OR pillbug$ OR "root feeder$" OR caterpillar$ OR "foliar feeder$" OR virosis OR viruses OR blight$ OR wilt$ OR wilted OR canker OR scab$ OR rot OR rots OR "rotten" OR "damping off" OR "damping-off" OR blister$ OR smut OR "mould" OR "mold" OR "damping syndrome$" OR mildew OR scald$ OR "root knot" OR "root-knot" OR rootkit OR cyst$ OR "dagger" OR "plant parasitic" OR "parasitic plant" OR "plant$parasitic" OR "root feeding" OR "root$feeding" OR "acari" OR "host$" OR "gall" OR "gall$" OR "whitefly" OR "whitefl*" OR "aleyrodidae" OR "thysanoptera" OR "moths" OR "scale" OR "scale$" OR "thripidae" OR "leafhoppers" OR "leafhopper$" OR "plant pathogens" OR "fungal" OR "aphididae"<br>NOT<br>TOPIC:<br>"heavy metal$" OR "pollut*" OR "weather" OR "propert*" OR probes OR "spectr*" OR "antioxidant$" OR "transformation" OR "Secondary plant metabolite$" OR metabolite$ OR Postharvest OR Pollin* OR Ethylene OR Thinning OR fertil* OR Mulching OR Nutrient$ OR "human virus" OR "animal disease$" OR "plant extracts" OR "immunological" OR "purified fraction" OR "traditional medicine" OR "medicine" OR mammal$ OR bird$ OR "human disease$" OR "*cancer*" OR "*therapeutic*" OR "*psoriasis*" OR "blood" OR "medicinal ethnobotany" OR "Nitrogen-fixing" OR "patients" OR "Probiotic drugs" OR "Antioxidant" OR "Anti-Inflammatory" OR "plasma levels" OR "ethnomedicinal" OR "traditional uses of medicinal plants" OR "Antitumor" OR "Neuroprotective" OR "Hypoglycemic" OR "ozone sensitivity"<br>NOT<br>TOPIC:<br>"*Aculops lycopersici*" OR "*Aphis gossypii*" OR "*Aulacorthum solani*" OR "*Bactrocera latifrons*" OR "*Bemisia tabaci*" OR "*Brephidium exilis*" OR "*Epilachna vigintioctomaculata*" OR "*Frankliniella occidentalis*" OR "*Heliothis virescens*" OR "*Liriomyza sativae*" OR "*Liriomyza trifolii*" OR "*Macrosiphum euphorbiae*" OR "*Myzus persicae*" OR "*Oligonychus pratensis*" OR "*Phthorimaea operculella*" OR "*Tetranychus urticae*" OR "*Trialeurodes vaporariorum*" OR "*Heterodera glycines*" OR "*Acidovorax konjaci*" OR "Alfalfa mosaic virus" OR "Andean potato latent virus" OR "Andean potato mottle virus" OR "Arabis mosaic virus" OR "Arracacha virus B" OR "Bell pepper mottle virus" OR "Calibrachoa mottle virus" OR "Chili Pepper Mild Mottle Virus" OR "Citrus exocortis viroid" OR "Columnea latent viroid" OR "Cucumber mosaic virus" OR "Hosta virus X" OR "Peach rosette mosaic virus" OR "Pepper chat fruit viroid" OR "Potato black ringspot virus "OR "Potato spindle tuber viroid" OR "Potato virus X" OR "Potato virus Y" OR "Potato yellow dwarf nucleorhabdovirus" OR "Tobacco mild green mosaic virus" OR "Tobacco mosaic virus" OR "Tobacco streak virus" OR "Tomato apical stunt viroid" OR "Tomato chlorotic dwarf viroid" OR "Tomato mosaic virus" OR "Tomato planta macho viroid" OR "Tomato spotted wilt virus" OR "*Alternaria porri*" OR "*Botrytis cinerea*" OR "*Botrytis paeoniae*" OR "*Euoidium longipes*" OR "*Nigrospora oryzae*" OR "*Phytophthora capsici*" OR "*Phytophthora cinnamomi*" OR "*Phytophthora citrophthora* "OR "*Phytophthora drechsleri*" OR "*Phytophthora infestans*" OR "*Phytophthora nicotianae*" OR "*Podosphaera xanthii*" OR "*Pseudoidium neolycopersici*" OR "*Sclerotinia sclerotiorum*" OR "*Stagonosporopsis andigena*" OR "*Thielaviopsis basicola*" OR "*Verticillium dahliae*" OR "*Phytophthora tropicalis*" |

In the table below the search string used in Web of Science is reported. In total, 561 papers were retrieved. Titles and abstracts were screened, and five pests were added to the list of pests (see Appendix D).

| | |
|---|---|
| Web of Science All databases | TOPIC:<br>"*Petunia*" OR "Petunias"<br>AND<br>TOPIC:<br>"pathogen*" OR "pathogenic bacteria" OR fung* OR oomycet* OR myce* OR bacteri* OR virus* OR viroid* OR insect$ OR mite$ OR phytoplasm* OR arthropod* OR nematod* OR disease$ OR infecti* OR damag* OR symptom* OR pest$ OR vector OR hostplant$ OR "host plant$" OR host OR "root lesion$" OR decline$ OR infestation$ OR damage$ OR symptom$ OR dieback* OR "die back*" OR malaise OR aphid$ OR curculio OR thrip$ OR cicad$ OR miner$ OR borer$ OR weevil$ OR "plant bug$" OR spittlebug$ OR moth$ OR mealybug$ OR cutworm$ OR pillbug$ OR "root feeder$" OR caterpillar$ OR "foliar feeder$" OR virosis OR viruses OR blight$ OR wilt$ OR wilted OR canker OR scab$ OR rot OR rots OR "rotten" OR "damping off" OR "damping-off" OR blister$ OR smut OR "mould" OR "mold" OR "damping syndrome$" OR mildew OR scald$ OR "root knot" OR "root-knot" OR rootkit OR cyst$ OR "dagger" OR "plant parasitic" OR "parasitic plant" OR "plant$parasitic" OR "root feeding" OR "root$feeding" OR "acari" OR "host$" OR "gall" OR "gall$" OR "whitefly" OR "whitefl*" OR "aleyrodidae" OR "thysanoptera" OR "moths" OR "scale" OR "scale$" OR "thripidae" OR "leafhoppers" OR "leafhopper$" OR "plant pathogens" OR "fungal" OR "aphididae" |

(Continues)

(Continued)

NOT
TOPIC:
"heavy metal$" OR "pollut*" OR "weather" OR "propert*" OR probes OR "spectr*" OR "antioxidant$" OR "transformation" OR "Secondary plant metabolite$" OR metabolite$ OR Postharvest OR Pollin* OR Ethylene OR Thinning OR fertil* OR Mulching OR Nutrient$ OR "human virus" OR "animal disease$" OR "plant extracts" OR "immunological" OR "purified fraction" OR "traditional medicine" OR "medicine" OR mammal$ OR bird$ OR "human disease$" OR "*cancer*" OR "*therapeutic*" OR "*psoriasis*" OR "blood" OR "medicinal ethnobotany" OR "Nitrogen-fixing" OR "patients" OR "Probiotic drugs" OR "Antioxidant" OR "Anti-Inflammatory" OR "plasma levels" OR "ethnomedicinal" OR "traditional uses of medicinal plants" OR "Antitumor" OR "Neuroprotective" OR "Hypoglycemic" OR "Mexican petunia" OR "ozone sensitivity"
NOT
TOPIC:
"*Aculops lycopersici*" OR "*Acyrthosiphon malvae*" OR "*Agrius convolvuli*" OR "*Anoecia corni*" OR "*Anoecia himalayensis*" OR "*Anthonomus eugenii*" OR "*Aphis craccivora*" OR "*Aphis fabae*" OR "*Aphis frangulae*" OR "*Aphis gossypii*" OR "*Aphis nasturtii*" OR "*Aulacorthum solani*" OR "*Bactrocera latifrons*" OR "*Bemisia tabaci*" OR "*Brachycaudus helichrysi*" OR "*Brephidium exilis*" OR "*Brevicoryne brassicae*" OR "*Enyo lugubris*" OR "*Epilachna vigintioctomaculata*" OR "*Epitrix cucumeris*" OR "*Epitrix tuberis*" OR "*Erinnyis ello*" OR "*Erinnyis lassauxi*" OR "*Eutrichosiphum khasyanum*" OR "*Exomala orientalis*" OR "*Frankliniella fusca*" OR "*Frankliniella intonsa*" OR "*Frankliniella occidentalis*" OR "*Hauptidia distinguenda*" OR "*Hauptidia lapidicola*" OR "*Helicoverpa armigera*" OR "*Heliothis virescens*" OR "*Heteronychus arator*" OR "*Hyles livornica*" OR "*Insignorthezia insignis*" OR "*Leptinotarsa decemlineata*" OR "*Lipaphis erysimi*" OR "*Liriomyza bryoniae*" OR "*Liriomyza huidobrensis*" OR "*Liriomyza sativae*" OR "*Liriomyza strigata*" OR "*Liriomyza trifolii*" OR "*Listroderes costirostris*" OR "*Macroglossum stellatarum*" OR "*Macrosiphum euphorbiae*" OR "*Mamestra configurata*" OR "*Manduca sexta*" OR "*Melanchra persicariae*" OR "*Melanoplus differentialis*" OR "*Myzus persicae*" OR "*Nasonovia ribisnigri*" OR "*Paracletus cimiciformis*" OR "*Peridroma saucia*" OR "*Petrobia harti*" OR "*Phenacoccus solenopsis*" OR "*Phthorimaea operculella*" OR "*Chromatomyia horticola*" OR "*Phytonemus pallidus*" OR "*Plusia angulum*" OR "*Porcupinychus abutiloni*" OR "*Rhizoecus falcifer*" OR "*Rhopalosiphum maidis*" OR "Rhopalosiphum rufiabdominale" OR "*Scopula fibulata*" OR "*Scopula minorata*" OR "*Sphinx justiciae*" OR "*Spilosoma virginica*" OR "*Spodoptera litura*" OR "*Spodoptera ornithogalli*" OR "*Stagmatophora serratella*" OR "*Strymon melinus*" OR "*Tetranychus neocaledonicus*" OR "*Tetranychus urticae*" OR "*Thrips flavus*" OR "*Thrips tabaci*" OR "*Trialeurodes abutiloneus*" OR "*Trialeurodes vaporariorum*" OR "*Trichoplusia ni*" OR "*Tuta absoluta*" OR "*Vanessa cardui*" OR "*Epitrix hirtipennis*" OR "*Lema bilineata*" OR "*Alternaria alternata*" OR "*Alternaria crassa*" OR "*Alternaria cylindrica*" OR "*Alternaria solani*" OR "*Ascochyta daturae*" OR "*Ascochyta petuniae*" OR "*Berkeleyomyces basicola*" OR "*Botrytis cinerea*" OR "*Cercospora apii*" OR "*Cercospora canescens*" OR "*Cercospora petuniae*" OR "*Cercospora petuniae*" OR "*Cercospora physalidis*" OR "*Choanephora infundibulifera*" OR "*Choanephora cucurbitarum*" OR "*Choanephora infundibulifera*" OR "*Colletotrichum truncatum*" OR "*Rhizoctonia solani*" OR "*Corynespora cassiicola*" OR "*Didymium fuckelianum*" OR "*Entyloma petuniae*" OR "*Entyloma australe*" OR "*Golovinomyces cichoracearum* "OR "*Erysiphe cruciferarum*" OR "*Golovinomyces orontii*" OR "*Golovinomyces orontii*" OR "*Fusarium avenaceum*" OR "*Fusarium roseum*" OR "*Fusarium equiseti*" OR "*Fusarium oxysporum*" OR "*Fusarium phyllophilum*" OR "*Fusarium solani*" OR "*Golovinomyces bolayi*" OR "*Golovinomyces orontii*" OR "*Golovinomyces tabaci* "OR "*Heterosporium petuniae*" OR "*Macrophomina phaseolina*" OR "*Rhizoctonia solani*" OR "*Mycocentrospora acerina* "OR "*Paramyrothecium roridum*" OR "*Fusarium solani*" OR "*Pseudoidium neolycopersici*" OR "*Golovinomyces longipes*" OR "*Phyllosticta petuniae*" OR "*Phytophthora cambivora*" OR "*Phytophthora capsici*" OR "*Phytophthora citricola* "OR "*Phytophthora citrophthora*" OR "*Phytophthora cryptogea*" OR "*Phytophthora drechsleri*" OR "*Phytophthora infestans*" OR "*Phytophthora lateralis*" OR "*Phytophthora meadii*" OR "*Phytophthora nicotianae*" OR "*Phytophthora palmivora*" OR "*Phytophthora nicotianae*" OR "*Podosphaera fusca*" OR "*Puccinia aristidae*" OR "*Puccinia subnitens* "OR "*Pythium aphanidermatum*" OR "*Rhizoctonia solani*" OR "*Sclerotinia sclerotiorum*" OR "*Athelia rolfsii*" OR "*Septoria lycopersici* "OR "*Podosphaera fuliginea*" OR "*Podosphaera fusca*"OR "*Stagonosporopsis andigena*" OR "*Stemphylium botryosum*" OR "*Rhizoctonia solani*" OR "*Berkeleyomyces basicola*" OR "*Trametes hirsuta*" OR "*Verticilium alboatrum*" OR "Verticillium dahlia" OR "*Helicotylenchus dihystera*" OR "*Helicotylenchus microlobus*" OR "*Heterodera glycines*" OR "*Longidorus africanus*" OR "*Longidorus diadecturus*" OR "*Longidorus elongatus*" OR "*Meloidogyne arenaria*" OR "*Meloidogyne enterolobii*" OR "*Meloidogyne graminicola*" OR "*Meloidogyne hapla*" OR "*Meloidogyne incognita*" OR "*Meloidogyne javanica*" OR "*Meloidogyne mayaguensis*" OR "*Meloidogyne petuniae*" OR "*Paralongidorus maximus*" OR "*Pratylenchus crenatus*" OR "*Pratylenchus penetrans*" OR "*Tylenchorhynchus clarus*" OR "*Xiphinema australiae*" OR "*Xiphinema diversicaudatum*" OR "*Xiphinema index*" OR "*Xiphinema vuittenezi*" OR "Ageratum yellow vein virus" OR "Alfalfa mosaic virus" OR "Andean potato latent virus" OR "Andean potato mottle virus" OR "Arabis mosaic virus" OR "Arracacha virus B" OR "Artichoke latent virus" OR "Artichoke yellow ringspot virus" OR "Bean yellow mosaic virus" OR "Beet curly top virus" OR "Bidens mottle virus" OR "Broad bean wilt virus 1" OR "Broad bean wilt virus 2" OR "Calibrachoa mottle virus" OR "Celery mosaic virus" OR "Cherry leaf roll virus" OR "Chilli leaf curl virus" OR "Chrysanthemum stem necrosis virus" OR "Chrysanthemum stunt viroid" OR "Chrysanthemum virus B" OR "Citrus exocortis viroid" OR "Citrus leaf rugose virus" OR "Colombian datura virus" OR "Cowpea aphid-borne mosaic virus" OR "Cucumber mosaic virus" OR "Elderberry latent virus" OR "Elm mottle virus" OR "Euphorbia leaf curl virus" OR "Groundnut ringspot virus" OR "Impatiens necrotic spot virus" OR "Impatiens necrotic spot virus" OR "Iris yellow spot virus" OR "Lettuce necrotic yellows cytorhabdovirus" OR "Malvastrum yellow vein virus" OR "melon chlorotic spot virus" OR "Papaya leaf curl China virus" OR "Peach rosette mosaic virus" OR "Pedilanthus leaf curl virus" OR "Pelargonium zonate spot virus" OR "Pepper chat fruit viroid" OR "Pepper mild mottle virus" OR "Pepper veinal mottle virus" OR "Petunia asteroid mosaic virus" OR "Petunia chlorotic mottle virus" OR "Petunia vein banding virus" OR "Petunia vein clearing virus" OR "Potato black ringspot virus "OR "Potato spindle tuber viroid" OR "Potato virus X" OR "Potato virus Y" OR "Potato yellow dwarf nucleorhabdovirus" OR "Potato yellow mosaic virus" OR "Raspberry ringspot virus "OR "Strawberry latent ringspot virus "OR "Tobacco etch virus" OR "Tobacco mild green mosaic virus" OR "Tobacco mosaic virus" OR "Tobacco necrosis virus "OR "Tobacco rattle virus" OR "Tobacco ringspot virus" OR "Tobacco streak virus" OR "Tomato aspermy virus" OR "Tomato black ring virus" OR "Tomato brown rugose fruit virus" OR "Tomato bushy stunt virus" OR "Tomato chlorotic dwarf viroid" OR "Tomato infectious chlorosis virus" OR "Tomato mosaic virus" OR "Tomato planta macho viroid" OR "Tomato ringspot virus" OR "Tomato spotted wilt virus" OR "Tomato yellow leaf curl virus" OR "Tomato yellow ring virus" OR "Turnip mosaic virus" OR "Turnip vein-clearing virus" OR "*Candidatus Phytoplasma solani*" OR "*Rhodococcus fascians*" OR "*Acidovorax konjaci*" OR "*Candidatus Phytoplasma aurantifolia*" OR "*Candidatus Phytoplasma asteris*" OR "*Dickeya chrysanthemi pv. chrysanthemi*" OR "*Dickeya dieffenbachiae*" OR "*Dickeya chrysanthemi pv. parthenii*" OR "*Dickeya zeae*" OR "*Pseudomonas cichorii*" OR "*Ralstonia solanacearum* species complex" OR "*Pseudomonas viridiflava*" OR "*Agrobacterium tumefaciens*"

## APPENDIX C

### List of pests with an uncertainty in one of the selection not further assessed (Reserve List)

In this list pest species are included if there is any uncertainty on: (a) the pest status in Guatemala; (b) if *Petunia* or *Calibrachoa* can be a host for the pest; (c) if the pest could have impact. If a virus is present in a neighbouring country, with likelihood of transmission (contact-, vector-transmitted) and the lack of regular surveillance including testing would justify its unnoticed presence in Guatemala, it is included in this list (Reserve List).

**TABLE C.1** List of potential pests not further assessed.

| Pest name | EPPO code | Group | Pest present in Guatemala | Present in the EU | EU regulatory status | Justification for inclusion in this list |
|---|---|---|---|---|---|---|
| *Puccinia subnitens* | – | Fungi | Yes | No | No | Uncertainty about impact and about the association with the commodity |
| *Colletotrichum nigrum* | COLLNG | Fungi | Yes | Limited (2) | No | Uncertainty about impact and about the association with the commodity |
| Andean potato mottle virus | APMOV0 | Virus | Uncertain | No | QP | Contact transmitted virus of Solanaceae and *Petunia/Calibrachoa* is experimental-systemic host. Present in Central America. Uncertainty on the presence in Guatemala |
| Beet curly top Iran virus | BCTIV0 | Virus | Uncertain | No | No | Vector (hopper-) transmitted virus of *Petunia/Calibrachoa*. Present in Central America. Uncertainty on the presence in Guatemala |
| Beet curly top virus | BCTV00 | Virus | Uncertain | Limited (2) | QP | Vector (hopper-) transmitted virus of *Petunia/Calibrachoa*. Present in Central America. Uncertainty on the presence in Guatemala |
| Columnea latent viroid | CLVD00 | Virus | Uncertain | Limited (3) | No | Contact transmitted viroid of *Petunia/Calibrachoa*. Present in Central America. Uncertainty on the presence in Guatemala |
| Pepper mottle virus | PEPMOV | Virus | Uncertain | EU Regulated pest | No | Aphid transmitted virus of Solanaceae and *Petunia/Calibrachoa* likely as a host. Present in Central America. Present in El Salvador (country of origin of the genetic material). Uncertainty on the presence in Guatemala |
| Potato aucuba mosaic virus | PAMV00 | Virus | Uncertain | Limited (3) | QP | Contact transmitted virus of Solanaceae and *Petunia/Calibrachoa* is an experimental/systemic host. Present in Central America. Uncertainty on the presence in Guatemala |
| Potato leafroll virus | PLRV00 | Virus | Uncertain | EU Regulated pest | QP | Aphid transmitted virus of Solanaceae and *Petunia/Calibrachoa* likely as a host. Present in Central America. Uncertainty on the presence in Guatemala |
| Potato spindle tuber viroid | PSTVD0 | Virus | Uncertain | EU Regulated pest | RNQP | Contact transmitted viroid of *Petunia/Calibrachoa*. Present in Central America. Uncertainty on the presence in Guatemala |
| Tobacco ringspot virus | TRSV00 | Virus | Uncertain | EU Regulated pest | QP | Nematode, seed-transmitted virus of Petunia. Present in Central America. Vectors present in Guatemala. Uncertainty on the presence in Guatemala |
| Tomato brown rugose fruit virus | TOBRFV | Virus | Uncertain | EU Regulated pest | QP | Contact transmitted virus of Solanaceae and *Petunia/Calibrachoa* is an experimental-systemic host. Present in Central America Present in Israel (country of origin of the genetic material). Uncertainty on the presence in Guatemala |
| Tomato chlorotic dwarf viroid | TCDVD0 | Virus | Uncertain | Limited (3) | No | Contact transmitted viroid of *Petunia/Calibrachoa*. Present in Central America.t Uncertainty on the presence in Guatemala |

(Continues)

**TABLE C.1** (Continued)

| Pest name | EPPO code | Group | Pest present in Guatemala | Present in the EU | EU regulatory status | Justification for inclusion in this list |
|---|---|---|---|---|---|---|
| Tomato chocolàte virus[a] | TOCHV0 | Virus | Yes | No | No | Whitefly-transmitted virus of Solanaceae and *Petunia/Calibrachoa* likely as a host. Not ICTV accepted species. Uncertainty on the taxonomic status |
| Tomato chocolate spot virus[a] | – | Virus | Yes | No | No | Whitefly-transmitted virus of Solanaceae and *Petunia/Calibrachoa* likely as a host. Not ICTV accepted species. Present in Guatemala. Uncertainty on the taxonomic status |
| Tomato infectious chlorosis virus | TICV00 | Virus | Uncertain | Limited (3) | No | Whitefly-transmitted virus of *Petunia/Calibrachoa*. Present in Central America. Uncertainty on the presence in Guatemala |
| Tomato marchitez virus[a] | TOANV0 | Virus | No | No | QP | Whitefly-transmitted virus of Solanaceae and *Petunia/Calibrachoa* likely as a host. Present in Central America. Uncertainty on the presence in Guatemala |
| Tomato mosaic Havana virus | THV000 | Virus | No | No | QP | Whitefly-transmitted virus of Solanaceae and *Petunia/Calibrachoa* likely as a host. Present in Central America |
| Tomato mottle virus | TOMOV0 | Virus | Uncertain | No | QP | Whitefly-transmitted virus of Solanaceae and *Petunia/Calibrachoa* is an experimental/systemic host. Present in Central America. Uncertainty on the presence in Guatemala |
| Tomato planta macho viroid | TPMVD0 | Virus | Uncertain | No | No | Contact transmitted viroid of *Petunia/Calibrachoa*. Present in Central America. Uncertainty on the presence in Guatemala |
| Tomato ringspot virus | TORSV0 | Virus | No | EU Regulated pest | QP | Nematode, seed, pollen-transmitted virus of Solanaceae and *Petunia/Calibrachoa* is an experimental/systemic host. Present in Central America. Uncertainty on the presence in Guatemala |

[a]Tomato chocolàte virus (ToChV) and tomato chocolate spot virus (ToChSV) are related to tomato marchitez virus (ToMarV) and to a lesser degree to tomato torrado virus (ToTV). The taxonomic position of ToChV, ToChSV as either distinct species in the genus *Torradovirus*, strains of a single new species in the genus *Torradovirus* or distant strains of the species Tomato marchitez virus remains unclear (ICTV).

## APPENDIX D

**Excel file with the pest list of *Petunia* and *Calibrachoa***

Appendix D can be found in the online version of this output (in the 'Supporting information' section):

**Footnotes**

The *Petunia/Calibrachoa* pest list includes viruses that are accepted species by ICTV 2021 taxonomy (ICTV_Master_Species_List_2021_v3.xlsx). The following viruses broad bean wilt virus, melon chlorotic spot virus, petunia chlorotic mottle virus and strawberry latent ringspot virus are also included, although not accepted ICTV species (ICTV_Master_Species_List_2021_v3.xlsx), because they are reported to systemically infect *Petunia hybrida* (as experimental host), they are described in EPPO GD and some are regulated. The same applies also for lucerne enation virus and tomato blistering which infects major Solanaceae species (no data for petunia).

Viruses belonging to the *Amalgavirus, Deltapartitivirus* and *Alphaendornavirus* genere were excluded from the pest list because they are cryptic viruses, displaying persistent lifestyles (cannot be removed from the plants with thermotherapy or other methods), they are apparently not associated with any visible alterations in infected hosts and are efficiently transmitted only via seeds and pollen (the later only known for *Alphaendornavirus*) (ICTV). These viruses are not reported to be transmitted horizontally by any vector or mechanical means.

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