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SCIENTIFIC OPINION

Commodity risk assessment of *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings from Costa Rica

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The declarations of interest of all scientific experts active in EFSA's work are available at https://ess.efsa.europa.eu/doi/doiweb/doisearch

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 Costa Rica. The relevance of any pest for this opinion was based on evidence collected according to specific criteria, following the methodology used for high-risk plants adapted for the specificity of this assessment. Twenty-two EU regulated pests (beet curly top virus, *Bemisia tabaci*, *Chloridea virescens*, *Eotetranychus lewisi*, *Epitrix cucumeris*, *Epitrix tuberis*, euphorbia mosaic virus, *Helicoverpa zea*, *Liriomyza huidobrensis*, *Liriomyza sativae*, *Liriomyza trifolii*, pepper golden mosaic virus, potato spindle tuber viroid, *Ralstonia pseudosolanacearum*, *Ralstonia solanacearum*, *Spodoptera ornithogalli*, squash leaf curl virus, *Thrips palmi*, tomato golden mosaic virus, tomato leaf curl Sinaloa virus, tomato spotted wilt virus, tomato yellow leaf curl virus) and one pest that is not regulated in the EU (*Aleurodicus dispersus*) fulfilled all relevant criteria and were selected for further evaluation. For these pests, the risk mitigation measures proposed in the technical dossier from Costa Rica were evaluated taking into account possible factors limiting their efficacies. Additionally, 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 estimated degree of pest freedom varies among the pests evaluated, with tomato spotted wilt virus being the pest most frequently expected on the imported cuttings. The expert knowledge elicitation indicated, with 95% certainty that between 9927 and 10,000 bags containing unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. per 10,000 would be free of tomato spotted wilt virus.

KEYWORDS

European Union, plant health, plant pest, quarantine, Solanaceae

CONTENTS

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 the genera *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 by Guatemala, with the identified pests and the details of the growing conditions is submitted with this request.

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, the protected zone quarantine pests, and the Union regulated non-quarantine pests (RNQPs)) and pest not regulated in the EU, 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 Costa Rica 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 Costa Rica following the Guidance on commodity risk assessment for the evaluation of high-risk plant dossiers (EFSA PLH Panel, 2019) and the protocol for commodity risk assessment as presented in the EFSA standard protocols for scientific assessment (EFSA PLH Panel, 2024; Gardi et al., 2024), taking into account the available scientific information, including the technical information provided by Costa Rica.

Following an exchange with the 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 (Costa Rica Plant Health Inspectorate Service – NPPO of Costa Rica) was sufficient to conduct a commodity risk assessment. When necessary, additional information was requested from the applicant.
- Considered the host status of *Petunia* spp. and *Calibrachoa* spp. 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 RNQPs regulated for *Petunia* spp., *Calibrachoa* spp., or for solanaceous crops and potentially associated with unrooted cuttings of the commodity species (*Petunia* spp. and/or *Calibrachoa* spp.), 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* spp. and/or *Calibrachoa* spp., 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* spp. and/or *Calibrachoa* spp. 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 Costa Rica.

2 | DATA AND METHODOLOGIES

2.1 | Data provided by the NPPO of Costa Rica

The Panel considered all the data and information provided by the NPPO of Costa Rica in response to EFSA's request, which was received on 31 March 2023. Further additional information was submitted by the NPPO of Costa Rica in response to EFSA's request on 18 January 2024, 28 May 2024 and 6 June 2024. 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* spp. and *Calibrachoa* spp._March 2023	Request Innovaplant Final.pdf
2.0	Answers to request of additional information on *Petunia* spp. and *Calibrachoa* spp._January2024	Anexo 2. Innovaplant.pdf
3.0	Table with status of *Petunia* spp. and *Calibrachoa* spp. pests in Costa Rica_January2024	Annex 2 – pest status specific requests to Costa Rica.xlsx
4.0	Answers to request of additional information on *Petunia* spp. and *Calibrachoa* spp._May2024	DSFE-0258-2024.pdf
5.0	Answer to request of additional information on *Petunia* spp._June2024	DSFE-0286-2024.EFSA *Petunia* spp. y *Calibrachoa* spp. consultas ARP 6 Junio

2.2 | Literature searches performed by NPPO of Costa Rica

The data and supporting information provided by the NPPO of Costa Rica 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 Costa Rica to compile the Dossier (Dossier Sections 1.0, 2.0 and 3.0).

TABLE 2 Database sources used in the literature searches by the NPPO of Costa Rica.

Acronym/short title	Database name and service provider	URL of database	Justification for choosing database
EPPO GD	EPPO Global Database Provider: European and Mediterranean Plant Protection Organization	https://gd.eppo.int/	Internationally recognised database
CABI CPC	CABI Crop Protection Compendium Provider: Centre for Agriculture and Biosciences International	https://www.cabidigitallibrary.org/product/QC	Internationally recognised database

Other resources used by the NPPO of Costa Rica

- Aguilar-Piedra, H., & Solano-Guevara, A. M. (2020). Nuevos hospederos y registros de ácaros fitófagos para Costa Rica: Periodo 2013–2018 (New hosts and records of plant feeding mites for Costa Rica: interval 2013–2018). *Agronomía Costarricence*, *44*(1). https://www.scielo.sa.cr/scielo.php?pid=S0377-94242020000100009&script=sci_arttext&tlng=es
- Aguilar-Piedra, H., & Solano-Guevara, A. M. (2020). Nuevos hospederos y registros de ácaros fitófagos para Costa Rica: Periodo 2013–2018 (New hosts and records of plant feeding mites for Costa Rica: interval 2013–2018). The main pathway of entry in the nursery from the surrounding environment is by yet unreported leafhoppers that can carry the virus.

- Alpizar, M. D. (1993). Aspectos básicos sobre las moscas blancas con énfasis en *Bemisia tabaci* y *Trialeurodes vaporarorium*. Comisión Nacional de Moscas Blancas Ministerio de Agricultura y Ganadería. San José Costa Rica.
- Calvo, C.E y Fuentes, G. (1980). Fluctuación de la población del áfido *Myzus pérsicae* (Suizer), en un bosque húmedo pre-montano, Alajuela Costa Rica. *Agronomía Costarricense*, *4*(1), 15–19. https://www.mag.go.cr/rev_agr/v04n01_015.pdf
- Meneses, R., Amador, R., & P. R. Los áfidos alados de la papa y su fluctuación poblacional en Costa Rica. CATIE, Turrialba (Costa Rica) https://repositorio.catie.ac.cr/handle/11554/6501
- Paramjit, K., Dhooria, M. S., Bhullar, M. B. (2006). Suitability of different flowering annuals as host of two-spotted spider mite, *Tetranychus urticae*. *Journal of Applied Zoological Researches*, *17*(1), 24–28. https://www.cabdirect.org/cabdirect/abstract/20083132636
- Paramjit, K., Dhooria, M. S., Bhullar, M. B. (2006). Suitability of different flowering annuals as host of two-spotted spider mite, *Tetranychus urticae*. *Journal of Applied Zoological Researches*, *17*(1), 24–28. https://www.cabdirect.org/cabdirect/abstract/20083132636
- Sánchez-Monge, A. Retana-Salazar, A., Brenes, S., & Agüero, R. (2010). New record of aphid-plant Associations (Hemiptera-Aphididae) from East Costa Rica. *Florida Entomologist*, *93*(4), 489–492. https://doi.org/10.1653/024.093.0402
- Voegtlin, D., Villalobos, W., Sánchez, M. V., Saborio-R. G., & Rivera, C. (2016). A guide to the winged aphids (Homoptera) of Costa Rica. *Revista Biología Tropical*, *51*(S2).

2.3 | Literature searches performed by EFSA

Literature searches were undertaken by EFSA to complete a list of pests potentially associated with the genera *Petunia* spp. and *Calibrachoa* spp. and other relevant solanaceous host plants (tomato, pepper, potato and cultivated tobacco). Two searches were combined: (i) a general search to identify pests of *Petunia* spp. and *Calibrachoa* spp. in different databases was run between 30 May 2022 and 11 June 2022 (EFSA PLH Panel, 2024a, 2024b), updated on August 2024 and (ii) a tailored search to identify whether these pests are present or not in Costa Rica and the EU. 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 the genera *Petunia* and *Calibrachoa* and other cultivated Solanaceae host plants. 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.

TABLE 3 Databases used by EFSA for the compilation of the pest list associated to the genera *Petunia* and *Calibrachoa* and other cultivated Solanaceae host plants.

Database	Platform/Link
Aphids on the World's 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
DPV - Database of Plant Viruses	https://www.dpvweb.net/
EPPO Global Database	https://gd.eppo.int/
EUROPHYT	https://webgate.ec.europa.eu/europhyt/
Leafminers	https://www.leafmines.co.uk/html/plants.htm
Nemaplex	https://nemaplex.ucdavis.edu/Nemabase2010/PlantNematodeHostStatusDDQuery.aspx
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 (version 2021)	https://nt.ars-grin.gov/fungaldatabases/fungushost/fungushost.cfm
Index Fungorum	https://fungi.ars.usda.gov/
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, FSTA, KCI-Korean Journal Database, Russian Science Citation Index, MEDLINE, SciELO Citation Index, Zoological Record)	https://www.webofknowledge.com
World Agroforestry	https://www.worldagroforestry.org/treedb2/speciesprofile.php?Spid=1749
A Catalog of the Cecidomyiidae (Diptera) of the World	https://www.ars.usda.gov/ARSUserFiles/80420580/Gagne, 2014, World, Cecidomyiidae, Catalog, 3rd, Edition.pdf

TABLE 3 (Continued)

Database	Platform/Link
Catalog of the Eriophoidea (Acarina: Prostigmata) of the World	https://www.cabi.org/isc/abstract/19951100613
Global Biodiversity Information Facility	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.

2.4 | 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 pests not regulated in the EU not known to occur in the EU were selected based on evidence of their potential impact in the EU.

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.

In the final step, the likelihood of the commodity being free from each of the relevant pests 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 52–100 unrooted cuttings.

The information provided in the Opinion is the result of the Panel interpretation of the text of the applicant Dossier.

2.4.1 | Commodity data

Based on the information provided by the NPPO of Costa Rica, the characteristics of the commodity are summarised in Section 3.0.

2.4.2 | Identification of pests potentially associated with the commodity

To evaluate the pest risk associated with the importation of the commodity from Costa Rica, a pest list was compiled. The pest list is a compilation of all identified pests reported to be associated with all species of the genera *Petunia* spp. and *Calibrachoa* spp., and the polyphagous pests associated with major Solanaceae plants reported to be present in Costa Rica based on information provided in the Dossier Sections 1.0, 2.0, 3.0, 4.0 and on searches performed by the Panel. All viruses and viroids infecting major solanaceous crops (tomato, pepper, potato and cultivated tobacco) retrieved from CABI (online) and EPPO (online) databases and recent review articles on the subject were also included.

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.

Plants of *Petunia* spp. are widely used in plant virology as experimental hosts. Therefore, much of the available data concerning host status for plant viruses refer to laboratory tests where *Petunia* spp. are reported either as a local host (where the virus is restricted to the inoculated leaf via cell-to-cell movement) or as a systemic host (where the virus spreads from the inoculated leaf to other parts of the plant via phloem movement). In this assessment, viruses recorded to infect *Petunia* spp. or *Calibrachoa* spp. naturally were included for further evaluation. Viruses that are reported to infect *Petunia* spp. or *Calibrachoa* spp. experimentally were included for further evaluation if (i) they infect *Petunia* spp. or *Calibrachoa* spp. systemically or (ii) they infect *Petunia* spp. or *Calibrachoa* spp. 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* spp. or *Calibrachoa* spp. 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 2024 (EUROPHYT, online, from 2009 to 2020 and TRACES-NT, online, from May 2020 to March 2024). To check whether *Petunia* spp. and *Calibrachoa* spp. can act as a pathway, all notifications (all origins) for *Petunia* spp. and *Calibrachoa* spp. were evaluated. It should be noted that the import in the EU of *Petunia* spp. and *Calibrachoa* spp. from Costa Rica is prohibited. For each selected pest, it was also checked if there were notification records for Costa Rica (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 pest was evaluated (Section 4.2).

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

The methodology used to establish pest presence relies in part on published literature. The limited number of publications from Costa Rica 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.

2.4.3 | 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* spp. and *Calibrachoa* spp. in nurseries and relevant risk mitigation measures were considered (Figure 1):

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

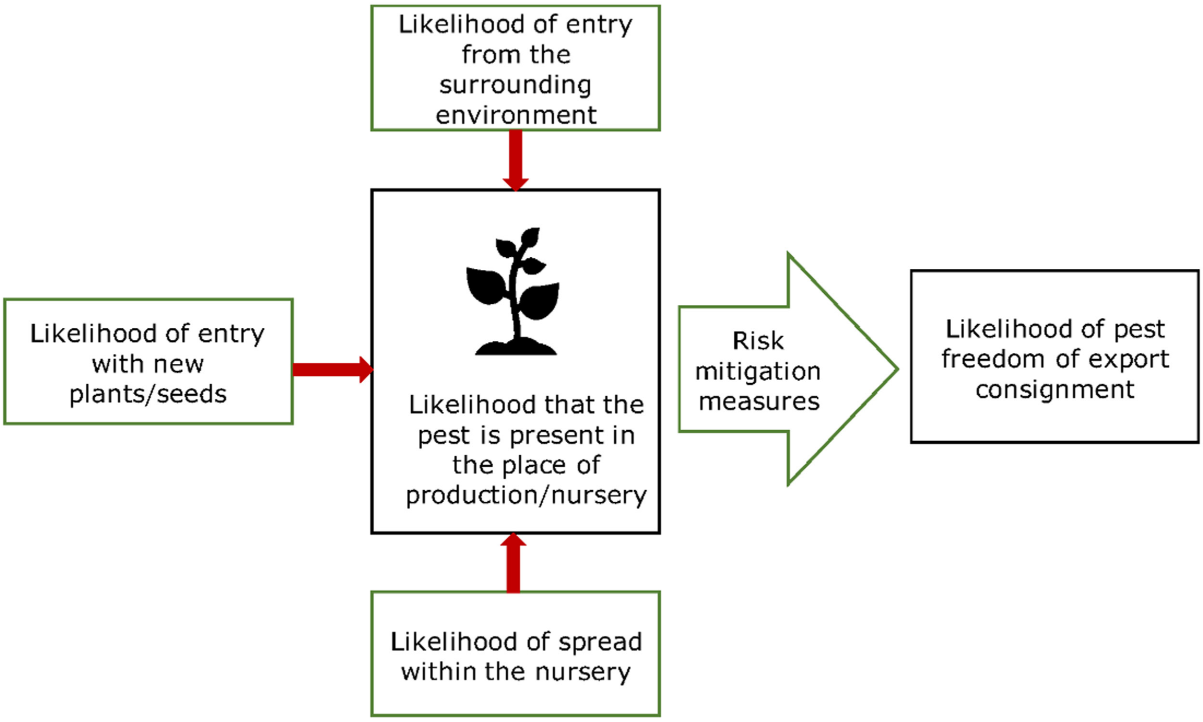

FIGURE 1 Conceptual framework to assess likelihood that plants are exported free from relevant pests (Source: EFSA PLH Panel, 2019).

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).

2.4.4 | 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* spp. and *Calibrachoa* spp. unrooted cuttings will be infested/infected with the relevant pest/pathogen when arriving in the EU?'

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

(i) Cuttings are exported in plastic bags, containing 50–100 unrooted cuttings. There is no information available regarding pooling of cuttings during production through packing.

(ii) For the pests under consideration a cross infestation/contamination between bags during transport is not likely.

Before the elicitation, the pests were grouped if they had similar characteristics, such as: close taxonomy; biology/life history; behavioural ecology; effect of management measures (e.g. mesh size); plant/pathogen/vector (if applicable) interactions.

For the assessment of some pests/cluster of pests, the results of the previous commodity risk assessment of *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings were also used (EFSA PLH Panel, 2024a, 2024b). In the case of similar pest species associated with the commodity in the different countries, a comparison was made of the: (1) production conditions, including applied risk mitigation measures; (2) climatic and environmental conditions; (3) pest pressure. When no major differences were identified, the results of the previous risk assessment were taken into consideration. When differences were identified, the EKE was based on the previously elicited values considering the necessary adaptations.

The uncertainties associated with the EKE were taken into account and quantified in a probability distribution by 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 (as defined in FAO, 2019) of *Petunia* spp. (common name: Petunia, garden Petunia; family: Solanaceae) and/or *Calibrachoa* spp. (common name: Calibrachoa, mini Petunia; family: Solanaceae). These unrooted cuttings measure about 3–4 cm in length (Figure 2) (Dossier section 1.0 and 2.0). These cuttings are obtained from mother plants between 8 and 25 weeks old.

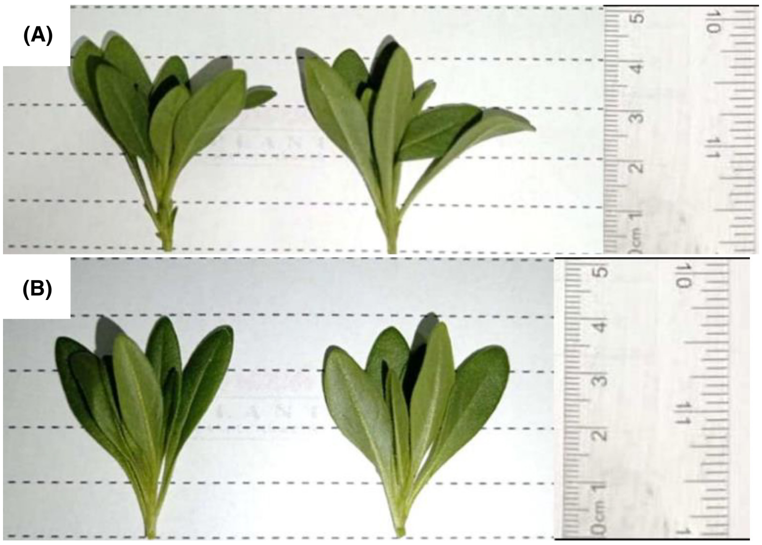

FIGURE 2 Unrooted cuttings of (A). *Petunia* spp. and (B). *Calibrachoa* spp. intended to be exported to the EU (Source: Dossier section 4.0).

3.2 | Description of the production area

There are five production sites spread across Costa Rica interested in exporting the unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. to the EU (Figure 3).

FIGURE 3 Location of the nurseries designated for export of *Petunia* spp. and *Calibrachoa* spp. to the European Union (Source: Dossier Section 1.0).

3.3 | Production and handling processes

3.3.1 | Source of planting material

All the planting material of *Petunia* spp. and *Calibrachoa* spp. before imported in Costa Rica, should be free from the following pests: (a) ***Petunia* spp.** is tested for *Chromatomyia horticola*, *Thrips flavus*, *Maconellicoccus hirsutus*, *Thrips palmi*, *Listroderes costirostris*, tomato infectious chlorosis virus (TICV), *Bactericera cockerelli*, *Maconellicoccus hirsutus*, *Phymatotrichopsis omnívora*, *Lygus lineolaris*, pepper veinal mottle virus (PVMV), *Achatina fulica*, *Opogona sacchari*, *Listroderes costirostris* and *Liriomyza bryoniae;* and (b) ***Calibrachoa* spp.** is tested for *Chromatomyia horticola*, *Thrips flavus*, *Maconellicoccus hirsutus*, *Phymatotrichopsis omnivore*, *T. palmi* and *Achatina fulica*. The consignment must also be accompanied by an Official Phytosanitary Certificate, indicating in the line of additional declarations that it is free of *Chromatomyia horticola* and *Thrips flavus* (Dossier Section 1.0).

For the production of *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings certified ('Elite') planting material (unrooted cuttings or tissue culture) originating from Germany are used to start the production of mother plants (Dossier Section 1.0 and 2.0).

For the following viruses and bacteria, tests are performed in the Elite certification system:

Enzyme linked immunosorbent assay (ELISA) tests are used for the following species (Dossier Section 2.0): angelonia flower break virus, alfalfa mosaic virus, arabis mosaic virus, broad bean wilt virus serotype 1 and 2, calibrachoa mottle virus, cucumber mosaic virus, chrysanthemum virus B, nemesia necrotic ringspot virus, papaya mosaic virus (alternanthera mosaic virus), pepino mosaic virus, petunia asteroid mosaic virus, potyviruses (broad range antiserum from Agdia for the general detection of all potyviruses including potato virus Y, turnip yellow mosaic virus, tobacco etch virus, lettuce mosaic virus etc), potato virus X, prunus necrotic ringspot virus, ribgrass mosaic virus, tomato aspermy virus, tomato black ring virus, tobacco mild green mottle virus, tobacco mosaic virus, tobacco necrosis virus, tomato mosaic virus, tomato ringspot virus, orthotospoviruses (tomato spotted wilt virus, groundnut ringspot virus, impatiens necrotic spot virus, tomato chlorotic spot virus, chrysanthemum stem necrosis virus, tobacco rattle virus, tobacco ringspot virus, tobacco streak virus, tomato yellow leaf curl virus) and tomato yellow leaf curl virus (the latter only for varieties imported from third countries, not Europe or Mediterranean countries).

Molecular (PCR or RT-PCR) tests are used for the following species: tomato yellow leaf curl virus (only varieties imported from third countries) and Pospiviroids (including potato spindle tuber viroid, tomato chlorotic dwarf viroid, tomato apical stunt viroid, chrysanthemum stunt viroid, citrus exocortis viroid, columnea latent viroid, mexican papita viroid, tomato planta macho viroid, iresine viroid 1 and pepper chat fruit viroid).

Concerning bacteria, PCR is used for *Ralstonia solanacearum* (only varieties imported from third countries (not Europe or Mediterranean countries)).

The planting material is approved for propagation by the NPPO of Costa Rica (SFE, Servicio Fitosanitario del Estado) only if the test is negative for all the above-mentioned pests (Dossier Section 1.0).

3.3.2 | Production cycle and conditions

The unrooted cuttings destined for export to the EU are produced in officially recognised nurseries (Figure 4). The greenhouse is protected with thrips-proof netting. A preventive maintenance programme is conducted every 2 weeks in order to make and maintain the greenhouse structure insect proof. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. The greenhouse has a double door system, with automatic closing and with a forced air exclusion system at the entrance of the greenhouse. Inside each greenhouse, there are cement corridors and the plants are kept on metal tables, which are placed on 'ground cover' (Dossier Section 1.0).

All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, before entering to the production area they should wear clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out (Dossier Section 1.0 and 2.0).

According to the planning, the necessary quantities are reproduced to create the mother plants for cutting production. The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle. Once all the stocks are planted in pots, they are maintained, based on weekly pinching and the necessary fertilisation to obtain the number of cuttings required weekly. Harvesting of cuttings is done every week, using all the mother plants of each variety (Dossier Section 1.0).

There is only one production season per year. The main stages of *Petunia* spp. and *Calibrachoa* spp. production are:

- Planting: September
- Growing: from September to harvesting
- Harvesting: from December to March.

FIGURE 4 (A) Aerial view of one of the nurseries designated for export of *Petunia* spp. and *Calibrachoa* spp. to the European Union (boxes in red indicate the production units for *Petunia* spp./*Calibrachoa* spp.); (B) Solanaceae production area, mother stock of *Petunia* spp./*Calibrachoa* spp. inside a 5000 m^2 greenhouse (Source: Dossier Section 1.0).

3.3.3 | Pest monitoring during production

Three types of monitoring are carried out:

- Monitoring is performed weekly with yellow sticky traps (40–60 per ha) (Figure 5A). They are placed in a zig-zag pattern alternating between the beginning, the middle and the end of the table. These are employed to trap *Myzus persicae*, *Aphis gossypii*, *Bemisia tabaci*, *Frankliniella occidentalis* (Dossier Section 1.0, 2.0, 3.0). For mass trapping, sticky yellow plastic rolls are used and are changed every 3–5 weeks.
- Visual monitoring that consists of inspection of plants in a production unit by trained personnel for the detection of pests or other problems in crops. At least once a week, a general review of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested and everything that is observed is reported in an online database (Figure 5B).
- Virus monitoring. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA (Figure 5C). The monitoring staff first look for any virus-like symptom; if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the infected plant and the surrounding ones, as well as to perform further analysis. Generally, the tests are carried out in the companies' own laboratories or in Universities' laboratories. The University laboratories inform the NPPO in case of detection of a regulated pest. Official NPPO inspectors, when visiting the production sites to verify phytosanitary conditions, may request the results of these analysis.

3.3.4 | Response when pest is detected in production unit

When a detection is reported in the production unit, several measures are taken to control the pest and prevent its spread. If *B. tabaci* infestation is detected a special equipment to vacuum the foliage (Figure 5D), is used to reduce the abundance of adults.

If symptoms/pests are detected on mother plants, the area within the greenhouse is set aside as a quarantine area, marked with tape to limit access and reduce the spread of any possible pests or pathogens (Figure 5G). Plants with visible symptoms are removed. Plants suspected of being diseased are sent to the Bioanalysis laboratory for phytosanitary diagnosis, including tests for virus presence using ELISA for a wide range of viruses. The sample taken is registered into the software for monitoring and once the laboratory result is obtained, the data is updated. For fungal diagnosis, isolation from plant tissue is performed and the developed colonies are then incubated onto potato dextrose agar (PDA) growing medium to allow sporulation for subsequent microscopic identification. In some cases, identification is made by direct observation under the microscope of fungal structures developed on the plant tissue. For bacteria, growth is made in selective media and is supported with PCR analysis in external laboratories.

If the internal team cannot detect the pathogen in symptomatic plants, sampling and analysis are coordinated with the NPPO. The NPPO does not authorise the export of *Petunia* spp. and *Calibrachoa* spp. material from the greenhouse until the pathogen is identified. If the analysis indicates the presence of a quarantine pest in the country of destination, the material is discarded and the affected area is disinfected (Dossier Section 1.0 and 3.0).

3.3.5 | General pest management

Crop management includes monitoring from the moment the plant material enters the greenhouse and applications of biological control agents (Table 4) to avoid the presence of pests (Figure 5E). Disease control begins with treatments to the growing medium 4 weeks after planting the crop and foliar applications after 8 weeks. Broad spectrum and preventive products are used, with weekly or biweekly applications (Figure 5F). In the case that monitoring detects symptomatic plants, the products and frequency are changed to control the specific pests (Dossier Section 1.0).

FIGURE 5 Pest monitoring: (A) monitoring with yellow sticky traps; (B) visual monitoring; (C) laboratory personnel performing virus monitoring (ELISA analysis); (D) method for vacuuming *Bemisia tabaci* adults; (E) example of application of biological control agents; (F) example of application of chemical control; (G) quarantine area (in blue) in production unit inside the greenhouse (Source: Dossier Section 3.0).

TABLE 4 List of biological control agents used in production of plants for planting in Costa Rica (Table B2 Dossier Section 1.0). All agents listed are listed in EPPO standard PM6/003(5): Biological control agents safely used in the EPPO region (2024 version).

Biological control agents used	EPPO code	Ecological role
Neoseiulus cucumeris	AMBSCU	Predatory mite
Amblyseius swirskii	AMBSSW	Predatory mite
Aphidius colemani	APHUCO	Parasitoid
Chrysopa carnea	CHROCR	Predator (lacewing)
Eretmocerus eremicus	ERETER	Parasitoid
Phytoseiulus persimilis	PHSLRI	Predatory mite

3.3.6 | Irrigation water source and testing

Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. Water samples are taken three times a week to verify the correct level of disinfection required. After each production cycle, the irrigation system is disinfected. (Dossier Section 1.0).

3.3.7 | Level of sanitation inside the greenhouse

The greenhouses have three different levels of sanitation: A, B & C; from the highest to the lowest which correspond to the susceptibility of the crop to viruses and other pests/pathogens. *Petunia* spp. and *Calibrachoa* spp. are produced under level A sanitation (Figure 6).

In Class A greenhouses, to enter the sanitation room (Figure 6), one must first disinfect their shoes, then wash their hands and forearms, put on a coat, plastic apron, latex gloves and hair net. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades (10% a.i, Benzoic Acid, active against bacteria, fungi, virus and viroids). The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that tell the harvester when to change the blade for disinfection (Dossier Section 2.0).

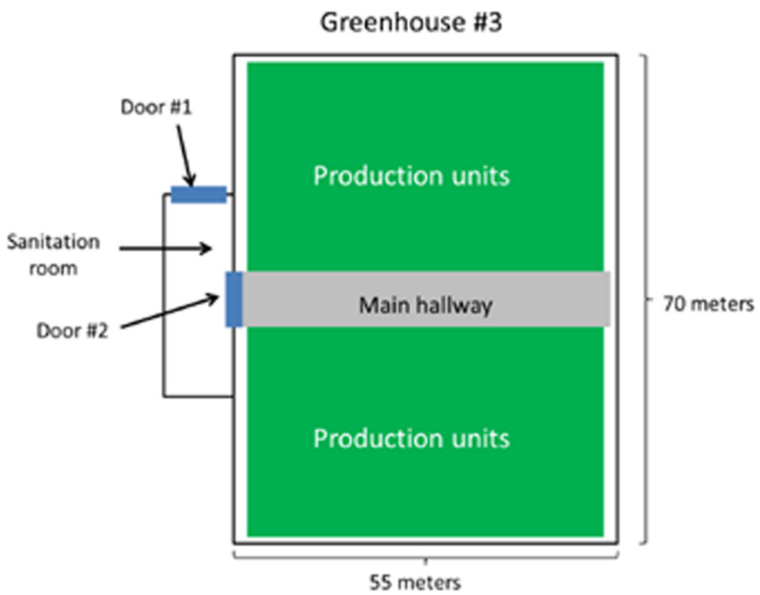

FIGURE 6 Map of a nursery unit designated for the production of *Petunia* spp. and *Calibrachoa* spp. to be exported to the European Union: Greenhouse #3 which does not rotate with any other plant and it is emptied for 3 months a year (Source: Dossier Section 2.0).

3.3.8 | Harvest processes and export procedure

Peak months for export range between December and March. Expected volume from an individual nursery is around 500.000 unrooted cuttings (both *Petunia* spp. and *Calibrachoa* spp.) shipped every week to EU.

For the harvest, the staff must comply with the sanitation procedures before changing the variety. Each worker has a disinfectant and four blades. At a predetermined number of pots (approximately 200 pots) the staff must change the blade and immerse it in disinfectant. The harvested cuttings are placed in new plastic bags (52–100 unrooted cuttings per bag), which are later placed in cardboard boxes (15–20 bags per cardboard box), which in turn are placed in larger boxes known as 'master boxes' (Figure 7A). Once the product is packaged, the labels with the product information are placed and it is stored in the cold room to be transported in clean and closed vehicles to the exit points for export (Figure 7B,C) (Dossier Section 1.0).

FIGURE 7 Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. packed for shipping: (A) harvest box; (B) cooler chamber with master boxes; (C) master boxes ready for shipment (Source: Dossier Section 1.0).

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 488 species (see file in Appendix D).

This list contains all the pests that were reported to infect/infest *Petunia* spp. or *Calibrachoa* spp. based on thematic databases and systematic literature searches.

Additional relevant pests, with a broad host range, including solanaceous host plants were included in the list, if there was evidence of presence in the country of export.

All viruses and viroids infecting major solanaceous crops (tomato, pepper, potato and cultivated tobacco) were included.

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) are based on assessments concluding that the pests can enter, establish, spread and have potential impact in the EU.

Seventy-six EU-regulated (QPs, RNQPs, emergency measures and protected zone (PZ) quarantine pests) species that are present in Costa Rica and reported to use *Petunia* spp. or *Calibrachoa* spp. or major solanaceous hosts were evaluated for their relevance of being included in this opinion (Table 5 and Appendix D).

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

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

A potential host is a plant species for which we don't have specific scientific evidence on its host status, but based on the reported polyphagy level of the pest, including relevant solanaceous plant species (considering also the phylogenetic distance), the Panel assumes *Petunia*/*Calibrachoa* could be a host for this pest.

For pests regulated as RNQPs, only regulated for solanaceous crops were selected for further evaluation. Table 5 presents the conclusions for the 76 EU-regulated pests of solanaceous host plants.

Of the 76 EU-regulated pest species evaluated, 22 were selected for further evaluation.

TABLE 5 Overview of the evaluation of the 76 EU-regulated pests present in Costa Rica (QPs, RNQPs, emergency measures and protected zone quarantine pests) known to use solanaceous host plants or specifically *Petunia* and/or *Calibrachoa* for their relevance for this Opinion. The host status 'Likely' refers to a polyphagous pest for which we don't have specific scientific evidence but based on the reported polyphagy including relevant solanaceous plant species, the Panel assumes *Petunia/Calibrachoa* could be a host for this pest.

Nr	Current scientific name	Synonyms/virus common names	EPPO code	Pest group	EU-Q status	*Petunia* and/or *Calibrachoa* as host	Final conclusion
1	*Aleurocanthus woglumi*		ALECWO	Insects & Mites	Quarantine pest (Annex II A)	No	*Petunia* spp. and *Calibrachoa* spp. unlikely as a host
2	*Anastrepha fraterculus*		ANSTFR	Insects & Mites	Quarantine pest (Annex II A)	No	No pathway
3	*Anastrepha ludens*		ANSTLU	Insects & Mites	Quarantine pest (Annex II A)	No	No pathway
4	*Anthonomus eugenii*		ANTHEU	Insects & Mites	Quarantine pest (Annex II A)	Yes	No pathway
5	*Aphelenchoides besseyi*		APLOBE	Nematoda	RNQP (No Solanaceae)	No	RNQP (No Solanaceae)
6	*Bactericera cockerelli*		PARZCO	Insects & Mites	Quarantine pest (Annex II A)	Likely	Reserve list (uncertainty about the pest status in Costa Rica)
7	*Begomovirus capsicummusivi**	Pepper golden mosaic virus	PEPGMV	Viruses and viroids	Quarantine pest (Non-EU Begomovirus, Annex II A)	Likely	Selected for further evaluation
8	*Begomovirus coheni**	Tomato yellow leaf curl virus	TYLCV0	Viruses and viroids	RNQP (Solanum)	Yes	Selected for further evaluation
9	*Begomovirus cucurbitapeponis**	Squash leaf curl virus	SLCV00	Viruses and viroids	Quarantine pest (Non-EU Begomovirus, Annex II A)	Likely	Selected for further evaluation
10	*Begomovirus euphorbiamusivi**	Euphorbia mosaic virus	EUMV00	Viruses and viroids	Quarantine pest (Non-EU Begomovirus, Annex II A)	Likely	Selected for further evaluation
11	*Begomovirus solanumaureimusivi**	Tomato golden mosaic virus	TOLCSI	Viruses and viroids	Quarantine pest (Non-EU Begomovirus, Annex II A)	Yes	Selected for further evaluation
12	*Begomovirus solanumhavanaense**	Tomato mosaic Havana virus	THV000	Viruses and viroids	Quarantine pest (Non-EU Begomovirus, Annex II A)	Likely	Reserve list (uncertainty about the pest status in Costa Rica)
13	*Begomovirus solanumsinaloaense**	Tomato leaf curl Sinaloa virus	TGMV00	Viruses and viroids	Quarantine pest (Non-EU Begomovirus, Annex II A)	Likely	Selected for further evaluation
14	*Bemisia tabaci*		BEMITA	Insects & Mites	Quarantine pest (Annex II A)	Yes	Selected for further evaluation
15	*Botrytis cinerea*		BOTRCI	Fungi & Chromista	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
16	*Candidatus Liberibacter asiaticus*		LIBEAS	Bacteria	Quarantine pest (Annex II A)	No	*Petunia* spp. unlikely as a host
17	*Candidatus Phytoplasma asteris*		PHYPAS	Bacteria	RNQP (No Solanaceae)	Yes	RNQP (Not for Solanaceae)
18	*Chloridea virescens*		HELIVI	Insects & Mites	Emergency measures	Likely	Selected for further evaluation
19	*Clavibacter michiganensis*		CORBMI	Bacteria	RNQP (Solanum)	No	*Petunia* spp. unlikely as a host
20	*Clavibacter sepedonicus*		CORBSE	Bacteria	Quarantine pest (Annex II B)	No	*Petunia* spp. unlikely as a host
21	*Colletotrichum acutatum*		COLLAC	Fungi & Chromista	RNQP (No Solanaceae)	No	RNQP (No Solanaceae)
22	*Colletotrichum gossypii*		GLOMGO	Fungi & Chromista	PZ Quarantine pest (Annex III)	No	*Petunia* spp. unlikely as a host

TABLE 5 (Continued)

Nr	Current scientific name	Synonyms/virus common names	EPPO code	Pest group	EU-Q status	*Petunia* and/or *Calibrachoa* as host	Final conclusion
23	*Comovirus andesense**	Andean potato mottle virus	APMOV0	Viruses and viroids	Quarantine pest (Annex II A)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia/Calibrachoa*)
24	*Cucumovirus CMV**	Cucumber mosaic virus	CMV000	Viruses and viroids	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
25	*Curtovirus betae**	Beet curly top virus	BCTV00	Viruses and viroids	Quarantine pest (Annex II A)	Yes	Selected for further evaluation
26	*Diabrotica virgifera zeae*		DIABVZ	Insects & Mites	Quarantine pest (Annex II A)	No	*Petunia* spp. unlikely as a host
27	*Ditylenchus dipsaci*		DITYDI	Nematoda	RNQP (No Solanaceae)	No	RNQP (No Solanaceae)
28	*Eotetranychus lewisi*		EOTELE	Insects & Mites	Quarantine pest (Annex II A)	Likely	Selected for further evaluation
29	*Epitrix cucumeris*		EPIXCU	Insects & Mites	Emergency measures	Yes	Selected for further evaluation
30	*Epitrix tuberis*		EPIXTU	Insects & Mites	Emergency measures	Yes	Selected for further evaluation
31	*Globodera pallida*		HETDPA	Nematoda	Quarantine pest (Annex II B)	No	No pathway
32	*Globodera rostochiensis*		HETDRO	Nematoda	Quarantine pest (Annex II B)	No	No pathway
33	*Helicoverpa zea*		HELIZE	Insects & Mites	Quarantine pest (Annex II A)	Likely	Selected for further evaluation
34	*Keiferia lycopersicella*		GNORLY	Insects & Mites	Quarantine pest (Annex II A)	No	No pathway
35	*Leptinotarsa decemlineata*		LPTNDE	Insects & Mites	PZ Quarantine pest (Annex III)	Yes	No pathway
36	*Liriomyza huidobrensis*		LIRIHU	Insects & Mites	PZ Quarantine pest (Annex III)	Yes	Selected for further evaluation
37	*Liriomyza sativae*		LIRISA	Insects & Mites	Quarantine pest (Annex II A)	Yes	Selected for further evaluation
38	*Liriomyza trifolii*		LIRITR	Insects & Mites	PZ Quarantine pest (Annex III)	Yes	Selected for further evaluation
39	*Meloidogyne arenaria*		MELGAR	Nematoda	RNQP (No Solanaceae)	Yes	No pathway
40	*Meloidogyne enterolobii*		MELGMY	Nematoda	Quarantine pest (Annex II A)	Yes	No pathway
41	*Meloidogyne hapla*		MELGHA	Nematoda	RNQP (No Solanaceae)	Yes	No pathway
42	*Meloidogyne incognita*		MELGIN	Nematoda	RNQP (No Solanaceae)	Yes	No pathway
43	*Meloidogyne javanica*		MELGJA	Nematoda	RNQP (No Solanaceae)	Yes	No pathway
44	*Neoleucinodes elegantalis*		NEOLEL	Insects & Mites	Quarantine pest (Annex II A)	No	No pathway
45	*Opogona sacchari*		OPOGSC	Insects & Mites	RNQP (No Solanaceae)	No	RNQP (No Solanaceae)
46	*Orthotospovirus impatiensnecromaculae**	Impatiens necrotic spot orthotospovirus	INSV00	Viruses and viroids	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
47	*Orthotospovirus tomatomaculae**	Tomato spotted wilt virus	TSWV00	Viruses and viroids	RNQP (Capsicum, Solanum)	Likely	Selected for further evaluation
48	*Phyrdenus muriceus*		PHRDMU	Insects & Mites	Quarantine pest (Annex II A)	No	*Petunia* spp. unlikely as a host
49	*Phytonemus pallidus*		TARSPA	Insects & Mites	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
50	*Phytophthora cinnamomi*		PHYTCN	Fungi & Chromista	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
51	*Phytophthora citrophthora*		PHYTCO	Fungi & Chromista	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)

(Continues)

TABLE 5 (Continued)

Nr	Current scientific name	Synonyms/virus common names	EPPO code	Pest group	EU-Q status	*Petunia* and/or *Calibrachoa* as host	Final conclusion
52	*Phytophthora parasitica*		PHYTNP	Fungi & Chromista	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
53	Potato leafroll virus*	Potato leafroll virus	PLRV00	Viruses and viroids	Quarantine pest (Annex II A)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia/Calibrachoa*)
54	*Pospiviroid fusituberis**	Potato spindle tuber viroid	PSTVD0	Viruses and viroids	RNQP (Solanum)	Yes	Selected for further evaluation
55	*Pratylenchus penetrans*		PRATPE	Nematoda	RNQP (No Solanaceae)	Yes	No pathway
56	*Pseudaulacaspis pentagona*		PSEAPE	Insects & Mites	RNQP (No Solanaceae)	No	RNQP (No Solanaceae)
57	*Puccinia pittieriana*		PUCCPT	Fungi & Chromista	Quarantine pest (Annex II A)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia/Calibrachoa*)
58	*Ralstonia pseudosolanacearum*		RALSPS	Bacteria	Quarantine pest (Annex II A)	Likely	Selected for further evaluation
59	*Ralstonia solanacearum*		RALSSL	Bacteria	Quarantine pest (Annex II B)	Likely	Selected for further evaluation
60	*Rhizoctonia solani*		RHIZSO	Fungi & Chromista	RNQP (Solanum)	Yes	No pathway
61	*Rhynchophorus palmarum*		RHYCPA	Insects & Mites	Quarantine pest (Annex II A)	No	*Petunia* spp. unlikely as a host
62	*Sclerotinia sclerotiorum*		SCLESC	Fungi & Chromista	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
63	*Spodoptera eridania*		PRODER	Insects & Mites	Quarantine pest (Annex II A)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia/Calibrachoa*)
64	*Spodoptera frugiperda*		LAPHFR	Insects & Mites	Quarantine pest (Annex II A)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia/Calibrachoa*)
65	*Spodoptera ornithogalli*		PRODOR	Insects & Mites	Emergency measures	Yes	Selected for further evaluation
66	*Spongospora subterranea*		SPONSU	Fungi & Chromista	RNQP (Solanum)	No	*Petunia* spp. unlikely as a host
67	*Tecia solanivora*		TECASO	Insects & Mites	Quarantine pest (Annex II A)	No	*Petunia* spp. unlikely as a host
68	*Tepovirus tafsolani**	Potato virus T	PVT000	Viruses and viroids	Quarantine pest (Annex II A)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia/Calibrachoa*)
69	*Tetranychus urticae*		TETRUR	Insects & Mites	RNQP (No Solanaceae)	Yes	RNQP (No Solanaceae)
70	*Thecaphora solani*		THPHSO	Fungi & Chromista	Quarantine pest (Annex II A)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia/Calibrachoa*)
71	*Thrips palmi*		THRIPL	Insects & Mites	Quarantine pest (Annex II A)	Likely	Selected for further evaluation
72	*Toxoptera citricida*		TOXOCI	Insects & Mites	Quarantine pest (Annex II B)	No	*Petunia* spp. unlikely as a host
73	*Xanthomonas axonopodis* pv. *phaseoli*		XANTPH	Bacteria	RNQP (No Solanaceae)	No	RNQP (No Solanaceae)

TABLE 5 (Continued)

Nr	Current scientific name	Synonyms/virus common names	EPPO code	Pest group	EU-Q status	*Petunia* and/or *Calibrachoa* as host	Final conclusion
74	*Xanthomonas hortorum* pv. *gardneri*		XANTGA	Bacteria	RNQP (Capsicum, Solanum)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia*/*Calibrachoa*)
75	*Xanthomonas vesicatoria*		XANTVE	Bacteria	RNQP (Capsicum, Solanum)	No	*Petunia* spp. unlikely as a host
76	*Xylella fastidiosa*		XYLEFA	Bacteria	Quarantine pest (Annex II B)	Uncertain	Reserve list (uncertainty about the host plants status of *Petunia*/*Calibrachoa*)

*According to ICTV rules (https://talk.ictvonline.org/information/w/faq/386/how-to-write-a-virus-name), common names of viruses are not italicised. The new binomial 'genus-species' format is adopted by the ICTV in 2021 and it is gradually implemented for viruses/viroids species.

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

The information provided by the NPPO of Costa Rica, integrated with the search EFSA performed, was evaluated to determine 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 pests non-regulated in the EU 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 Costa Rica;
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 four criteria were selected for further evaluation.

Based on the information collected, 412 potential pests not regulated in the EU, known to be associated with solanaceous host plants and potentially associated with *Petunia* spp. and *Calibrachoa* spp. were evaluated for their relevance to this opinion. Details can be found in Appendix D. Of the evaluated pests that are not regulated in the EU, one species was selected for further evaluation (Table 6). More information on this pest species can be found in the pest datasheets (Appendix A).

TABLE 6 Overview of other relevant pests (non-regulated in the EU) associated with the commodity selected for further evaluation.

No.	Pest species	EPPO code	Pest group	*Petunia* spp./*Calibrachoa* spp. as a host	Conclusion
1	*Aleurodicus dispersus*	ALEDDI	Insects & Mites	Likely	Selected for further evaluation

4.3 | Summary of pests selected for further evaluation

Twenty-three pests that were identified to be present in Costa Rica 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.

	Current scientific name	Synonyms/virus common names	EPPO code	Taxonomic information	Pest group	EKE cluster	EU_Qstatus
1	*Aleurodicus dispersus*		ALEDDI	Class: Insecta Order: Hemiptera Family: Aleyrodidae	Insects & Mites	Whitefly	No
2	*Begomovirus capsicummusivi**	Pepper golden mosaic virus	PEPGMV	Order: Geplafuvirales Family: Geminiviridae Genus: Begomovirus	Viruses and viroids	Bemisia-transmitted viruses	Non-EU Begomovirus
3	*Begomovirus coheni**	Tomato yellow leaf curl virus	TYLCV0	Order: Geplafuvirales Family: Geminiviridae Genus: Begomovirus	Viruses and viroids	Bemisia-transmitted viruses	RNQP (Annex IV)
4	*Begomovirus cucurbitapeponis**	Squash leaf curl virus	SLCV00	Order: Geplafuvirales Family: Geminiviridae Genus: Begomovirus	Viruses and viroids	Bemisia-transmitted viruses	Non-EU Begomovirus
5	*Begomovirus euphorbiamusivi**	Euphorbia mosaic virus	EUMV00	Order: Geplafuvirales Family: Geminiviridae Genus: Begomovirus	Viruses and viroids	Bemisia-transmitted viruses	Non-EU Begomovirus
6	*Begomovirus solanumaureimusivi**	Tomato golden mosaic virus	TGMV00	Order: Geplafuvirales Family: Geminiviridae Genus: Begomovirus	Viruses and viroids	Bemisia-transmitted viruses	Non-EU Begomovirus
7	*Begomovirus solanumsinaloaense**	Tomato leaf curl Sinaloa virus	TOLCSI	Order: Geplafuvirales Family: Geminiviridae Genus: Begomovirus	Viruses and viroids	Bemisia-transmitted viruses	Non-EU Begomovirus
8	*Bemisia tabaci*		BEMITA	Class: Insecta Order: Hemiptera Family: Aleyrodidae	Insects & Mites	Whitefly	Quarantine pest (Annex II A)
9	*Chloridea virescens*		HELIVI	Class: Insecta Order: Lepidoptera Family: Noctuidae	Insects & Mites	Moths	Emergency measures
10	*Curtovirus betae**	Beet curly top virus	BCTV00	Order: Geplafuvirales Family: Geminiviridae Genus: Curtovirus	Viruses and viroids	Curtovirus (hoppers transmitted)	Quarantine pest (Annex II A)
11	*Eotetranychus lewisi*		EOTELE	Class: Arachnida Order: Acarida Family: Tetranychidae	Incests & Mites	Mite	Quarantine pest (Annex II A)
12	*Epitrix cucumeris*		EPIXCU	Class: Insecta Order: Coleoptera Family: Chrysomelidae	Insects & Mites	Flea beetle	Emergency measures
13	*Epitrix tuberis*		EPIXTU	Class: Insecta Order: Coleoptera Family: Chrysomelidae	Insects & Mites	Flea beetle	Emergency measures

(Continues)

TABLE 7 (Continued)

	Current scientific name	Synonyms/virus common names	EPPO code	Taxonomic information	Pest group	EKE cluster	EU_Qstatus
14	*Helicoverpa zea*		HELIZE	Class: Insecta Order: Lepidoptera Family: Noctuidae	Insects & Mites	Moths	Quarantine pest (Annex II A)
15	*Liriomyza huidobrensis*		LIRIHU	Class: Insecta Order: Diptera Family: Agromyzidae	Insects & Mites	Leafminers	PZ Quarantine pest (Annex III)
16	*Liriomyza sativae*		LIRISA	Class: Insecta Order: Diptera Family: Agromyzidae	Insects & Mites	Leafminers	Quarantine pest (Annex II A)
17	*Liriomyza trifolii*		LIRITR	Class: Insecta Order: Diptera Family: Agromyzidae	Insects & Mites	Leafminers	PZ Quarantine pest (Annex III)
18	*Orthotospovirus tomatomaculae* (tomato spotted wilt virus)*		TSWV00	Order: Bunyavirales Family: Tospoviridae Genus: Orthotospovirus	Viruses and viroids	Orthotospovirus (thrips transmitted)	RNQP (Capsicum, Solanum)
19	*Pospiviroid fusituberis**	Potato spindle tuber viroid	PSTVD0	Family: Pospiviroidae Genus: Pospiviroid	Viruses and viroids	Viroid (contact transmitted)	RNQP (Solanum)
20	*Ralstonia pseudosolanacearum*		RALSPS	Class: Betaproteobacteria Order: Burkholderiales Family: Burkholderiaceae	Bacteria	Ralstonia	Quarantine pest (Annex II A)
21	*Ralstonia solanacearum*		RALSSL	Class: Betaproteobacteria Order: Burkholderiales Family: Burkholderiaceae	Bacteria	Ralstonia	Quarantine pest (Annex II B)
22	*Spodoptera ornithogalli*		PRODOR	Class: Insecta Order: Lepidoptera Family: Noctuidae	Insects & Mites	Moths	Emergency measures
23	*Thrips palmi*		THRIPL	Class: Insecta Order: Thysanoptera Family: Thripidae	Insects & Mites	Thrips	Quarantine pest (Annex II A)

*According to ICTV rules (https://talk.ictvonline.org/information/w/faq/386/how-to-write-a-virus-name), common names of viruses are not italicised. The new binomial 'genus-species' format is adopted by the ICTV in 2021 and it is gradually implemented for viruses/viroids species.

4.4 | List of potential pests not further assessed (Reserve list)

From the list of pests not selected for further evaluation, the Panel highlighted 22 species (Appendix C) for which there is uncertainty on either: (a) the pest status in Costa Rica; or (b) if *Petunia* spp. or *Calibrachoa* spp. can be a host for the pest; or (c) if the pest could have impact.

5 | RISK MITIGATION MEASURES

For each selected pest for further evaluation, 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 the pest data sheets (see Appendix A).

5.1 | Possibility of pest presence in the export nurseries

For each selected pest listed in 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 infected/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 of Costa Rica (Dossier sections 1.0, 2.0, 3.0, 4.0 and 5.0), the Panel summarised the risk mitigation measures (Table 8) that are currently applied in the production nursery.

TABLE 8 Overview of the proposed risk mitigation measures for *Petunia* spp. and *Calibrachoa* spp. cuttings designated for export to the EU from Costa Rica.

	Risk mitigation measure	Proposed measures in Costa Rica
1	Growing plants in isolation	The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover.
2	Dedicated hygiene measures	Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection.
3	Treatment of growing media	The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.

(Continues)

TABLE 8 (Continued)

	Risk mitigation measure	Proposed measures in Costa Rica
4	Quality of source plant material	All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1 for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants.
5	Crop rotation	In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
6	Disinfection of irrigation water	Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
7	Treatment of crop during production	To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export.
8	Pest monitoring and inspections	Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop.
9	Sampling and testing	In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, 1 square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).
10	Official Supervision by NPPO	Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11).
11	Surveillance of production area	No details are given for the surveillance of any other possible pests/pathogens.

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 (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 5.3.1–5.3.12). The outcome of EKE on pest freedom after the evaluation of the proposed risk mitigation measures is summarised in the Section 5.3.13.

5.3.1 | Overview of the evaluation of *Aleurodicus dispersus*

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	9978 out of 10,000 bags	9990 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	10 out of 10,000 bags	22 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** The whitefly, *A. dispersus (Aleyrodidae)* is a highly polyphagous pest, common on a wide range of different plant families including Solanaceae. Due to its wide host range, *Petunia* spp. and *Calibrachoa* spp. can be suitable host plants. Local populations of *A. dispersus* can be present on host plant species in the neighbouring environment of the nursery producing *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings for export to the EU. Flying adults of *A. dispersus* could enter the nursery through defects in the insect proof screen or as hitchhiker on clothes of nursery staff from host plants that might be present in the surrounding environment. Also, as the eggs and early larval instars are often cryptic and very small, their detection upon visual inspection may not be easy, hence they may be present on the harvested unrooted cuttings. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material and considered pest free. *A. dispersus* could enter the nursery through unnoticed holes in the insect proof netting or through hitchhiking on nursery staff. The yellow sticky traps are not appropriate for monitoring *A. dispersus*. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** • Presence and distribution of host plants in the surroundings. • *A. dispersus* population pressure in the surrounding environment of the nursery. • Presence of unnoticed defects in the greenhouse structure. • The intensity and the design of the surveillance scheme.				

5.3.2 | Overview of the evaluation of beet curly top virus

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	9993 out of 10,000 bags	9996 out of 10,000 bags	9998 out of 10,000 bags	9999 out of 10,000 bags	10,000 out of 10,000 bags

(Continues)

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Proportion of infected bags	0 out of 10,000 bags	1 out of 10,000 bags	2 out of 10,000 bags	4 out of 10,000 bags	7 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** Beet curly top virus (BCTV) is widespread in Costa Rica (Dossier Section 3.0). The natural host range of BCTV is extremely wide as it can infect more than 300 dicotyledonous species in 44 botanical families, including *Petunia* spp. and several other species of the Solanaceae family. In nature, the major insect vector of BCTV is the leafhopper species *Neoaliturus tenellus* (synonym *Circulifer tenellus* EFSA PLH Panel, 2017), while *C. opacipennis* and *C. haematoceps* have also been reported as vectors. The virus is present in Costa Rica and reported to infect host plants despite leafhopper vectors are not reported to be present in Costa Rica. The main pathway of entry into the nursery from the surrounding environment is by yet unreported leafhoppers that can carry the virus. The virus can enter the nursery with infected starting material. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material. BCTV is not included in the certification scheme applied, however the certified material is expected to be free of symptoms. The leafhopper vectors could enter the nursery through unnoticed holes in the insect proof netting. During production no testing is performed for BCTV. However, if hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the virus is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – No information on the possible presence of the vectors in the country. – The presence of defects in the greenhouse structure. – There is no detailed information on inspection frequency and design prevalence.				

5.3.3 | 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** Euphorbia mosaic virus (EuMV), pepper golden mosaic virus (PepGMV), squash leaf curl virus (SLCV), tomato golden mosaic virus (TGMV), tomato leaf curl Sinaloa virus (ToLCSiV) and tomato yellow leaf curl virus (TYLCV) are reported to be present in Costa Rica (PepGMV is the only one reported with restricted distribution). For ToLCSiV and TYLCV Petunia spp. is reported as a natural host, while for TGMV as experimental host. *Bemisia tabaci*, the vector of begomoviruses, is reported to be present in Costa Rica, and widespread according to the NPPO of the country. The main pathway of entrance of the virus from the surrounding environment in the nursery is through viruliferous *B. tabaci* adults.				

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	Pest control measures applied during production The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material. Begomoviruses are not included in the certification scheme applied, however the certified material is expected to be free of non-EU begomoviruses. The vector *B. tabaci* could enter the nursery through unnoticed holes in the insect proof netting or through hitchhiking on nursery staff. Inspection of plants is unlikely to detect begomovirus-associated symptoms in the early stage of infection. No testing is performed for any begomovirus during production of cuttings. There are measures in place that control the vector *B. tabaci* (monitoring, insecticide treatment) which would control spread of begomovirus. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the virus is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – No details were provided about the results of surveillance activities on the presence and population pressure of *B. tabaci* and begomoviruses in the neighbouring environment of the nursery. – The presence of defects in the greenhouse structure. – The efficacy of detecting individuals of *B. tabaci*.

5.3.4 | 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	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	54 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *B. tabaci* is a polyphagous whitefly (Aleyrodidae) present in Costa Rica and the biotypes Med, MEAM1 and New World 1 are reported from Costa Rica to infest many plant host species. Certain *Petunia* spp. (*P. axillaris*, *P. grandiflora*, *P. integrifolia*, *P. hybrida*) and *Calibrachoa* spp. are reported as host plants for *B. tabaci*. 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 and can enter the production greenhouse through defects in the greenhouse structure or through hitchhiking on nursery workers. Eggs and first instar larvae are difficult to detect and may be present on the harvested cuttings. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area.				

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	Evaluation of control measures The mother plants used for the production of unrooted cuttings are derived from imported certified material and considered pest free. *B. tabaci* could enter the nursery through unnoticed holes in the insect proof netting or through hitchhiking on nursery staff. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – *B. tabaci* population pressure in the surrounding environment of the nursery. – The level of resistance of *B. tabaci* populations in Costa Rica against the listed insecticides. – Presence of unnoticed defects in the greenhouse structure. – Presence and distribution of host plants of *B. tabaci* in the surroundings.

5.3.5 | Overview of the evaluation of *Eotetranychus lewisi*

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** The spider mite *E. lewisi (Acarida)* is a highly polyphagous pest and it is reported to be present in Costa Rica. 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* spp./*Calibrachoa* spp. could be suitable host plants. 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. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material and considered pest free. Mites could be present on other host plants present in the nursery. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – Pressure of *E. lewisi* and the presence and distribution of host plants in the surroundings. – The presence of defects in the greenhouse structure. – The intensity and the design of the surveillance scheme.				

5.3.6 | 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

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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
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** The flea beetles *E. cucumeris* and *E. tuberis* (Chrysomelidae) are present in Costa Rica. The main host of *E. cucumeris* and *E. tuberis* is potato (*Solanum tuberosum*), but they have also been reported on many other Solanaceae plants, like several species of the genera *Solanum*, *Lycopersicum*, *Nicotiana* and *Capsicum*. *E. cucumeris* and *E. tuberis* are reported as pest of *Petunia* spp. but not as pest of *Calibrachoa* spp. plants, however the Panel assumes that both plant genus are likely host plants of these two insects. 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. Adults of *E. tuberis* instead can fly and their dispersal capacity could be higher. 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. *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. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material and considered pest free. *Epitrix* fleabeetles could enter the nursery through unnoticed holes in the insect proof netting or be introduced on other host plants into the nursery. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – 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. – The presence of defects in the greenhouse structure. – There is no detailed information on inspection frequency and design prevalence.				

5.3.7 | 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** The three leafminer species *Liriomyza huidobrensis* (Blanchard), *L. sativae* (Blanchard), and *L. trifolii* (Burgess) (Diptera: Agromycidae) are present in Costa Rica and are highly polyphagous. *Petunia* spp. and other solanaceous plants such as tomato and pepper are reported to be hosts. It is possible that local populations of leafminers are present in the neighbouring environment from which adults can spread over short distances through flight or wind assisted dispersal through defects in the greenhouse structure. When present in the greenhouse, flying adults can spread from infested host plants species within the nursery. Eggs and feeding larvae may be present inside leaves of harvested unrooted cuttings. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis.				

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	Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material and considered pest free. Lyriomyza flies could enter the nursery through unnoticed holes in the insect proof netting or be introduced on other host plants into the nursery. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – Presence and distribution of host plants of leafminers in the surroundings. – Leafminers population pressure in the surrounding environment of the nursery. – The presence of unnoticed defects in the greenhouse structure. – There is no detailed information on inspection frequency and design prevalence.

5.3.8 | **Overview** of the evaluation of moths

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** *Helicoverpa zea*, *Chloridea virescens* and *Spodoptera ornithogalli* are highly polyphagous moths (Lepidoptera: Noctuidae). The three moth species are present in Costa Rica (EPPO, online). *C. virescens* and *S. ornithogalli* are reported on *Petunia* spp. or *Calibrachoa* spp. 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. The three moth species could be present on host plant crops cultivated in the area where the export nurseries are located. It is possible that mated females are present near the 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. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material and considered pest free. Moths need quite large holes in the insect proof netting to be able to enter the nursery. The yellow sticky traps are not appropriate for monitoring moths; there are no moth specific (pheromone) traps used in the monitoring system in the nursery. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – No details were provided about the results of surveillance activities on the presence and population pressure of the three moths in the neighbouring environment of the nursery. – The presence of defects in the greenhouse structure. – There is no detailed information on inspection frequency and design prevalence.				

5.3.9 | Overview of the evaluation of potato spindle tuber viroid

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	9982 out of 10,000 bags	9994 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	6 out of 10,000 bags	18 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** Potato spindle tuber viroid (PSTVd) is present in Costa Rica. *Petunia* spp. and *Calibrachoa* spp. including numerous solanaceous species are reported to be hosts of PSTVd. PSTVd can be experimentally transmitted by contact and cutting tools. In addition, PSTVd can spread by vegetative propagation and transmission via seeds. Furthermore, horizontal transmission through infected pollen has been documented for PSTVd. PSTVd spread via contact can also be facilitated by insects. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** While the imported material from Germany is PSTVd-free and propagated plants are inspected for symptoms and tested for a range of viruses, there is no PSTVd testing programme in place for the propagated material. As PSTVd does not elicit symptoms on petunia there is no mean of controlling PSTVd spread in the greenhouses, should a plant become infected. No other 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 cuttings. **Main uncertainties** – Infection (PSTVd) pressure in the environment of the nursery (presence and distribution of host plants in the surroundings). – The presence of defects in the greenhouse structure. – There is no detailed information on inspection frequency and design prevalence for viroids.				

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	9929 out of 10,000 bags	9968 out of 10,000 bags	9982 out of 10,000 bags	9989 out of 10,000 bags	9999 out of 10,000 bags
Proportion of infested bags	1 out of 10,000 bags	11 out of 10,000 bags	18 out of 10,000 bags	32 out of 10,000 bags	71 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *R. solanacearum* and *R. pseudosolanacearum* are soil-borne bacteria present in Costa Rica. *R. solanacearum* is indicated as endemic pathogen in rainforest (Coto valley, southwest Costa Rica) (Blomme et al., 2017). They are transmitted by contaminated soil, irrigation water, tools and infected plant materials. Bacteria enter the plants usually by root and stem injuries and colonise the xylem vessels. *R. solanacearum* and *R. pseudosolanacearum* have a wide host range including solanaceous host plants, and therefore the Panel assumes that *Petunia* spp./*Calibrachoa* spp. could be a natural host for *R. pseudosolanacearum*. It is probable that isolates of *R. pseudosolanacearum* were identified as *R. solanacearum* before 2017. Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. can be systemically infected. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis.				

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	Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** No tests specific to *R. solanacearum* and *R. pseudosolanacearum* are reported to be performed during the production process and before export. Visual inspection of the crop could detect symptoms of *Ralstonia* spp., however due to the long latent period some infections may go undetected. **Main uncertainties** – There is no information if irrigation water is tested for *Ralstonia* spp. – The presence of defects in the greenhouse structure. – There is no detailed information on inspection frequency and design prevalence.

5.3.11 | Overview of the evaluation of *Thrips palmi*

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	9978 out of 10,000 bags	9990 out of 10,000 bags	9995 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	5 out of 10,000 bags	10 out of 10,000 bags	22 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *T. palmi* (Thysanoptera) is reported to be widespread and under official control in Costa Rica (Dossier Section 3.0) and given the wide host range of this pest it is possible that local populations are present in the neighbouring environment of the greenhouses with *Petunia* spp./*Calibrachoa* spp. plants destined for the production of unrooted cuttings for the export. The pest is very small and could enter the production greenhouse through defects in the greenhouse structure or through hitchhiking on nursery workers. Eggs and early stages of the insect are difficult to detect and may be present on the harvested cuttings. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material and considered pest free. *T. palmi* could enter the nursery through unnoticed holes in the insect proof netting or be introduced or on other host plants into the nursery. The yellow sticky traps are not appropriate for monitoring *T. palmi*. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – No details were provided about the results of surveillance activities on the presence and population pressure of *T. palmi* in the neighbouring environment of the nursery. – The presence of defects in the greenhouse structure. – There is no detailed information on inspection frequency and design prevalence.				

5.3.12 | 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** The thrips transmitted tomato spotted wilt virus (TSWV) is present in Costa Rica. TSWV infects *Petunia* spp., tomato, pepper and potato in nature, but there are no records that *Calibrachoa* spp. are hosts. *Frankliniella occidentalis,* the most efficient vector of TSWV is present in Costa Rica. TSWV can also be very efficiently transmitted by *Thrips tabaci* populations, which are also present in Costa Rica. Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. can be infected by TSWV and/or infested by viruliferous thrips. **Pest control measures applied during production** The mother plants used for the production of cuttings to be exported originate from certified plant material (Elite) imported from Germany and are grown in dedicated officially approved greenhouses, protected with thrips-proof netting. There are hygienic measures in place for nursery workers entering the production unit. All greenhouses have double doors. Daily scouting is conducted by nursery staff and sticky traps are used to monitor insects inside the greenhouses. Routine monitoring is carried out to detect the presence of symptomatic plants every week. If no symptom is observed, random samples are taken for analysis. Nurseries exporting plants for planting consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. Inspections, biological control and the use of pesticides are implemented during the growing period and prior to export. For viruses sampling and testing (ELISA) are carried out for CMV, TMV, ToMV, RMV, Tospoviruses, Potyviruses, TMGMV, CBMV. In general, the tests are carried out in the companies' own laboratories or in universities laboratories. In the case of a positive finding the affected area is quarantined, 1 m^2 around is discarded and more tests are done on the periphery, in addition to disinfecting the area. **Evaluation of control measures** The mother plants used for the production of unrooted cuttings are derived from imported certified material. TSWV is included in the certification scheme applied (in Tospoviruses test), therefore the certified material is expected to be pest free. The thrips vectors could enter the nursery through unnoticed holes in the insect proof netting or through hitchhiking on nursery staff. Inspection of plants is unlikely to detect TSWV-associated symptoms. Testing is performed for TSWV during production of cuttings. There are measures in place that control thrips (monitoring, insecticide treatment) which would control spread of TSWV. If hygiene measures, inspections and pesticide applications during the growing period and prior to export are implemented correctly, it is unlikely that the virus is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings. **Main uncertainties** – The efficiency of detecting early thrips infestations and virus presence, especially in low infection levels. – The intensity and the design of surveillance scheme for thrips and TSWV (if any). – Infection (TSWV) and infestation (thrips) pressure in the environment of the nursery (presence and distribution of host plants in the surroundings).				

5.3.13 | Outcome of expert knowledge elicitation

Table 9 and Figure 8 show the outcome of the EKE regarding pest freedom after the evaluation of the currently proposed risk mitigation measures for the selected pests.

Figure 9 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 9 Assessment of the likelihood of pest freedom following evaluation of current risk mitigation measures against the evaluated pests *Aleurodicus dispersus*, beet curly to virus, begomoviruses (euphorbia mosaic virus, pepper golden mosaic virus, squash leaf curl virus, tomato golden mosaic virus, tomato leaf curl Sinaloa virus, tomato yellow leaf curl virus), *Bemisia tabaci*, Eotetranychus lewisi, leafminers (*Liriomyza huidobrensis, L. sativae, L. trifolii*), moths (*Helicoverpa zea*, *Chloridea virescens, Spodoptera ornithogalli*), tomato spotted wilt virus, potato spindle tuber viroid, *Ralstonia* spp. (*R. solanacearum, R. pseudosolanacearum*), *Thrips palmi* 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 panels A and 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	Insect	*Aleurodicus disperses*						**L**		**MU**
2	Virus and viroid	Beet curly top virus							**L**	**MU**
3	Virus and viroid	Begomoviruses						**L**	**M**	**U**
4	Insect	*Bemisia tabaci*					**L**		**M**	**U**
5	Mite	*Eotetranychus lewisi*						**L**	**M**	**U**
6	Insect	*Epitrix* spp.								**LMU**
7	Insect	Leafminers						**L**	**M**	**U**
8	Insect	Moths							**L**	**MU**
9	Virus and viroid	Potato spindle tuber viroid					**L**		**M**	**U**
10	Bacteria	*Ralstonia* spp.					**L**	**M**		**U**
11	Insect	*Thrips palmi*						**L**	**M**	**U**
12	Virus and viroid	Tomato spotted wilt virus					**L**	**M**		**U**

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

PANEL B

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

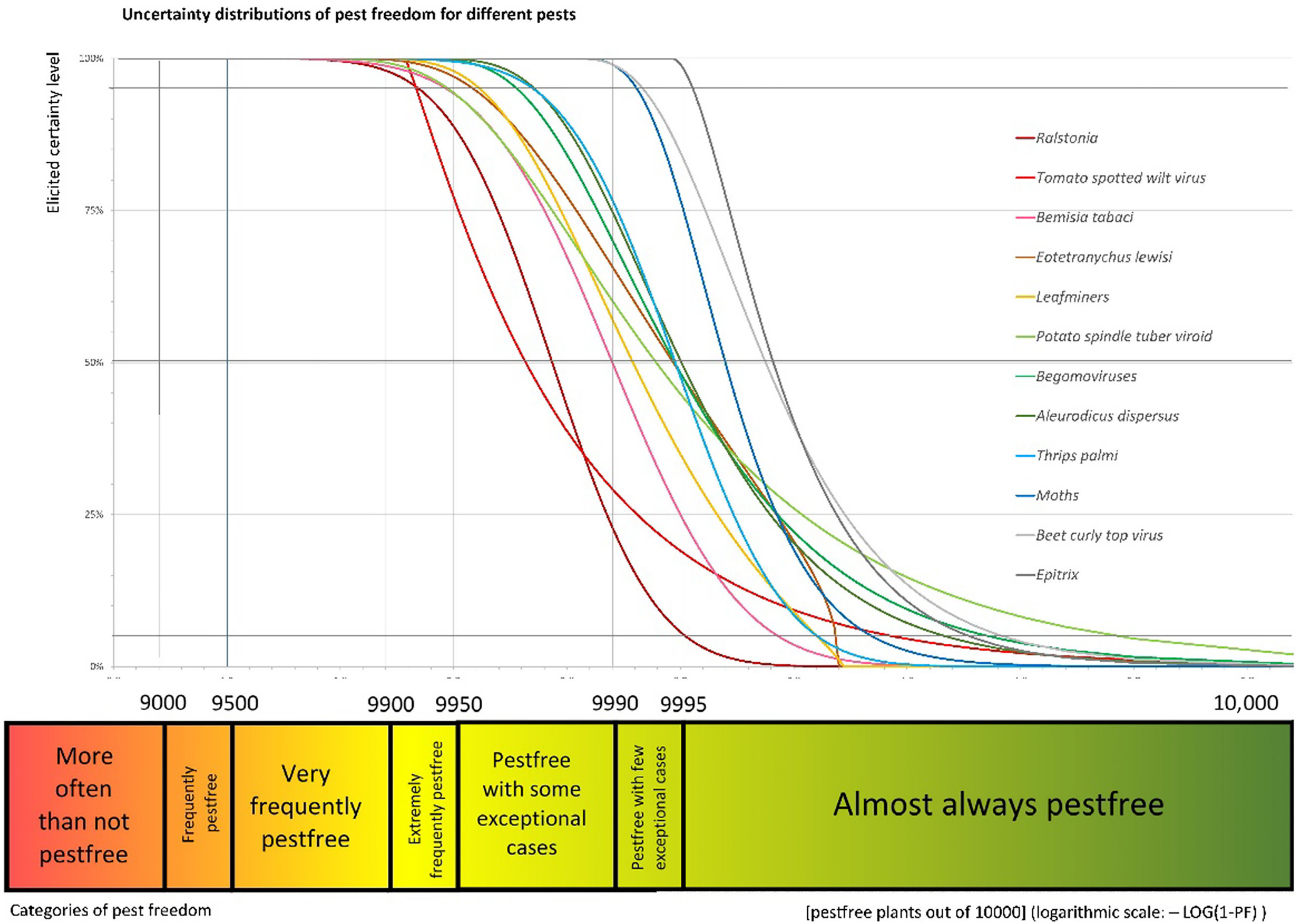

FIGURE 8 Elicited certainty (*y*-axis) of the number of pest-free *Petunia* spp. and *Calibrachoa* spp. bags (*x*-axis; log-scaled) out of 10,000 bags designated for export to the EU introduced from Costa Rica for all evaluated pests visualised as descending distribution function. Horizontal lines indicate the percentiles (starting from the bottom 5%, 25%, 50%, 75%, 95%).

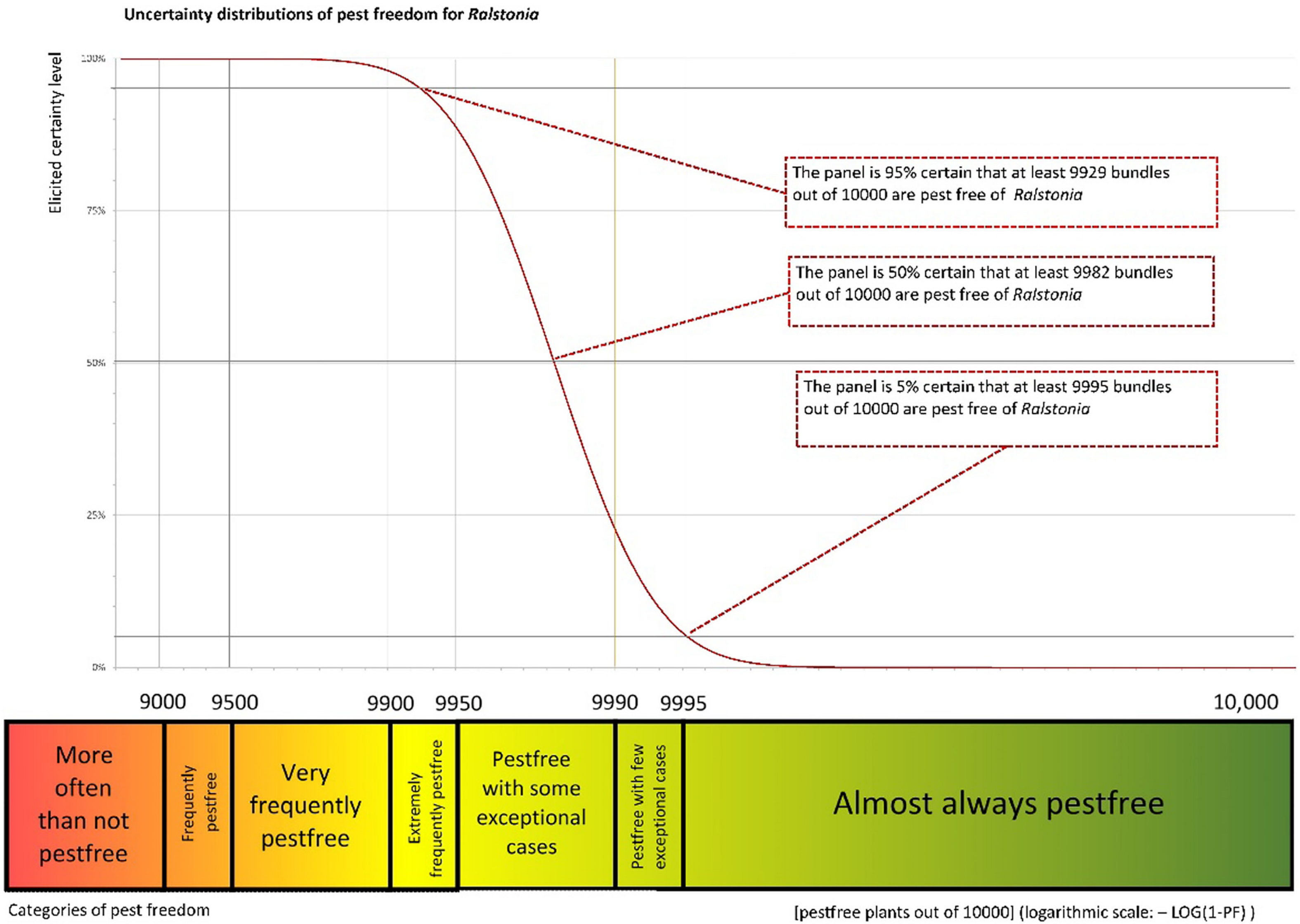

FIGURE 9 Explanation of the descending distribution function describing the likelihood of pest freedom after the evaluation of the currently proposed risk mitigation measures for plants designated for export to the EU based on the example of *Ralstonia* spp.

6 | CONCLUSIONS

There are 23 pests identified to be present in Costa Rica and considered to be potentially associated with unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. imported from Costa Rica and relevant for the EU. The likelihood of 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.

For *Aleurodicus dispersus*, 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 Expert Knowledge Elicitation indicated, with 95% certainty, that between 9978 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *A. dispersus*.

For beet curly top virus, 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 Expert Knowledge Elicitation indicated, with 95% certainty, that between 9993 and 10,000 bags containing unrooted cuttings per 10,000 will be free from the selected aphid transmitted viruses.

For the selected begomoviruses (euphorbia mosaic virus, pepper golden mosaic virus, squash leaf curl virus, tomato golden mosaic virus, tomato leaf curl Sinaloa virus and 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 containing unrooted cuttings per 10,000 will be free from the selected begomoviruses.

For *Bemisia tabaci*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with some exceptional case' 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 *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 the selected leafminers species.

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

For the selected leafminers (*L. 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 the selected moths (*H. zea, C. virescens and 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 moth species.

For potato spindle tuber viroid, 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 9947and 10,000 bags containing unrooted cuttings per 10,000 will be free from potato spindle tuber viroid.

For *Ralstonia* species complex (*R. solanacearum, R. pseudosolanacearum*), 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 9929 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *Ralstonia* species complex.

For *T. palmi*, 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 Expert Knowledge Elicitation indicated, with 95% certainty, that between 9978 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *T. palmi*.

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 containing unrooted cuttings per 10,000 will be free from tomato spotted wilt virus.

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

APHA	Animal and Plant Health Agency
CABI	Centre for Agriculture and Bioscience International
DEFRA	Department for Environment Food and Rural Affairs
EKE	expert knowledge elicitation
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
ISPM	International Standards for Phytosanitary Measures
NPPO	National Plant Protection Organisation
PLH	Plant Health
PRA	Pest Risk Assessment
PZQPs	Protected Zone Quarantine Pests
RNQPs	Regulated Non-Quarantine Pests

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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 | *ALEURODICUS DISPERSUS*

A.1.1 | Organism information

Taxonomic information	Current valid scientific name: *Aleurodicus dispersus* (Russell, 1965) [ALEDDI] Name used in the EU legislation: *Aleurodicus dispersus* Common name: Spiralling whitefly Class: Insecta Order: Hemiptera Family: Aleyrodidae	
Regulated status	*A. dispersus* is not regulated in the EU and it is not included in the Commission Implementing Regulation (EU) 2019/2072. Formerly in EPPO Alert List (2000–2006)	
Host status on *Petunia* spp. and *Calibrachoa* spp.	*A. dispersus* is a highly polyphagous insect, common on a wide range of different plant families including ornamentals, fruit trees and annual crops, including Solanaceae but it has not been reported to feed either on *Petunia* spp. or on *Calibrachoa* spp. plants (CABI, online; EPPO, online). Given the wide host range including Solanaceae the Panel assumes that *Petunia* spp. and *Calibrachoa* spp. can be a suitable host plant. Uncertainties: The host status of *Petunia* spp. and *Calibrachoa* spp. to *A. dispersus*	
Pest status in Costa Rica	Present, no details (CABI, online; EPPO, online)	
Pest status in the EU	Present in Madeira of Portugal and Canary Islands of Spain (CABI, online; EPPO, online)	
Risk assessment information	No Pest risk analysis have been conducted for *A. dispersus*	
Other relevant information for the assessment		
Biology	Females begin to lay their eggs at the day of emergence and continue throughout their lifetime. The eggs along with numerous tiny waxy secretions, are deposited usually on the underside of leaves, in both regular and irregular spiralling patterns (Jayma et al., 1993; Tsatsia & Jackson, 2021). The spiralling of waxy material is the feature from which this whitefly derives its common name. The larvae hatch after 7–10 days and they develop through four instars (CABI, online; Jayma et al., 1993; Tsatsia & Jackson, 2021). The first instar is called 'crawler' and it is the only immature stage with functional legs and distinct antennae. It moves to find a suitable place on the leaf surface to settle, usually to the leaf veins (Jayma et al., 1993; Tsatsia & Jackson, 2021). The other immature stages are sedentary. The larvae exude characteristic waxy tufts on the anterior part of their body. The third instar produces glass-like waxy rods along the sides of its body, which may grow to a length of 8 mm although most are shorter because they break before reaching this length. The fourth instar is called puparium. This stage feeds at first and then stops, undergoes internal changes, before adult emergence (Jayma et al., 1993; Tsatsia & Jackson, 2021). The immature development lasts from 16 to 38 days depending on temperature and the adults live from 14 to 39 days (CABI, online; Jayma et al., 1993; Tsatsia & Jackson, 2021). Fecundity is about 60 eggs per female (Balikai and Pushpalatha, 2018). Unmated females produce only male offspring while mated females produce both sexes. The adults disperse by flying and they are most active during the morning hours (Jayma et al., 1993). Cool and rainy weather is not favourable for the insect while its population increases when the weather is warm and dry (Aishwariya et al., 2007; Tsatsia & Jackson, 2021). The insect may become very abundant during droughts when its natural enemies decline (Tsatsia & Jackson, 2021).	
Symptoms	**Main type of symptoms**	Adults and larvae of the whitefly cause damage by their direct feeding on plant sap. The insect infestation may cause premature leaf drop, yellowing of leaves and reduce yield in crops. Yellow speckling, crinkling and curling of the leaves have also been reported. Plants may also be disfigured and become unmarketable. The honeydew excreted by the larvae causes the growth of sooty mould on leaf surfaces, reducing the photosynthetic capacity of the plants. The white, waxy material secreted by larvae may also spread elsewhere by wind causing nuisance (Balikai and Pushpalatha, 2018; Chin et al. 2008; EPPO, 2006; Ramani et al., 2002). *A. dispersus* has also been reported as a vector of more than 25 different diseases. (CABI, online).
	Presence of asymptomatic plants	No asymptomatic plants are known to occur. However, because eggs and early larval instars are often cryptic (CABI, online) and very small their detection upon visual inspection may not be easy.
	Confusion with other pathogens/pests	*A. dispersus* is closely related to other species of the genus (*A. coccolobae and A. flavus*). Reliable identification requires microscopic study of slide-mounted puparium. Confusion also may occur with other species of this genus which also lay their eggs in spiral patterns.
Host plant range	*A. dispersus* is a highly polyphagous species and its host list includes 481 plant species belonging to 295 genera from 90 families (Boopathi et al., 2014). Among them there are many vegetable, ornamental and fruit crops, as well as numerous trees and shrubs. Major host plants with high economic importance are *Capsicum*, *Citrus*, *Cocos nucifera* (coconut), *Euphorbia pulcherrima* (poinsettia), *Glycine max* (soybean), *Hibiscus*, *Lycopersicon esculentum* (tomato), *Mangifera indica* (mango), *Musa* (banana), *Persea americana* (avocado), *Prunus* spp., *Psidium guajava* (guava), *Solanum melongena* (aubergine) (EPPO, 2006).	

(Continues)

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What life stages could be expected on the commodity	Eggs, larvae and adults may be present on the unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp.
Evidence of impact of non-regulated pest	This whitefly is a quarantine pest in several countries.
Surveillance information	No information

A.1.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation:** The thrips-proof netting should prevent the introduction of this whitefly from the surrounding environment. However, *A. dispersus* adults may be introduced through defects in the greenhouse. **Uncertainties:** Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: The double door system can be effective in preventing the entry of *A. dispersus* via active flying. Changing clothes prevents also the entrance of whiteflies via hitchhiking. **Uncertainties**: none.
Treatment of growing media	N	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1 for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: The probability that *A. dispersus* is present on the certified starting material from the EU is negligible. **Uncertainties**: none.

(Continued)

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Crop rotation	N	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation**: The products used may also have an effect on populations of *A. dispersus*. **Uncertainties**: The efficacy of the plant protection products against the specific insect pest is not known.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: Populations of whiteflies are monitored through yellow sticky traps and the presence of the pest in the nursery may be detected at an early stage. **Uncertainties**: /
Sampling and testing	N	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, one square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).

(Continues)

(Continued)

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: Inspections for *Bemisia tabaci* may help in the detection of populations of *A. disperses* **Uncertainties**: The awareness of the staff for the specific pest is unknown
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any other possible pests/pathogens. **Evaluation**: There is no information on the pest pressure in the surrounding environment. **Uncertainties**: There is no information on the pest pressure in the surrounding environment.

A.1.3 | Information from interceptions

There are no interceptions of *A. dispersus* from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.1.4 | Possibility of pest presence in the nursery

A.1.4.1 | Possibility of entry from the surrounding environment

A. dispersus is a pest of many plants belonging to 90 families and it is reported to be present in Costa Rica. Given the wide host range of this pest it is possible that local populations of *A. dispersus* may be present in the neighbouring environment. Flying adults of *A. dispersus* and young first instar crawlers, can enter the nursery through defects in the insect proof screen or as hitchhiker on clothes of nursery staff from host plants that might be present in the surrounding environment.

<u>Uncertainties</u>

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

A.1.4.2 | Possibility of entry with new plants/seeds

- The certified plant material used to start a new production cycle of *Petunia* spp. is not an introduction pathway for *A. dispersus*.

<u>Uncertainties</u>

None.

A.1.4.3 | Possibility of spread within the nursery

Other solanaceous and non-solanaceous host plants could be present in the same nursery. When present, flying adults searching for food sources can spread from infested host plants species within the nursery. *Petunia* spp. plants for export are produced in a separate unit with hygienic standards (thrips-proof netting, double doors, clean uniforms) with no mixing with the other ornamentals. It is unlikely that whiteflies can spread to the production unit of *Petunia* spp. plants if all hygienic standards are correctly applied.

<u>Uncertainties</u>: The presence of other ornamental host plants of *A. dispersus* other than *Petunia* spp. and *Calibrachoa* spp. that are grown in the nursery.

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 *A. dispersus* adults is limited.
- Low population pressure of *A. dispersus* in the surrounding environment, due to the limited presence of preferred host plants.
- Greenhouse structure is thrips-proof and entrance of whiteflies is 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 *A. dispersus*.
- At harvest and packing, cuttings with symptoms will be detected.

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

- *A. dispersus* is present throughout Costa Rica and they have a wide host range, mainly Solanaceae plants, therefore it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *A. dispersus* is present and abundant (e.g. *Citrus*).
- Presence of *A. dispersus* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *A. dispersus*.

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

- The protective effect of the greenhouse structure and hygienic measures.

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 *A. dispersus* in the surrounding environment.

A.1.6 | Elicitation outcomes of the assessment of the pest freedom for *Aleurodicus dispersus*

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 *A. dispersus* 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		10					50
EKE	0.0633	0.164	0.341	0.717	1.26	2.01	2.86	4.96	7.94	10.1	13.0	16.8	22.0	27.1	34.0

Note: The EKE results is the *BetaGeneral* (0.966, 1330.8, 0, 10,000) 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 *A. dispersus* per 10,000 bags 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	9950					9990		9995		9998					10,000
EKE results	9966	9973	9978	9983	9987	9990	9992	9995	9997	9998.0	9998.7	9999.3	9999.7	9999.8	9999.9

Note: The EKE results are the fitted values.

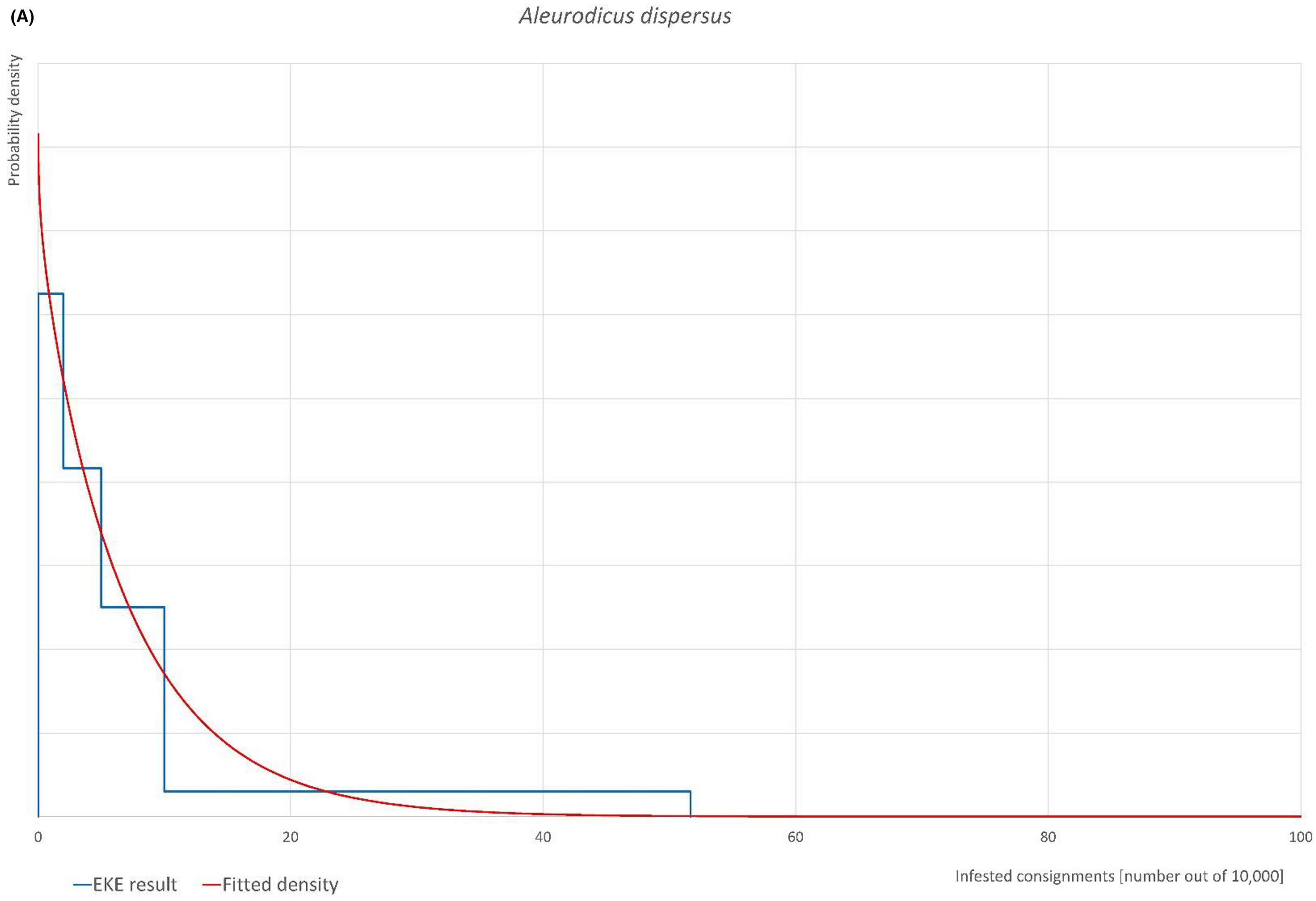

FIGURE A.1 (Continued)

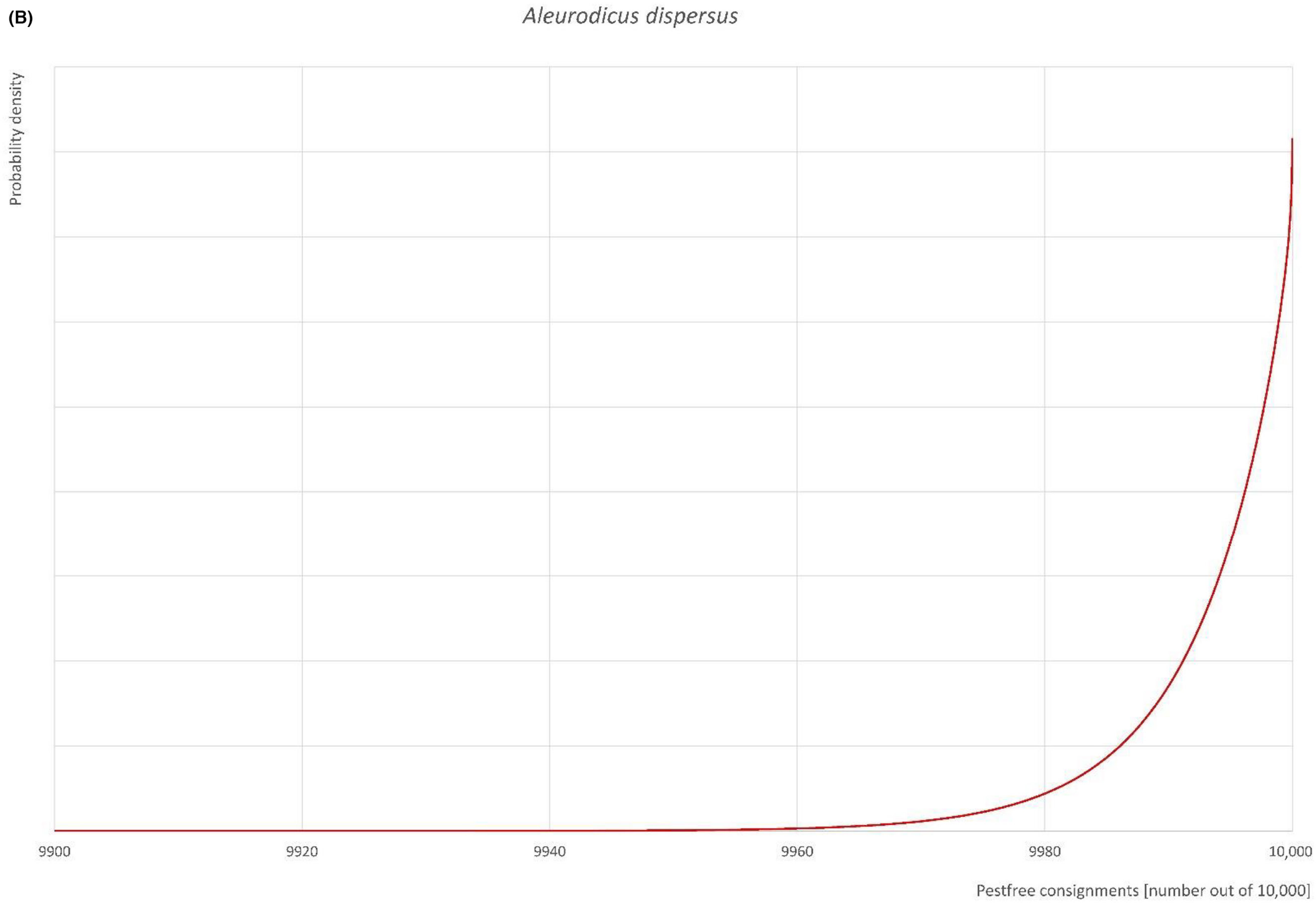

FIGURE A.1 (Continued)

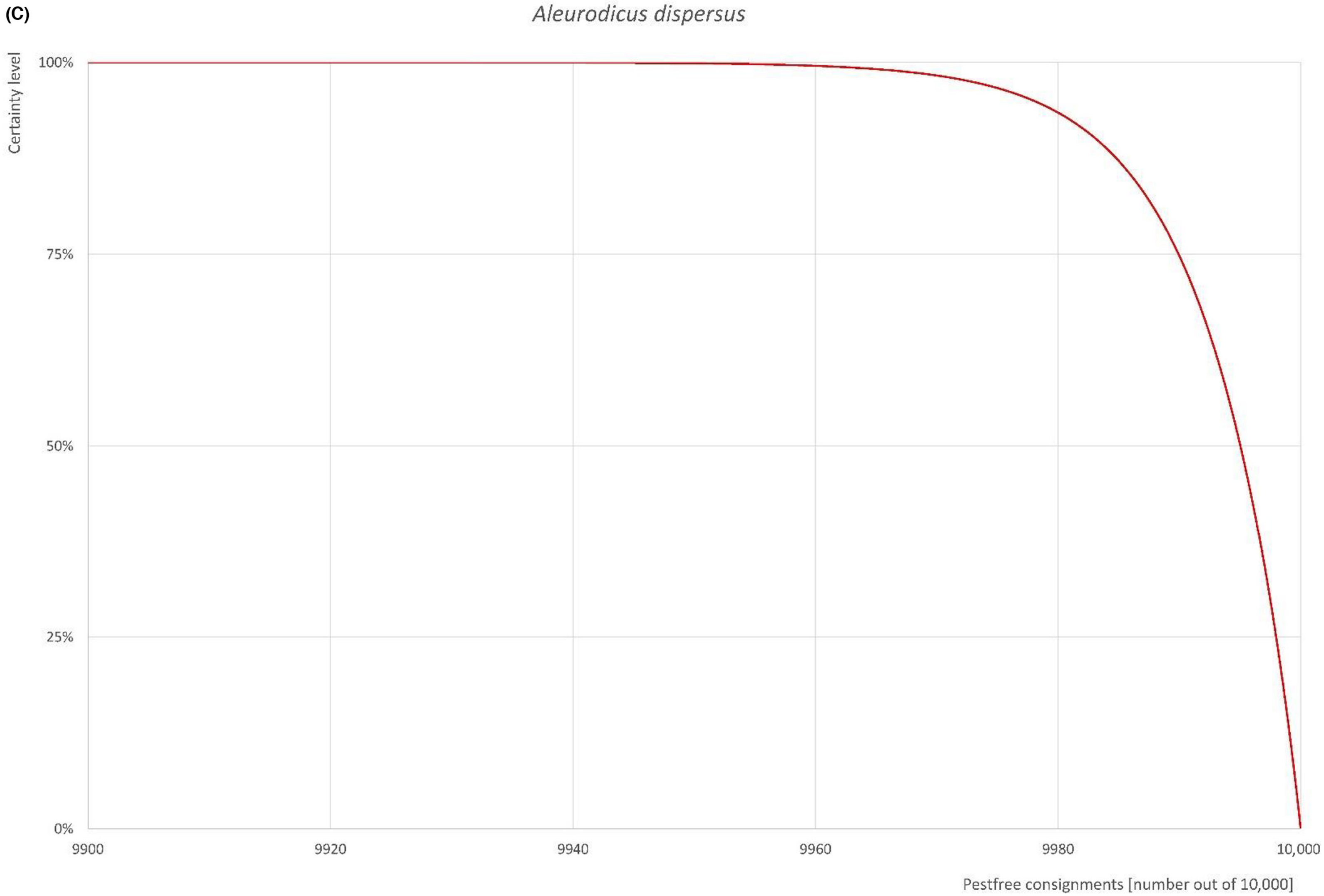

FIGURE A.1 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *A. dispersus* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty 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.

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A.2 | BEET CURLY TOP VIRUS

A.2.1 | Organism information

Taxonomic information	Current valid scientific name: *Curtovirus betae* [BCTV00] Synonyms: Beet curly top virus; Beet curly top curtovirus; Beet mild curly top virus; Beet severe curly top virus; Pepper curly top virus; Pepper yellow dwarf virus; Potato green dwarf virus; Spinach curly top virus; Sugarbeet curly-leaf virus; Sugarbeet virus 1; Tomato yellows virus; Western yellow blight virus; Beet curly top geminivirus; beet curly top hybrigeminivirus; BCTV (CABI, EPPO; online) Name used in the EU legislation: Beet curly top virus Common name: beet curly top; curly top of beet; potato green dwarf; sugar beet curly top; sugar beet curly-leaf; tomato yellows Kingdom: Viruses and viroids Order: Geplafuvirales Family: Geminiviridae Genus: Curtovirus (International Committee on Taxonomy of Viruses, https://ictv.global/report/chapter/geminiviridae/geminiviridae/curtovirus)
Regulated status	Beet curly top virus is regulated as a quarantine pest not known to occur in the union territory. Commission Implementing Regulation (EU) 2019/2072, *ANNEX II, Part A*.
Pest status in Costa Rica	Present (CABI, EPPO; online).
Pest status in the EU	EU regulated pest.
Host status on *Petunia* spp.	*Petunia* spp. plants are hosts of beet curly top virus (Anabestani et al., 2017).
Host status on *Calibrachoa* spp.	There are no records that *Calibrachoa* spp. plants are hosts of beet curly top virus. Uncertainties: the host status of *Calibrachoa* spp. to beet curly top virus.
PRA information	There are no available Pest Risk Assessments.
Other relevant information for the assessment – Pest categorisation of Beet curly top virus (non-EU isolates) (EFSA PLH Panel, 2017). – Pest survey card on Beet curly top virus (EFSA, 2023). – Beet curly top virus. EPPO datasheets on pests recommended for regulation (EPPO, 2024).	
Biology	Beet curly top virus (BCTV) was originally described in affected sugar beets in Iran (Bennett, 1971), and since then the virus spreads in Canada, Mexico, the United States of America, Costa Rica, Argentina, Bolivia, Uruguay, India, Iran, Japan, Cote d'Ivoire, Egypt, Türkiye, Cyprus and Italy (EPPO, 2024). However, the records of BCTV in Cyprus and Italy are old and the virus was not detected again in these countries. Therefore, it may be considered that the virus is absent from the EU territory (EFSA, 2023). The virus belongs to the *Curtovirus* genus and its virions are twinned (geminate) incomplete icosahedra with a single coat protein. Its genome consists of a single stranded, circular DNA segment (NC_001412, 2994 bp) that encodes seven ORFs, three in the viral sense strand and four in the complementary strand. The viral sense strand contains the coat protein gene (*CP*, V1 ORF), the movement protein gene (*MP*, V2 ORF) and a regulatory gene (*Reg*, V3 ORF). The replication-associated protein gene (*Rep*, C1 ORF), a gene expressing a protein with silencing suppressor functions (*ss*, C2 ORF), the replication enhancer gene (*REn*, C3 ORF) and a symptom determinant gene (*sd*, C4 ORF) (Stenger et al., 1990; Varsani et al., 2014).

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	In nature, the major insect vector of BCTV is the leafhopper species *C. tenellus*, while *C. opacipennis* and *C. haematoceps* have also been reported as vectors (EPPO Global Database; Kheyri, 1969; Taheri & Behjatnia, 2012; Thomas & Mink, 1979). The virus is transmitted in a circulative, persistent, non-propagative manner. The leafhoppers can acquire the virus after 1 h of feeding on infected plants and they can retain the virus for up to 30 days (Soto & Gilbertson, 2003). Finally, BCTV is difficult to be transmitted by mechanical means, however seed transmission was recorded on Petunia spp. plants infected with a BCTV clone through Agrobacterium-mediated inoculation (Anabestani et al., 2017)	
Symptoms	**Main type of symptoms**	The appearance of symptoms varies according to the host, the viral isolate and the environmental conditions. However, in the majority of the hosts, BCTV is responsible for the curly top disease (CTD). In sugar beet, BCTV affected plants exhibit vein-clearing, upward and inward leaf rolling, vein swelling and galling, and roughened lower leaf surface. Occasionally droplets are exuded from petioles, midribs and veins on the lower leaf surface. In roots, the virus induces an increased number of rootlets resulting in a hairy or woolly condition of the roots. Finally, in transverse sections of the roots, phloem necrosis is observed as dark concentric rings. In tomato plants severe curly top symptoms are observed upon BCTV infection. During early infection, leaves show a downward curling and drooping followed by the development of purple veins and yellowing. Plants are stunted, fruits ripen prematurely and stems become hollow due to breakdown of the pith. Finally, plants turn brown and die. In potato BCTV induces curly top symptoms with rolling of the upper leaves, dwarfing and yellowing. Outer leaflets remain green, while the rest of the leaflet turns yellow. Aerial tubers may form. BCTV affected pepper plants show severe yellowing, upward leaf rolling, while they produce smaller leaves and a few deformed fruits. The virus-infected bean plants show curling, yellowing of leaves and pods are distorted. BCTV positive *Petunia* spp. plants exhibit interveinal chlorosis, vein swelling and severe leaf curling (Anabestani et al., 2017; CABI, 2021; EPPO, 2024; Sastry et al., 2019).
	Presence of asymptomatic plants	In general, BCTV infection results in the induction of symptoms. However, some weeds remain symptomless upon BCTV infection (Lam et al., 2009).
	Confusion with other pathogens/pests	Symptoms induced by BCTV can be confused with those induced by other members of the *Curtovirus* genus.
Host plant range	BCTV has a wide host plant range and the most economically affected crops are sugarbeet, cucurbits, coriander, bean, spinach, tomato and pepper. The virus host plant range includes *Acmispon americanus, Acmispon strigosus, Amaranthus deflexus, Amaranthus graecizans, Amaranthus retroflexus, Apium graveolens, Armoracia rusticana, Atriplex argentea var. expansa, Atriplex bracteosa, Atriplex fruticulosa, Atriplex patula, Atriplex rosea, Bassia scoparia, Beta vulgaris, Brassica oleracea var. capitata, Brassica rapa, California macrophylla, Cannabis sativa, Capsella bursa-pastoris, Capsicum annuum, Capsicum baccatum, Capsicum chacoense, Capsicum chinense, Capsicum frutescens, Celosia argentea, Chenopodiastrum murale, Chenopodium leptophyllum, Citrullus lanatus, Coreopsis tinctoria, Coriandrum sativum, Cosmos bipinnatus, Cucumis melo, Cucurbita pepo, Cucumis sativus, Datura ferox, Dianthus plumarius, Dysphania ambrosioides, Erodium botrys, Erodium cicutarium, Gnaphalium chilense, Lasthenia minor, Lepidium nitidum, Linum usitatissimum, Malva parviflora, Malva pusilla, Medicago polymorpha, Microseris douglasii, Mirabilis jalapa, Modiola caroliniana, Monolepis nuttalliana, Moricandia arvensis, Nicotiana tabacum, Pelargonium x hortorum, Persicaria amphibia, Persicaria lapathifolia, Persicaria maculosa, Petroselinum crispum, Petunia* spp. *hybrids, Phacelia ramosissima, Phaseolus vulgaris, Physalis acutifolia, Plantago erecta, Polygonum aviculare, Raphanus sativus, Scabiosa atropurpurea, Solanum douglasii, Solanum lycopersicum, Solanum tuberosum, Sonchus asper, Spinacia oleracea, Streptanthus lasiophyllus, Tropaeolum majus, Vigna unguiculata, Viola cornuta, Viola tricolor, Xanthium spinosum, Xerochrysum bracteatum, Zinnia elegans* (CABI, 2021; EPPO, 2024).	
Evidence that the commodity can be a pathway	*Petunia* spp. plants are hosts of beet curly top virus therefore the commodity can serve as pathway of entrance of the virus in the EU territory. Uncertainties: the host status of *Calibrachoa* spp. to beet curly top virus.	
Surveillance information	No information.	

A.2.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover.

(Continues)

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
		Evaluation: Insects (leafhoppers) will transmit BCTV. The insect proof netting prevents the introduction of insects from the surrounding environment. However, insects may be introduced through defects in the greenhouse or as hitchhiking on workers. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: Hygiene measures in place and the double door system with the expeller fan at the door can be effective in preventing the entry of insects that transmit BCTV. BCTV is not surveyed and tested in imported mother stocks and propagated material. **Uncertainties**: The strictness of the measures in place.
Treatment of growing media	N	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1. for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: We assume that all plants originate from EU countries (Germany). As BCTV is a quarantine virus (EU A1 list), it is assumed that the starting material is pest-free. The Panel assumes that the phytosanitary status of the intermediate stock is similar to that of the imported ELITE material. **Uncertainties**: the host status of *Calibrachoa* spp. to beet curly top virus. The status of BCTV as not included in the testing plan of propagated sp.
Crop rotation	N	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation**: Insect (leafhoppers) will transmit BCTV, therefore the application of products against a range of insect species may limit its spread **Uncertainties**: The efficiency of the applied insecticides against leafhoppers and their effect on BCTV spread.

(Continued)

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: Yellow and blue sticky traps are effective to detect the presence of insects. However, early infections cannot be detected due to the lack of symptoms. **Uncertainties**: – The efficiency of monitoring and inspection. – The length of the latent period necessary to the expression of BCTV symptoms.
Sampling and testing	Y	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, one square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4). **Evaluation**: Imported mother plants and propagated plants are not tested for BCTV. Therefore, the virus may be present. **Uncertainties**: The status of BCTV in propagated plants. The host status of *Calibrachoa* spp. to BCTV. The sampling measures might miss BCTV infected asymptomatic plants
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: – BCTV is not tested in the imported certified material used to start the production units and propagated plants. Most BCTV infections are asymptomatic on ornamentals. – Early infections cannot be detected due to the lack of symptoms and there is no specific testing applied for BCTV. **Uncertainties**: – The efficiency of monitoring of disease symptoms and inspection. – The host status of *Calibrachoa* spp. to BCTV.
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any other possible pests/pathogens. **Evaluation**: The surveillance in the area surrounding the nurseries could provide data on the presence and abundance of BCTV and its leafhoppers vectors. However, no specific data are available for the evaluation of the efficacy of the surveillance. **Uncertainties**: The design of the surveillance scheme.

A.2.3 | Possibility of pest presence in the nursery

A.2.3.1 | Possibility of entry from the surrounding environment

BCTV is present in Costa Rica and has an extensive host range as it can infect more than 300 dicotyledonous species in 44 botanical families (Bennett, 1971) including weeds that can act as reservoir for the virus. In nature, BCTV is transmitted with

N. tenellus (syn *Circulifer tennellus;* EFSA PLH Panel, 2017) leafhoppers in a persistent, circulative non-propagative manner. The virus is present in Costa Rica and reported to infect host plants while leafhopper vectors are not reported to be present in Costa Rica. The main pathway of entry in the nursery from the surrounding environment is by yet unreported leafhoppers that can carry the virus.

Uncertainties

- Presence of defects in the greenhouse structure.
- Presence and distribution of host plants in the surroundings.
- Infection (BCTV) and infestation (leafhoppers-vector) pressure in the surroundings.
- Uncertainty of others *Neoaliturus* spp. vectors presence and efficiency of transmission of BCTV in Costa Rica.

A.2.3.2 | Possibility of entry with new plants/seeds

Petunia spp. plants are hosts of BCTV therefore the virus can enter the nursery with new infected plants. Recently it was also demonstrated that the virus can be transmitted by seeds originated from infected *Petunia* spp. plants with a seed transmission rate reaching up to 78% (Anabestani et al., 2017). Therefore, the virus can enter the nursery with infected plants.

Plant material (cuttings) for *Petunia* spp. and *Calibrachoa* spp. mother plants used for the production of unrooted cuttings originate from Germany. BCTV is not present in the EU (A1 list, EPPO GD). However, only 'Elite planting material' is imported and certification scheme in place for *Petunia* spp. and *Calibrachoa* spp.

Other solanaceous and non-solanaceous plants are produced in the same nursery, even though not in the same compartments. No data are provided for the identity, proportion, origin and phytosanitary status of plants other than *Petunia* spp. and *Calibrachoa* spp. produced in the same nursery.

Uncertainties

- The origin, the host status for BCTV and the phytosanitary status of other plant species (solanaceous, non-solanaceous) than *Petunia* spp. and *Calibrachoa* spp. entering the same nursery (although other compartments).
- The host status of *Calibrachoa* spp. to BCTV.

A.2.3.3 | Possibility of spread within the nursery

BCTV is not readily transmitted by mechanical means. Therefore, the spread of BCTV upon in the propagation unit requires the presence of its leafhopper insect vectors. *Petunia* spp. and *Calibrachoa* spp. are cultivated in compartments dedicated for their cultivation without mixing with other crop/plants (Dossier point 1.8). However, other plants (solanaceous and non-solanaceous) possible hosts of BCTV are cultivated and leafhoppers could be present in other greenhouses/compartments of the nursery. Viruliferous leafhoppers could spread BCTV between the different or within the same greenhouse/compartment. There are strict hygiene conditions inside the nursery. However, leafhoppers due to their size are more amenable to be detected than other insects.

Uncertainties

- The presence and incidence of BCTV and leafhoppers vectors in the nursery.
- The presence and the host status for BCTV of other plant species (solanaceous, non-solanaceous) growing in the same nursery.
- The level of physical separation (with leafhoppers-proof netting) of the *Petunia* spp. and *Calibrachoa* spp. production units with other production units.
- Host status of *Calibrachoa* spp. to BCTV.

A.2.4 | Information from interceptions

There are no interceptions of beet curly top virus from Costa Rica on any imported commodity or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

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

- BCTV has not been reported to infect *Calibrachoa* spp.
- BCTV has not been reported on *Petunia* spp. in Costa Rica.
- BCTV has never been intercepted on produce from Costa Rica (ornamentals).
- Low infection pressure (prevalence of host plants) of BCTV in the surrounding environment.

- No infection pressure (prevalence of host plants) of BCTV in other greenhouses/compartments of the nursery.
- Transfer of infected insect vector 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.
  - pest free area of production.

- The scouting monitoring regime is effective and infected plants by the listed virus species in from individuals present in the nurseries are expected to be easily detected.
- Application of the insecticides have a good efficacy against insect vector.
- At harvest and packing, cuttings with symptoms are easy to be detected.
- 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 *Calibrachoa* spp. is a host plant for BCTV, given the sensitivity of solanaceous hosts it is likely that *Petunia* spp./*Calibrachoa* spp. could be a suitable host plant.
- Solanaceous are very sensitive to listed virus species infections and infections are reported in BCTV.
- High population pressure in highly preferred host (e.g. abandoned infected field of highly preferable host close to the greenhouse).
- Presence of BCTV in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure or leafhoppers hitchhike on greenhouse staff or materials.
- Transmission of BCTV via vegetative propagated material increases the probability of their entry and establishment in the nursery on *Petunia* spp./*Calibrachoa* spp. or other host plant species.
- The leafhopper vectors are colonising in *Petunia* spp./*Calibrachoa* spp. and have a high efficiency of transmission.
- Insect vector have developed insecticide resistance to the applied insecticides.
- Insect vectors are widespread in Costa Rica and considering its wide host range it is likely that host plants are present in the surrounding environment.
- Presence of insect vector in the environment is not monitored.
- Early (asymptomatic) infections cannot be visually detected.
- Sanitisation measures are not efficient against listed virus species.

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

- Solanaceae are sensitive/generic hosts for BCTV, therefore *Petunia* spp./*Calibrachoa* spp. is expected to be host also for BCTV.
- The protective effect of the greenhouse structure.
- The insecticides treatments are moderately effective against aphid sp.
- The high density of 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 beet curly top virus

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 beet curly top 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					1		2		4					10
EKE	0.0418	0.099	0.190	0.372	0.620	0.944	1.29	2.11	3.18	3.89	4.84	5.95	7.33	8.56	10.0

Note: The EKE results is the *BetaGeneral* (1.0764, 6.8505, 0, 20) 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 beet curly top virus per 10,000 bags 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	9990					9996		9998		9999					10,000
EKE results	9990	9991	9993	9994	9995	9996.1	9996.8	9997.9	9998.7	9999.1	9999.4	9999.6	9999.8	9999.90	9999.96

Note: The EKE results are the fitted values.

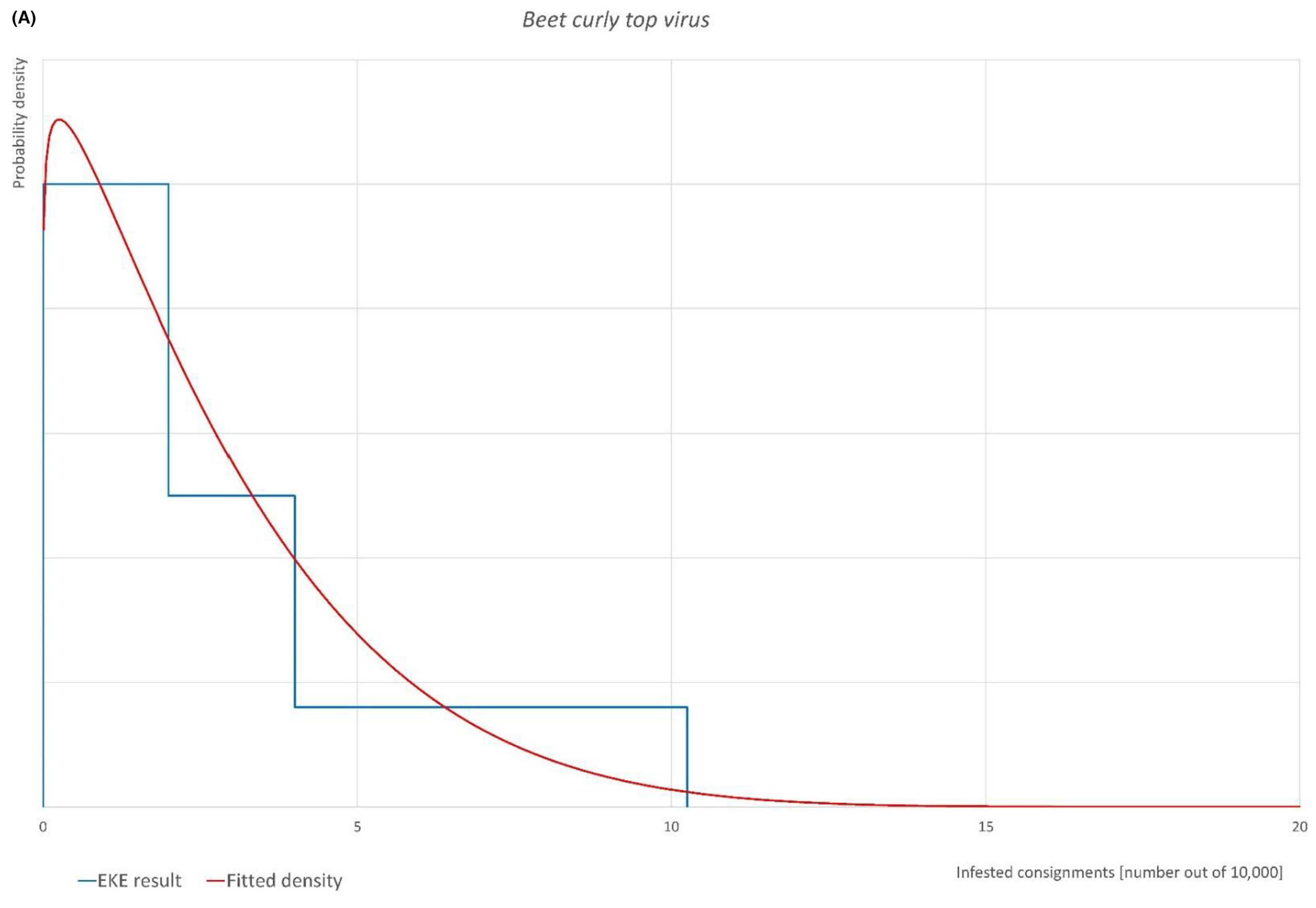

FIGURE A.2 (Continued)

(B)

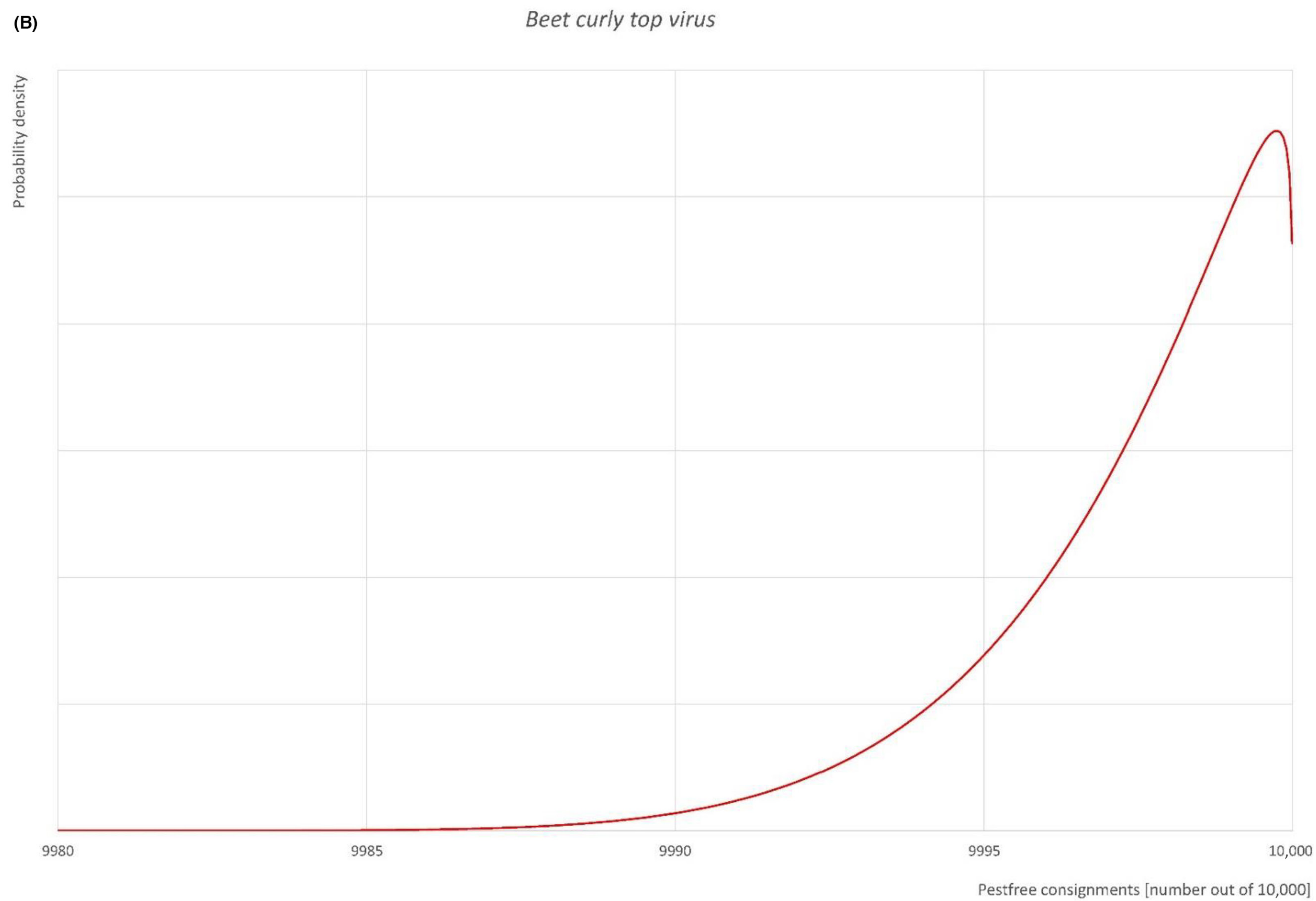

FIGURE A.2 (Continued)

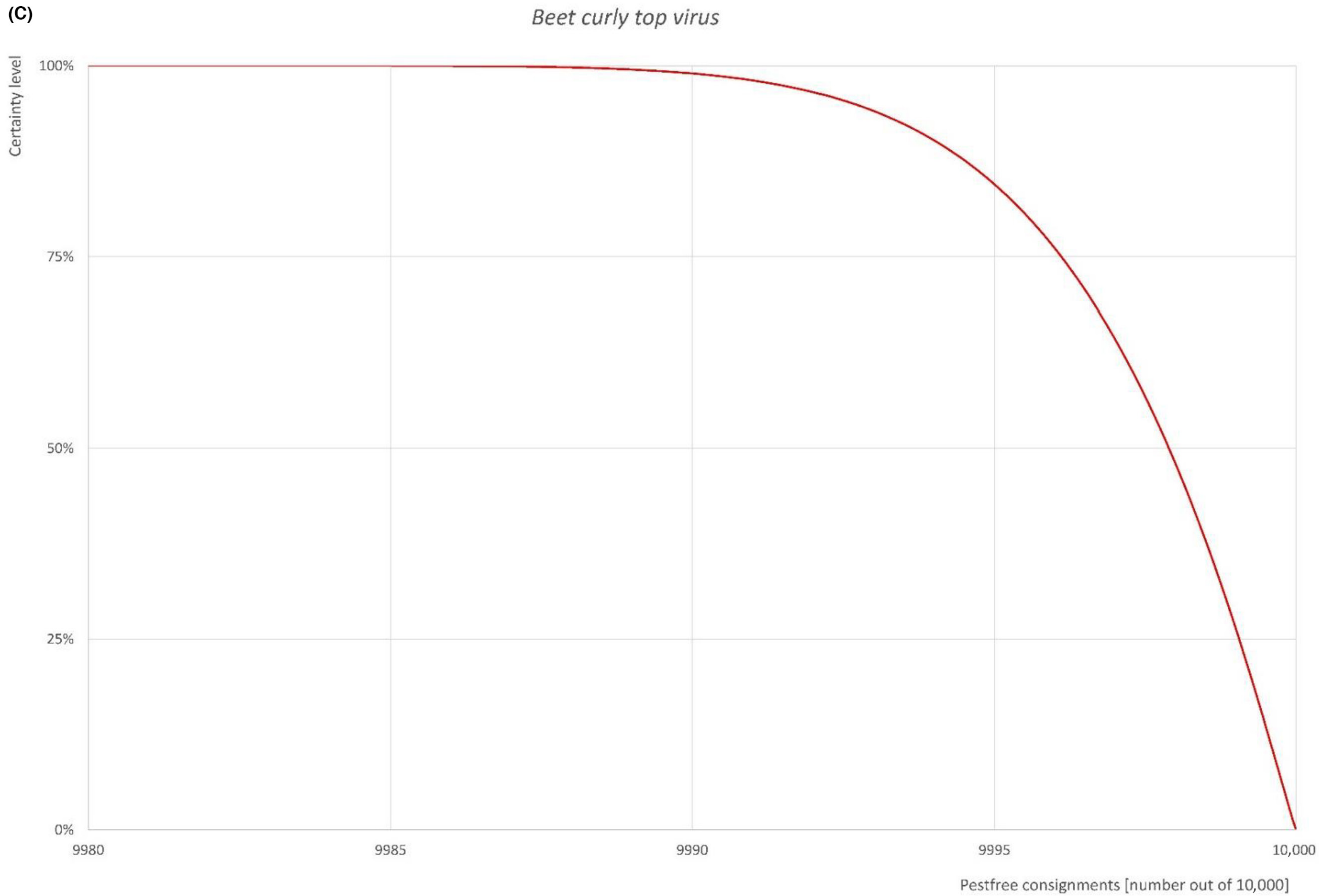

FIGURE A.2 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for beet curly top virus (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) 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.

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A.3 | BEGOMOVIRUSES

A.3.1 | Organism information

Taxonomic Information	• **Euphorbia mosaic virus (EuMV)** Species: *Begomovirus euphorbiamusivi* EPPO code: EUMV00 Synonyms: Euphorbia mosaic virus; Euphorbia mosaic begomovirus; Euphorbia mosaic bigeminivirus; Euphorbia mosaic geminivirus; EuMV (CABI, EPPO, online) Name used in the EU legislation: Begomoviruses, except: Abutilon mosaic virus [ABMV00], Papaya leaf crumple virus [PALCRV], Sweet potato leaf curl virus [SPLCV0], Tomato leaf curl New Delhi Virus [TOLCND], Tomato yellow leaf curl virus [TYLCV0], Tomato yellow leaf curl Sardinia virus [TYLCSV], Tomato yellow leaf curl Malaga virus [TYLCMA], Tomato yellow leaf curl Axarquia virus [TYLCAX] Common name: Euphorbia mosaic virus • **Pepper golden mosaic virus (PepGMV)** Species: *Pepper golden mosaic virus* EPPO code: PEPGMV Synonyms: Pepper golden mosaic begomovirus; Pepper Texas begomovirus; Serrano golden mosaic begomovirus; Serrano golden mosaic virus; Texas pepper begomovirus (EPPO, online) Name used in the EU legislation: Begomoviruses, except: Abutilon mosaic virus [ABMV00], Papaya leaf crumple virus [PALCRV], Sweet potato leaf curl virus [SPLCV0], Tomato leaf curl New Delhi Virus [TOLCND], Tomato yellow leaf curl virus [TYLCV0], Tomato yellow leaf curl Sardinia virus [TYLCSV], Tomato yellow leaf curl Malaga virus [TYLCMA], Tomato yellow leaf curl Axarquia virus [TYLCAX] Common name: pepper golden mosaic virus • **Squash leaf curl virus (SLCV)** Species: *Squash leaf curl virus* EPPO code: SLCV00 Synonyms: Squash leaf curl begomovirus; Squash leaf curl bigeminivirus; Squash leaf curl geminivirus; Melon leaf curl virus; Squash leaf curl; Watermelon curly mottle virus (CABI, EPPO; online) Name used in the EU legislation: Begomoviruses, except: Abutilon mosaic virus [ABMV00], Papaya leaf crumple virus [PALCRV], Sweet potato leaf curl virus [SPLCV0], Tomato leaf curl New Delhi Virus [TOLCND], Tomato yellow leaf curl virus [TYLCV0], Tomato yellow leaf curl Sardinia virus [TYLCSV], Tomato yellow leaf curl Malaga virus [TYLCMA], Tomato yellow leaf curl Axarquia virus [TYLCAX] Common name: leaf curl of squash

(Continued)

	• **Tomato golden mosaic virus (TGMV)** Species: *Begomovirus solanumaureimusivi* EPPO code: TGMV00 Synonyms: Tomato golden mosaic virus; Tomato golden mosaic begomovirus; Tomato golden mosaic bigeminivirus; Tomato golden mosaic geminivirus; TGMV (CABI, EPPO, online) Name used in the EU legislation: Begomoviruses, except: Abutilon mosaic virus [ABMV00], Papaya leaf crumple virus [PALCRV], Sweet potato leaf curl virus [SPLCV0], Tomato leaf curl New Delhi Virus [TOLCND], Tomato yellow leaf curl virus [TYLCV0], Tomato yellow leaf curl Sardinia virus [TYLCSV], Tomato yellow leaf curl Malaga virus [TYLCMA], Tomato yellow leaf curl Axarquia virus [TYLCAX] Common name: tomato golden mosaic virus • **Tomato leaf curl Sinaloa virus (ToLCSiV)** Species: Current valid scientific name: *Begomovirus solanumsinaloaense* EPPO code: TOLCSI Synonyms: Sinaloa tomato leaf curl virus; Tomato leaf curl Sinaloa begomovirus; Sinaloa tomato leaf curl geminivirus; SToLCV; ToLCSiV (CABI, EPPO, online) Name used in the EU legislation: Begomoviruses, except: Abutilon mosaic virus [ABMV00], Papaya leaf crumple virus [PALCRV], Sweet potato leaf curl virus [SPLCV0], Tomato leaf curl New Delhi Virus [TOLCND], Tomato yellow leaf curl virus [TYLCV0], Tomato yellow leaf curl Sardinia virus [TYLCSV], Tomato yellow leaf curl Malaga virus [TYLCMA], Tomato yellow leaf curl Axarquia virus [TYLCAX] • **Tomato yellow leaf curl virus (TYLCV)** Species: *Tomato yellow leaf curl virus* EPPO code: TYLCV0 Synonyms: tomato leaf curl bigeminivirus, tomato leaf curl geminivirus, tomato leaf curl Oman virus, tomato yellow leaf curl begomovirus, tomato yellow leaf curl bigeminivirus, tomato yellow leaf curl geminivirus, tomato yellow leaf curl Gezira virus (EPPO, online) **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. Kingdom: Viruses and viroids Order: *Geplafuvirales* Family: *Geminiviridae* Genus: *Begomovirus* (International Committee on Taxonomy of Viruses, https://ictv.global/report/chapter/geminiviridae/geminiviridae/begomovirus)
Regulated status	Euphorbia mosaic virus (EuMV), pepper golden mosaic virus (PepGMV), squash leaf curl virus (SLCV), tomato golden mosaic virus (TGMV), tomato leaf curl Sinaloa virus (ToLCSiV) are regulated as quarantine pests (as a non-EU begomoviruses) in Commission Implementing Regulation (EU) 2019/2072, *ANNEX II, Part A*. Tomato yellow leaf curl virus (TYLCV0) is regulated as an RNQP in Commission Implementing Regulation (EU) 2019/2072, ANNEX IV, Part I.
Pest status in Costa Rica	Euphorbia mosaic virus (EuMV): Present (CABI, EPPO; online). Pepper golden mosaic virus (PepGMV): Present, restricted distribution (CABI, EPPO; online). Squash leaf curl virus (SLCV): Present (CABI, EPPO; online). Tomato golden mosaic virus (TGMV): Present (CABI, EPPO; online). Tomato leaf curl Sinaloa virus (ToLCSiV): Present (CABI, EPPO; online). Tomato yellow leaf curl virus (TYLCV): Present (CABI, EPPO; online).

Host status on *Petunia* spp./*Calibrachoa* spp.	**Virus name**	***Petunia* spp./*Calibrachoa* spp. host status**	**Solanaceae host plants**
	Euphorbia mosaic virus (EuMV)	No data	Tomato (experimental), pepper, tobacco
	Pepper golden mosaic virus (PepGMV)	No data	Tomato, pepper, tobacco
	Squash leaf curl virus (SLCV)	No data	Tomato, pepper
	Tomato golden mosaic virus (TGMV)	Petunia spp. is an experimental host	Tomato
	Tomato leaf curl Sinaloa virus (ToLCSiV)	Petunia spp. is a natural host	Tomato
	Tomato yellow leaf curl virus (TYLCV)	Petunia spp. is a natural host	Tomato, potato, pepper, tobacco

Uncertainties:
There are no records that *Petunia* spp. or *Calibrachoa* spp. plants are hosts of EuMV, PepGMV and SLCV and that *Calibrachoa* spp. plants are hosts of any of these viruses. However, begomoviruses infecting solanaceous species are expected to have an extended host range especially within the Solanaceae family (Devendran et al., 2022; Hancinský et al., 2020). Therefore, *Petunia* spp. and *Calibrachoa* spp. are likely to be host plants of all these viruses.

PRA information	Available Pest Risk Assessments: – 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). – Scientific Opinion on the pest categorisation of Tomato yellow leaf curl virus and related viruses causing tomato yellow leaf curl disease in Europe (EFSA PLH Panel, 2014).

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Other relevant information for the assessment	
Biology	**Transmission:** 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 larvae can ingest and transmit begomoviruses. All evidence reported so far supports that infectious begomoviruses are not transovarially passed onto the insect progeny (EFSA PLH Panel, 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 sometime among different populations of the same species (EFSA PLH Panel, 2013; Ran Rosen et al., 2015). 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. **Uncertainly on biology:** Seed transmission of the begomoviruses in *Petunia* spp. or *Calibrachoa* spp. **Host range and distribution of host plants in the environment:** The host plant range of **EuMV** includes *Arabidopsis thaliana* (experimental), *Capsicum annuum*, *Datura metel* (experimental), *D. stramonium* (experimental), *Euphorbia prunifolia*, *Euphorbia heterophylla*, *Glycine max* (experimental), *Nicotiana benthamiana* (experimental), *N. glauca*, *N. tabacum, Phaseolus vulgaris* (experimental), *Solanum lycopersicum* (experimental) and *Wissadula amplissima* (EPPO, online; Fiallo-Olivé, et al., 2010; Hernández-Zepeda et al., 2007; Sastry et al., 2019). 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 (Castro et al., 2013; EPPO GD; Méndez-Lozano et al., 2001; Holguín-Peña et al., 2004; McLaughlin, et al., 2008). The natural hosts of **SLCV** include cucurbits (*Cucurbita pepo, C. moschata, C. maxima, Citrullus lanatus, Cucumis melo* and *C. sativa*), tomato (*Solanum lycopersicum*), pepper (*Capsicum annum*), eggplant (*Solanum melongena*), common bean (*Phaseolus vulgaris*), cheeseweed (*Malva parviflora*), *Proboscidea louisianica, Sinapis arvensis* and members of the *Cactaceae* family (Al-Musa et al., 2008; CABI, 2021; Díaz-Nájera, 2018; Fontenele et al., 2021). The natural host of **TGMV** is tomato (*Solanum lycopersicum*). The experimental hosts include *S. pennelli*, *Nicotiana benthamiana, N. clevelandii, N. debneyi, N. glutinosa, N. tabacum, Petunia* spp. *hybrida* and the weeds *Datura stramonium,* and *Physalis* sp. (CABI, 2019; Descriptions of plant viruses https://www.dpvweb.net). The host range of **ToLCSiV** includes *Capsicum annuum*, *Nicotiana tabacum*, *N. benthamiana, Solanum lycopersicum, Solanum melongena* and the weeds *Datura metel* (experimental), *D. stramonium* (experimental), *Malva parviflora* (experimental), (EPPO; online; Idris & Brown, 1998). **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) (Papayiannis et al., 2011; CABI, 2012). Among cultivated plants it infects tomato, bean (*Phaseolus vulgaris*), Petunia spp. (*Petunia* spp. *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). 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., 2020; Prajapat et al., 2014). **Uncertainly on host range:** The actual host range of most begomoviruses (besides TYLCV) is largely unknown. **Ecology and biology of the vectors:** *B. tabaci* is reported as present in Costa Rica with a restricted distribution (EPPO GD). However, according the NPPO of Costa Rica *B. tabaci* is widely distributed throughout the country (Dossier Section 1.0). *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). **Symptoms on Petunia spp./Calibrachoa spp.:** 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). *P. hybrida* plants infected with ToLCSiV show yellow lesions on infected leaves (Idris & Brown, 1998). *Petunia* spp. plants infected with TYLCV 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* spp. 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* spp. infected with 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 two to 3 weeks) and disease severity. **Uncertainly on symptoms:** Older plants may show partial recovery of symptoms with the production of healthy leaves, while begomovirus symptoms are generic and not indicative of a specific species.

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Evidence that the commodity can be a pathway	Unrooted cuttings of *Petunia* spp. or *Calibrachoa* spp. can be systemically infected by begomoviruses and/or infested by viruliferous whiteflies.
Surveillance information	There are no targeted surveys for begomoviruses in Costa Rica.

A.3.2 | Risk Mitigation Measure applied in the nurseries

Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: The insect proof netting prevents the introduction of insects including whiteflies from the surrounding environment. However, whiteflies may be introduced through defects in the greenhouse or as hitchhikers on workers. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: The double door system can be effective in preventing the entry of *B. tabaci* via active flying and entry and spread of begomoviruses. Changing clothes prevents also the entrance of vectors via hitchhiking. **Uncertainties**: The strictness of the measures applied.
Treatment of growing media	N	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1 for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: We assume that all plants originate from EU countries (Germany). Therefore, it is highly unlikely that the starting material is infected with non-EU begomoviruses. TYLCV has an RNQP status in the EU and the starting material is not tested for this begomovirus. However, certified plants are expected to be free of symptoms of any pest and disease therefore, the possibility that it is infected with TYLCV is unlikely. The Panel assumes that the phytosanitary status of the intermediate stock is similar to that of the imported ELITE material. **Uncertainties**: none.
Crop rotation	Y	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season. **Evaluation**: In the case of introduction into the greenhouse, populations of the vector *B. tabaci* may build up, since the same unit is used for production of *Petunia* spp. and *Calibrachoa* spp. However, cleaning and disinfection in addition with keeping the greenhouse empty for 3 months (when applied) are considered efficient to eliminate whitefly population when alternate crops between seasons. **Uncertainties**: None.

(Continues)

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Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation**: The applied insecticides are effective against whiteflies. However, *B. tabaci* and especially some species of the complex (eg MED) are known for having developed resistance to some insecticides. **Uncertainties**: The efficacy and timing of the applied insecticide are not known.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: General inspection can monitor flying whiteflies however, begomoviruses can be transmitted to many plants by a singled/few unnoticed individuals difficult to notice in low populations. The monitoring can detect the presence of begomoviruses. – If symptoms of begomovirus are detected, the State Phytosanitary Service can take samples for analysis in the laboratories of the University of Costa Rica (laboratory recognised by the SFE). – If viral symptoms are detected by the company, internal tests (ImmunoStrips) are carried out, and samples are sent for PCR analysis. – In addition, if begomoviruses are not detected, no further phytosanitary measures are performed. **Uncertainties**: None.
Sampling and testing	Y	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, 1 square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4). **Evaluation**: No testing is performed for any begomovirus. **Uncertainty**: none
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory.

(Continued)

Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Official Supervision by NPPO	Y	The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: The monitoring can detect the presence of *B. tabaci* and of begomoviruses. As stated in Dossier section 3 in case of a finding of *B. tabaci* in a production unit, the monitoring and the treatments are intensified, including cultural methods such as hoovering plants. There are no official measures implemented in case of *B. tabaci* finding. Furthermore, there is no specific testing applied for begomoviruses. **Uncertainties**: The efficiency of monitoring and inspection.
Surveillance of production area	N	**Description**: No details are given for the surveillance of any other possible pests/pathogens.

A.3.3 | Possibility of pest presence in the nursery

A.3.3.1 | 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 Costa Rica (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., 2014); EuMV naturally infects euphorbia plants, SLCV infects *Malva parviflora*, *Sinapis arvensis* and *Proboscidea louisianica* (Al-Musa et al., 2008; Díaz-Nájera, 2018; Fontenele et al., 2021) and ToLCSiV was experimentally transmitted to weeds as *Malva parviflora* and *Datura* sp. (Idris & Brown, 1998). 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.

<u>Uncertainties</u>

- 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.3.3.2 | Possibility of entry with new plants/seeds

Mother plants used for the production of unrooted cutting originate from certified material from Germany. Incoming mother plants are not tested in the nursery for begomoviruses at the start of the production. However, certified plants imported from Germany are expected to be free of non-EU begomoviruses and symptoms of any pest and disease therefore, the possibility that it is infected with TYLCV is unlikely (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* spp./*Calibrachoa* spp. plants produced in the same nursery. It is possible that begomoviruses are present on other host plants present in the nursery.

<u>Uncertainties</u>

- The origin and the host status for begomoviruses and the phytosanitary status of other plant species (solanaceous, non-solanaceous) present in the same nursery.

A.3.3.3 | 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) present in the same nursery.

A.3.4 | Information from interceptions

There are no interceptions of begomovirus from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.3.5 | Overall likelihood of pest freedom

Begomoviruses were already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of Begomoviruses in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- External environment/land use (Costa Rica, coffee is the dominant cultivation in the surrounding of the nurseries).
- The official testing regime of the starting material is less strict in Guatemala than in Costa Rica (certification system).
- Source of water used for irrigation (surface water for Guatemala, sealed wells in Costa Rica).
- In Guatemala there were more production cycles (with disinfection of growing media with metamsodium) per year and in Costa Rica one cycle with new growing media.

Because no major differences were identified the Panel decided to use the same values elicited for begomoviruses on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA PLH Panel, 2024).

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

- EuMV, PepGMV and SLCV have not been reported to infect *Petunia* spp./*Calibrachoa* spp.
- Begomoviruses have not been reported on *Petunia* spp./*Calibrachoa* spp. in Costa Rica.
- Begomoviruses have never been intercepted on produce from Costa Rica.
- 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* spp./*Calibrachoa* spp. 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.
- *B. 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.3.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- Even if there is no evidence that *Petunia* spp./*Calibrachoa* spp. is a host plant for EuMV, PepGMV and SLCV, given the sensitivity of solanaceous hosts it is likely that *Petunia* spp./*Calibrachoa* spp. is a suitable host plant.
- Solanaceous are very sensitive to begomovirus infections and infections are reported in Costa Rica.
- High population pressure in highly preferred host (e.g. abandoned infected field of highly preferable host close to the greenhouse).
- 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* spp./*Calibrachoa* spp. or other host plant species.
- *B. tabaci* has developed insecticide resistance to the applied insecticides.
- *B. tabaci* is widespread in Costa Rica 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.3.5.3 | 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* spp./*Calibrachoa* spp. is expected to be host also for EuMV, PepGMV and SLCV.
- There are no records of interceptions from Costa Rica.
- 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.3.5.4 | 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.3.6 | 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.5) and pest freedom (Table A.6).

TABLE A.5 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

Note: 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.6.

TABLE A.6 The uncertainty distribution of plants free of begomoviruses per 10,000 bags 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	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	10000.0

Note: The EKE results are the fitted values.

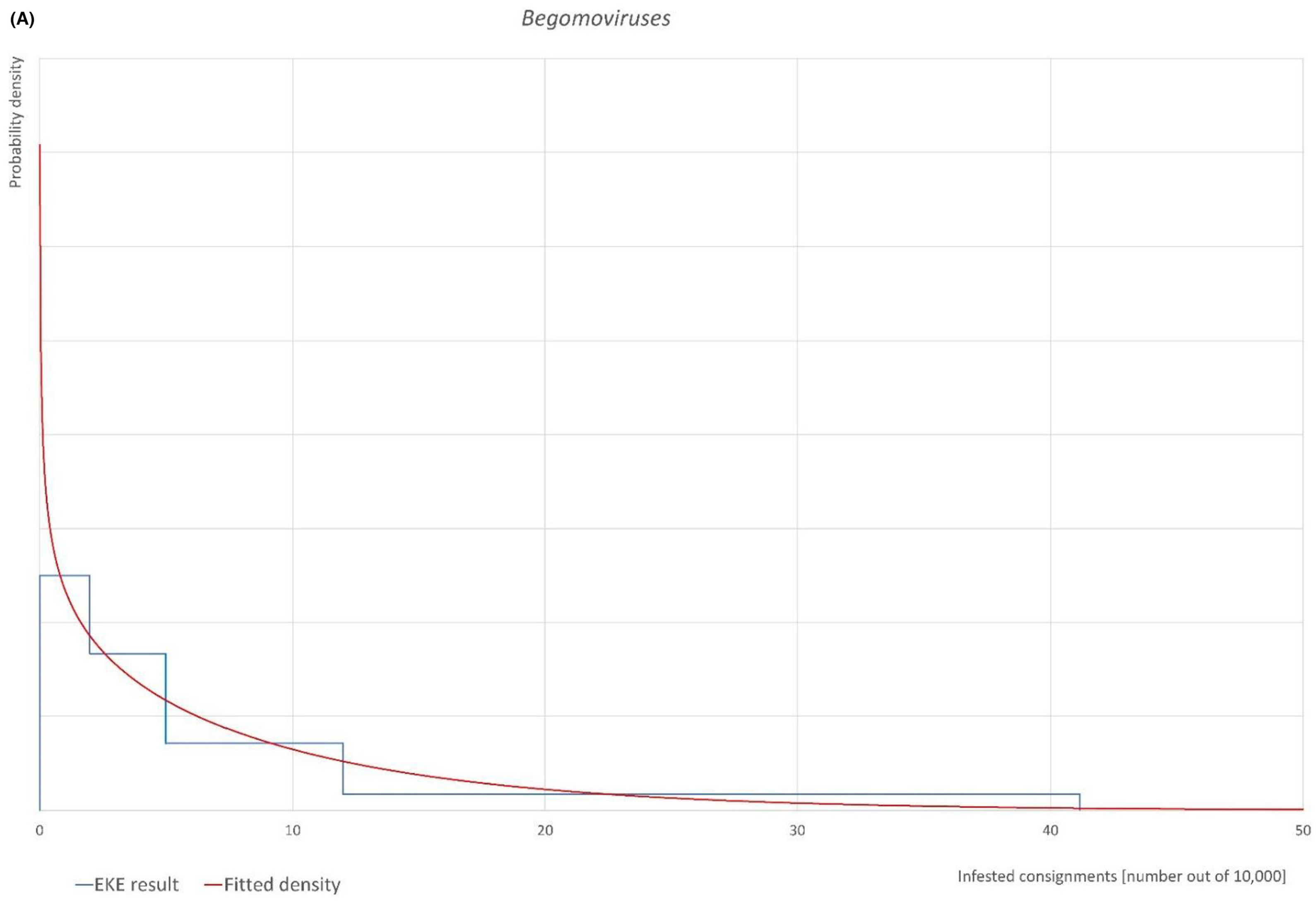

FIGURE A.3 (Continued)

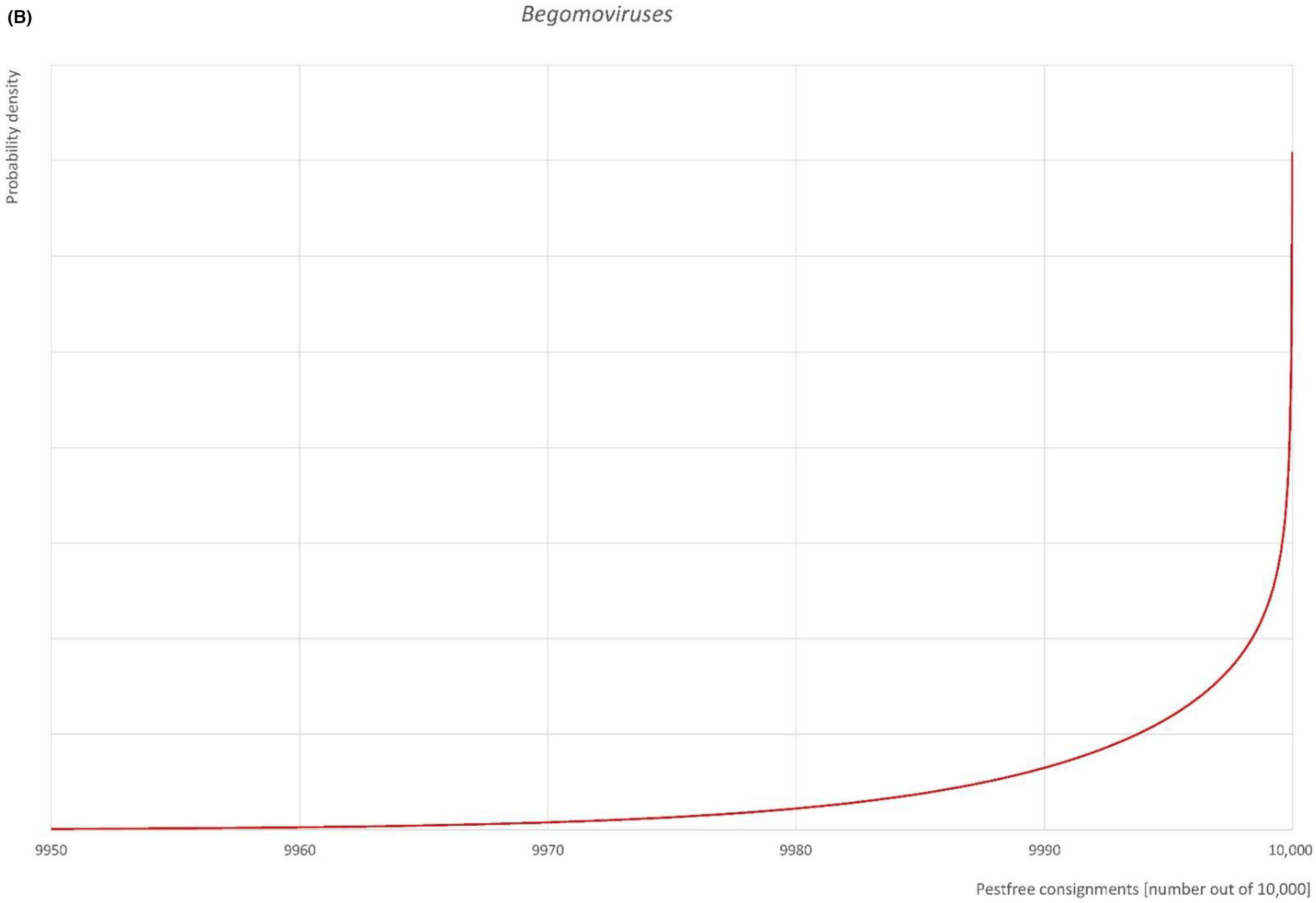

FIGURE A.3 (Continued)

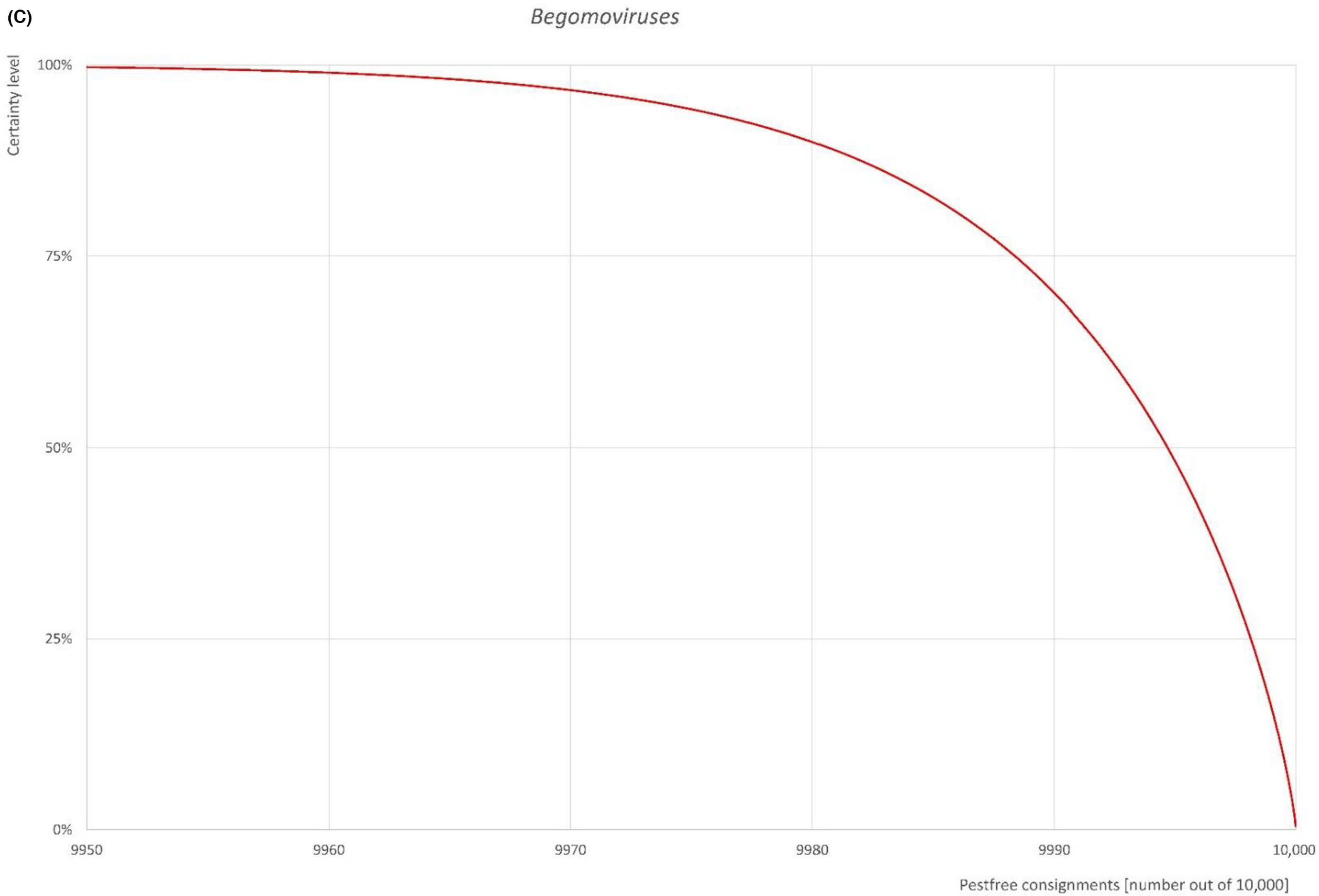

FIGURE A.3 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for begomoviruses (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty 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.

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A.4 | *BEMISIA TABACI*

A.4.1 | Organism information

Taxonomic information	Current valid scientific name: *Bemisia tabaci* (Gennadius, 1889) [BEMITA] 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* Name used in the EU legislation: *Bemisia tabaci* Genn. (non-European populations) known to be vector of viruses [BEMITA] Common name: tobacco whitefly, cassava whitefly, cotton whitefly, silver-leaf whitefly, sweet-potato whitefly Class: Insecta Order: Hemiptera Family: Aleyrodidae
Regulated status	The pest is listed in Annex II/A of Commission implementing Regulation (EU) 2019/2072 as *B. 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 *Costa Rica*	*B. tabaci* is present in *Costa Rica* (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 Costa Rica to infest many plant host species (Bethke et al. 2009; Kanakala and Ghanim 2019; McKenzie et al. 2012; Shatters et al. 2009). Bethke et al. (2009) investigated the presence of *B. tabaci* biotypes in production greenhouses of Poinsettia (Eurphorbia) and its surrounding environment (weeds and crops) in Costa Rica. *B. tabaci* was found to be present inside two greenhouses (on Euphorbia) and outside the greenhouse on Hibiscus, Lactuca, Cucumis, Phaseolus.
Pest status in the EU	Not relevant.
Host status on *Petunia* spp. and *Calibrachoa* spp.	Certain *Petunia* species (*P. axillaris, P. grandiflora, P. integrifolia, P. hybrida*) and *Calibrachoa* spp. 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 spp. 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). – Scientific Opinion on the commodity risk assessment of *Persea americana* from Israel (EFSA PLH Panel, 2021). – Scientific report on the commodity risk assessment of specified species of *Lonicera* potted plants from Turkey (EFSA PLH Panel, 2022a). – Scientific Opinion on the commodity risk assessment of *Jasminum polyanthum* unrooted cuttings from Uganda (EFSA PLH Panel, 2022b). – UK Risk Register Details for *Bemisia tabaci* non-European populations (DEFRA, online).
Other relevant information for the assessment	
Biology	*B. 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). *B. tabaci* adult is about 1 mm long. It develops through three life stages: egg, larva (four instars) and adult (Walker et al., 2009). Larvae 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). *B. 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). Out of all life stages, only the first instar larva (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).
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).

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	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) could be present on harvested unrooted cuttings o *Petunia* spp./*Calibrachoa* spp. *B. tabaci* is regularly intercepted in the EU on different commodities including plants for planting and unrooted cuttings (EUROPHYT/TRACES-NT, online).	
Surveillance information	There are no targeted surveys for the presence of *B. tabaci* in Costa Rica.	

A.4.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: 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. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: These measures could be effective in reducing the risk of introduction and/or spread of whitefly. **Uncertainties**: Is not known if there is an additional change and disinfection area before entering the *Petunia* spp./*Calibrachoa* spp. production units.
Treatment of growing media	N	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1. for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: *B. tabaci* is present in El Salvador and Israel. **Uncertainties**: The details of the certification schemes and the phytosanitary status of the imported material from the non-EU countries.

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Crop rotation	N	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in the case of the capture of two adult *B. tabaci* with sticky traps it is recommended to treat the crop and check the leaves for the presence of larvae. If during the official export controls larvae are found on the leaves, the export of the crop is suspended until appropriate treatment is carried out. The effectiveness of the treatment is checked before the export is allowed again. **Evaluation**: If correctly applied the listed products are effective against eggs, larvae and adults of *B. tabaci* and if the official measures are followed it is unlikely that *B. tabaci* is present on exported unrooted cuttings. **Uncertainties**: The level of resistance against the listed insecticides of *B. tabaci* populations in Costa Rica.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: The monitoring can detect the presence of *B. tabaci* adults. If the presence of *B. tabaci* is identified the following actions are adopted (Dossier section 4.0): – Use of special equipment to vacuum the foliage (S5d), reducing the presence of adults. – Increase of the frequency of specific phytosanitary applications, mainly using biological control, which includes entomopathogens, parasitoids and predators, and as an alternative measure, chemical control, with products registered for the control of this pest. – Increase on the density of sticky yellow plastic traps or rolls in the affected area to use them as traps to capture the insect. – Reduction of the crop density to improve the effectiveness of biological control and/or chemical pesticide applications. **Uncertainties**: The efficiency of monitoring and inspection.
Sampling and testing	N	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, one square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: The monitoring can detect the presence of *B. tabaci*. **Uncertainties**: The efficiency of monitoring and inspection is not known.
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any other possible pests/pathogens. **Evaluation**: 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. **Uncertainties**: The intensity and the design of surveillance scheme.

A.4.3 | Possibility of pest presence in the nursery

A.4.3.1 | Possibility of entry from the surrounding environment

B. tabaci is a polyphagous whitefly that is widespread in Costa Rica and reported occurring in many horticultural crops, such as melon (Bethke et al., 2009). It is likely that *B. tabaci* is present in the area where the nurseries are located. For another similar commodity in Costa Rica (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., 2009). 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* spp./*Calibrachoa* spp. cuttings are produced in a greenhouse protected against insects by screened windows and double doors. Small insects as *B. tabaci* (1mm) 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.4.3.2 | 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.4.3.3 | 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.4.4 | Information from interceptions

Bemisia tabaci is the most intercepted pest species on plants for planting in the EU, including unrooted cuttings

There were 20 interceptions of *B. tabaci* on different commodities (*Eustoma* sp.: two; *Lisianthus* sp.: one; *Monarda* sp.: six; *Eupatorium* sp.: three; *Lantana* sp.: three; *Salvia* sp.: two; *Osteospermum* sp.: four) imported into the EU from Costa Rica.

There are no interceptions of *B. tabaci* from Costa Rica on any imported commodity or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

In the EUROPHYT/TRACES-NT database there are two records of interception of *Bemisia* spp. on *Calibrachoa* spp. from Israel.

A.4.5 | Overall likelihood of pest freedom

B. tabaci was already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of *B. tabaci* in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- More interceptions of *B. tabaci* from Costa Rica (maybe related to the different trade volume).
- External environment/land use (Costa Rica, coffee is the dominant cultivation in the surrounding of the nurseries).

Because no major differences were identified the Panel decided to use the same values elicited for *B. tabaci* on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA, 2024).

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.
- 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 (Solanacea, 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.4.5.2 | 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 Costa Rica.
- *B. tabaci* is present throughout Costa Rica and they have a wide host range, mainly solanaceaus planst, 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*.
- 100 cuttings per bag.

A.4.5.3 | 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.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 *B. tabaci* in the surrounding environment.

A.4.6 | 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.7) and pest freedom (Table A.8).

TABLE A.7 Elicited and fitted values of the uncertainty distribution of pest infestation by *B. 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.8.

TABLE A.8 The uncertainty distribution of plants free of *B. tabaci* per 10,000 bags 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	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.

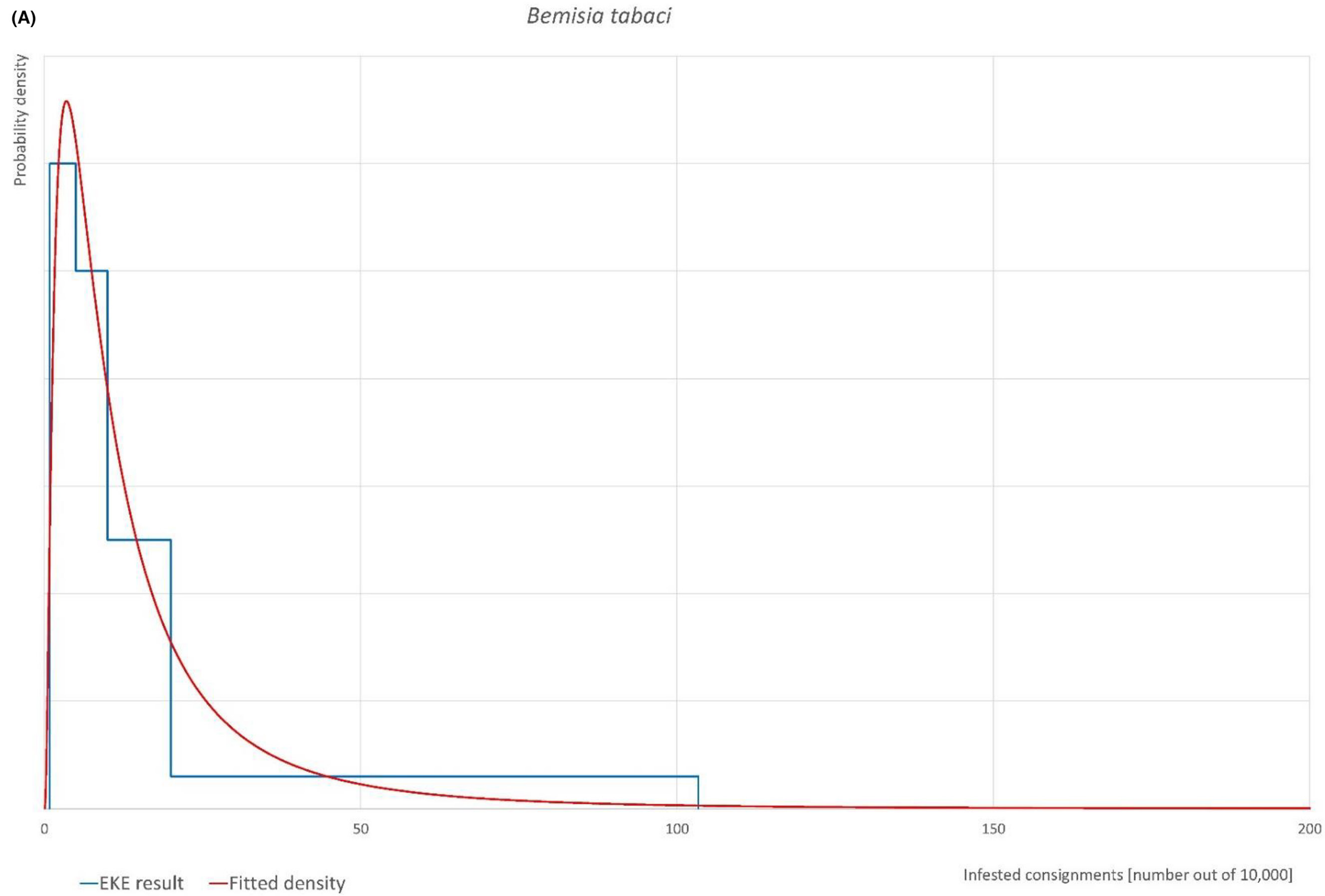

FIGURE A.4 (Continued)

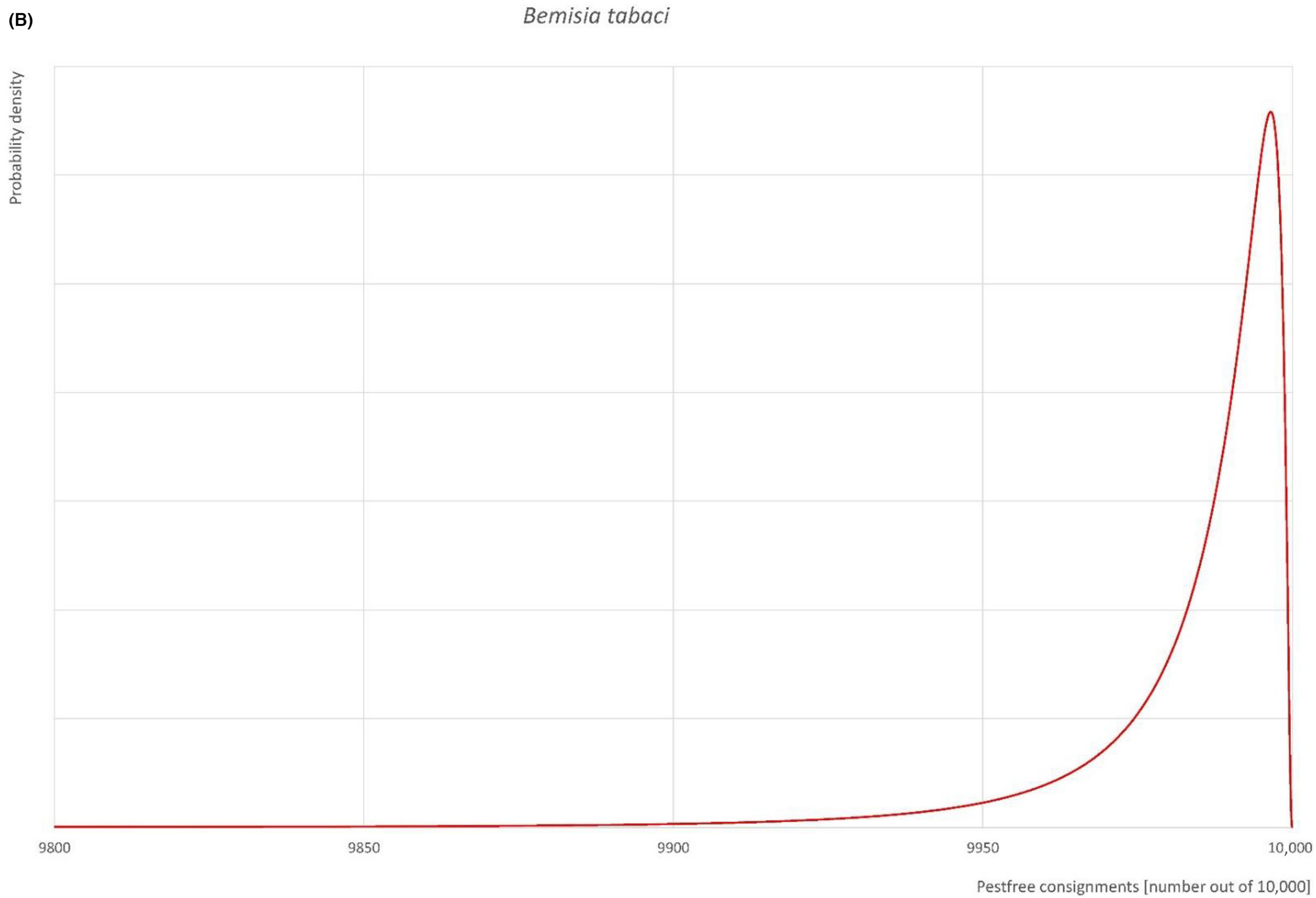

FIGURE A.4 (Continued)

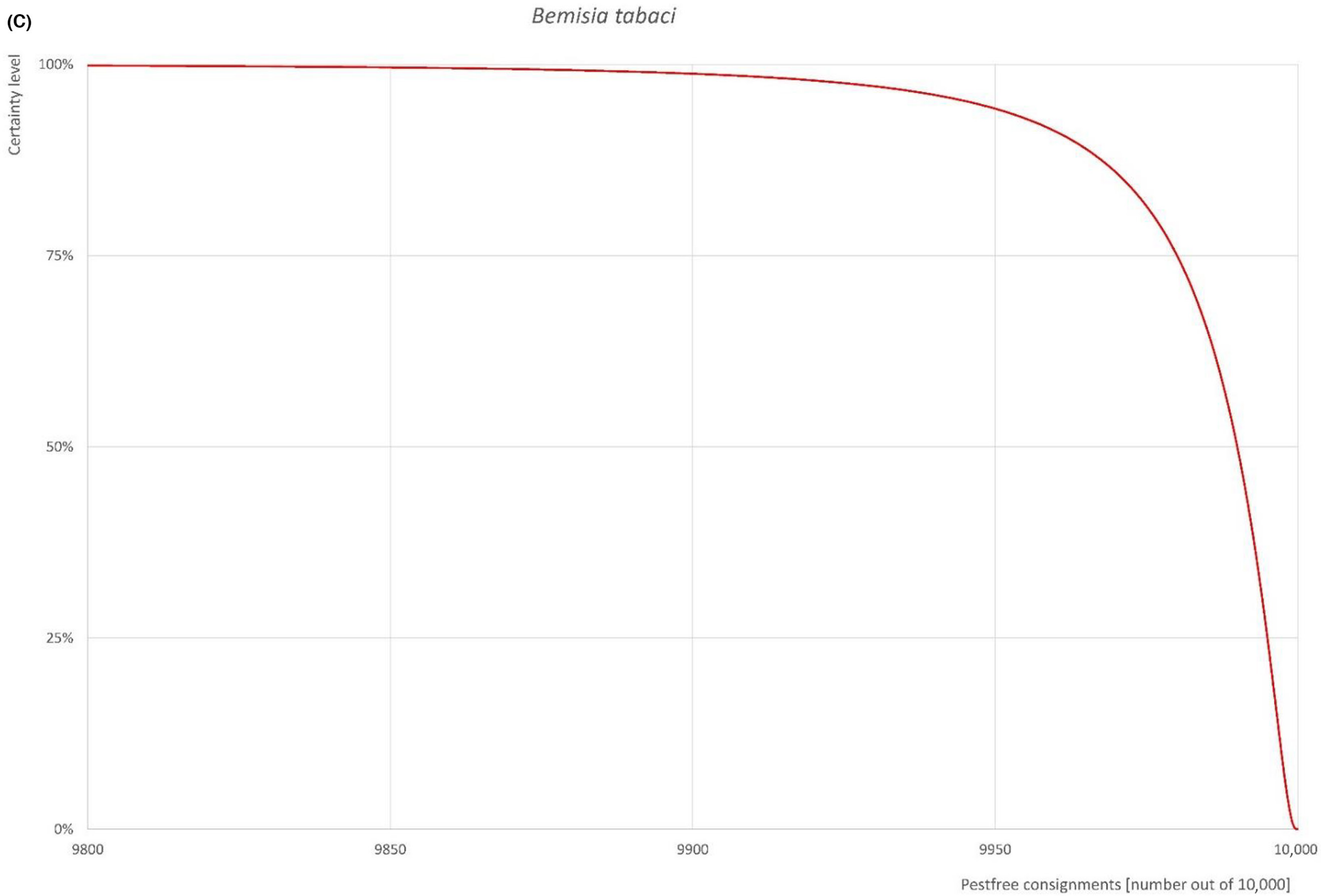

FIGURE A.4 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *B. tabaci* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty 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.

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A.5 | *EOTETRANYCHUS LEWISI*

A.5.1 | Organism information

Taxonomic information	Current valid scientific name: *Eotetranychus lewisi* (McGregor, 1943) [EOTELE] Synonyms: *Tetranychus lewisi* Common name: Lewis spider mite Class: Arachnida Order: Acarida Family: Tetranychidae	
Regulated status	Quarantine pest in the EU (Annex II Part A)	
Pest status in Costa Rica	Present (EPPO GD, online)	
Pest status in the EU	EU quarantine pest	
Host status on *Petunia* spp. *and Calibrachoa* spp. *spp*	*E. lewisi* is a pest of 86 plant species belonging to 26 different families (EFSA PLH Panel, 2017; EPPO, online). 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* spp./*Calibrachoa* spp. are suitable host plants. Uncertainties: the host status of *Petunia* spp. and *Calibrachoa* spp. plants to *E. lewisi*.	
PRA information	A pest risk assesment of *E. lewisi* has been prepared by EFSA PLH Panel (2017).	
Other relevant information for the assessment		
Biology	*E. 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 (EFSA PLH Panel, 2014; EPPO, 2006). The life cycle of the mite includes five stages: egg, larva, protonymph, deutonymph and adult (EFSA PLH Panel, 2014). The females start their oviposition in less than 24 h after emergence and deposit five eggs per day on average at temperatures from 17°C to 23°C (McGregor, 1943). The fecundity of *E. lewisi* is 41 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 11 days on strawberry leaves at 25°C (Kaur and Zalom, 2017). The life cycle of the mite is completed in 19 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, *E. lewisi* can complete over 10 generations per year (EFSA PLH Panel, 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 PLH Panel, 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. Early infestations can be difficult to be detected.
	Confusion with other pathogens/pests	*E. lewisi* is similar in colour to *Tetranychus urticae* but it is a little smaller and narrower with several small greenish spots, in contrast to *T. urticae* that has only two greenish spots (Gilrein, 2006). A diagnostic protocol for *E. lewisi* is given by EPPO (2006).

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Host plant range	*E. 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, papaya and vines as well as several tree species like acacias, pines and aspens (EFSA PLH Panel, 2017; EPPO, online). 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 PLH Panel, 2017).
What life stages could be expected on the commodity	Eggs, larvae, nymphs and adults may be present on harvested unrooted cuttings. No information for this pest on *Petunia* spp. or *Calibrachoa* spp. plants is available.
Surveillance information	There is no specific surveillance for *E. lewisi* in Costa Rica.

A.5.2 | Risk Mitigation Measure applied in the nurseries

Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation:** 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. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: Mites could be introduced into the nursery by hitchhiking on clothes of nursery staff. *Petunia* spp./*Calibrachoa* spp. plants are produced in compartments with the highest sanitation level (A). The hygiene measures (e.g. clean clothes) could be effective in reducing the risk of introduction and/or spread of mites. **Uncertainties**: None.
Treatment of growing media	Y	**Description** The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option. **Evaluation** It is unlikely that mites are present on the new growing media used for producing the mother plants. **Uncertainties** None.

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Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Quality of source plant material	Y	**Description** All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1 for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation** All plants used to start a new production cycle of *Petunia* spp./*Calibrachoa* spp. are Elite certified and originate from Germany. It is highly unlikely that mites are present on this certified plant material, furthermore *E. lewisi* is not present in Germany. **Uncertainties**: None.
Crop rotation	Y	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season. **Evaluation**: The crop rotating plants Chrysanthemum is not a host for *E. lewisi*. Greenhouses used for the production of *Petunia* spp./*Calibrachoa* spp. are emptied for 3 months and disinfected. Therefore, it is highly unlikely that *E. lewisi* is present. **Uncertainties**: none.
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description** To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation** Some of the applied insecticides/acaricides are effective against *E. lewisi*. **Uncertainties** The efficacy and timing of the applied insecticide/acaricide are not known.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation** The visual examination of plants can detect the presence of *E. lewisi* adults. **Uncertainties**: The efficiency of monitoring and inspection for pre-adult stages of the mite.

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Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Sampling and testing	N	**Description** In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, one square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).
Official Supervision by NPPO	Y	**Description** Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation** The official inspection can detect the presence of *E. lewisi*. **Uncertainties** The efficiency of monitoring and inspection is not known.
Surveillance of production area	Y	**Description** No details are given for the surveillance of any pests/pathogens in the surrounding environment of the nursery. **Evaluation** There is no specific surveillance for *E. lewisi*, therefore the pest pressure level in the surrounding environment is uncertain. **Uncertainties** There is no specific surveillance for *E. lewisi,* therefore the pest pressure level in the surrounding environment is uncertain.

A.5.3 | Possibility of pest presence in the nursery

A.5.3.1 | 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 Costa Rica. 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 be transported to 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.

Uncertainties

- Presence of defects in the greenhouse structure.
- Abundance of *E. lewisi* in the surrounding environment.

A.5.3.2 | Possibility of entry with new plants/seeds

Mother plants used for the production of unrooted cutting originate from certified material from Germany. *E. lewisi* is not present in Germany.

<u>Uncertainties</u>

The host status of *E. lewisi* on *Petunia* spp. and *Calibrachoa* spp.

A.5.3.3 | 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 on clothing and tools of staff.

<u>Uncertainties</u>

There are no uncertainties.

A.5.4 | Information from interceptions

There are no interceptions of *E. lewisi* from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.5.5 | Overall likelihood of pest freedom

E. lewisi was already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of *E. lewisi* in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- External environment/land use (Costa Rica, coffee is the dominant cultivation in the surrounding of the nurseries).
- The official testing regime of the starting material is less strict in Guatemala than in Costa Rica (certification system).
- Source of water used for irrigation (surface water for Guatemala, sealed wells in Costa Rica).
- In Guatemala there were more production cycles (with disinfection of growing media with metamsodium) per year and in Costa Rica one cycle with new growing media.

Because no major differences were identified the Panel decided to use the same values elicited for *E. lewisi* on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA PLH Panel, 2024).

A.5.5.1 | 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.
- *Eotetranychus lewisi* has never been intercepted on produce from Costa Rica.
- 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 insecticide/acaricide have a good efficacy against *E. lewisi*.
- At harvest and packing, cuttings with symptoms will be detected.
- Hygiene measures are effective in preventing introduction and spread within the greenhouse.

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

- *E. ewisi* is present throughout Costa Rica 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/acaricide treatments have low efficacy for *E. lewisi*.
- *Petunia* spp. and *Calibrachoa* spp. are suitable host plants.
- There are failures in the application of the hygiene measures.

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 and hygiene measures.
- The insecticide/acaricide treatments are effective.
- There are no records of interceptions from Costa Rica.

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

- The host status of *Petunia* spp. and *Calibrachoa* spp. for *E. lewisi*.
- Pest pressure in the environment.

A.5.6 | Elicitation outcomes of the assessment of the pest freedom for *Eotetranychus lewisi*

E. lewisi was already assessed as relevant pest for commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA, 2024). The similarities between the dossier of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse with dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring and sampling process in place.

The uncertainty of pest pressure of *E. lewisi* in the surrounding environment.

The only difference between Costa Rica and Guatemala is that for Costa Rica there is no uncertainty that the starting material is Elite certified and declared free of specified viruses and bacteria.

Because no major differences were identified the Panel reused the results and reasonings of the Expert Elicitation of pest freedom of the pest *E. lewisi* on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA 2024).

A.5.7 | Elicitation outcomes of the assessment of the pest freedom for *Eotetranychus lewisi*

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 by *E. 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, 11, 050) 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 *E. lewisi* per 10,000 bags 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	9930					9985		9995		9998					9999
EKE results	9930	9947	9959	9971	9979	9986	9990	9995	9997	9998.1	9998.6	9998.9	9999.0	9999.0	9999.0

Note: The EKE results are the fitted values.

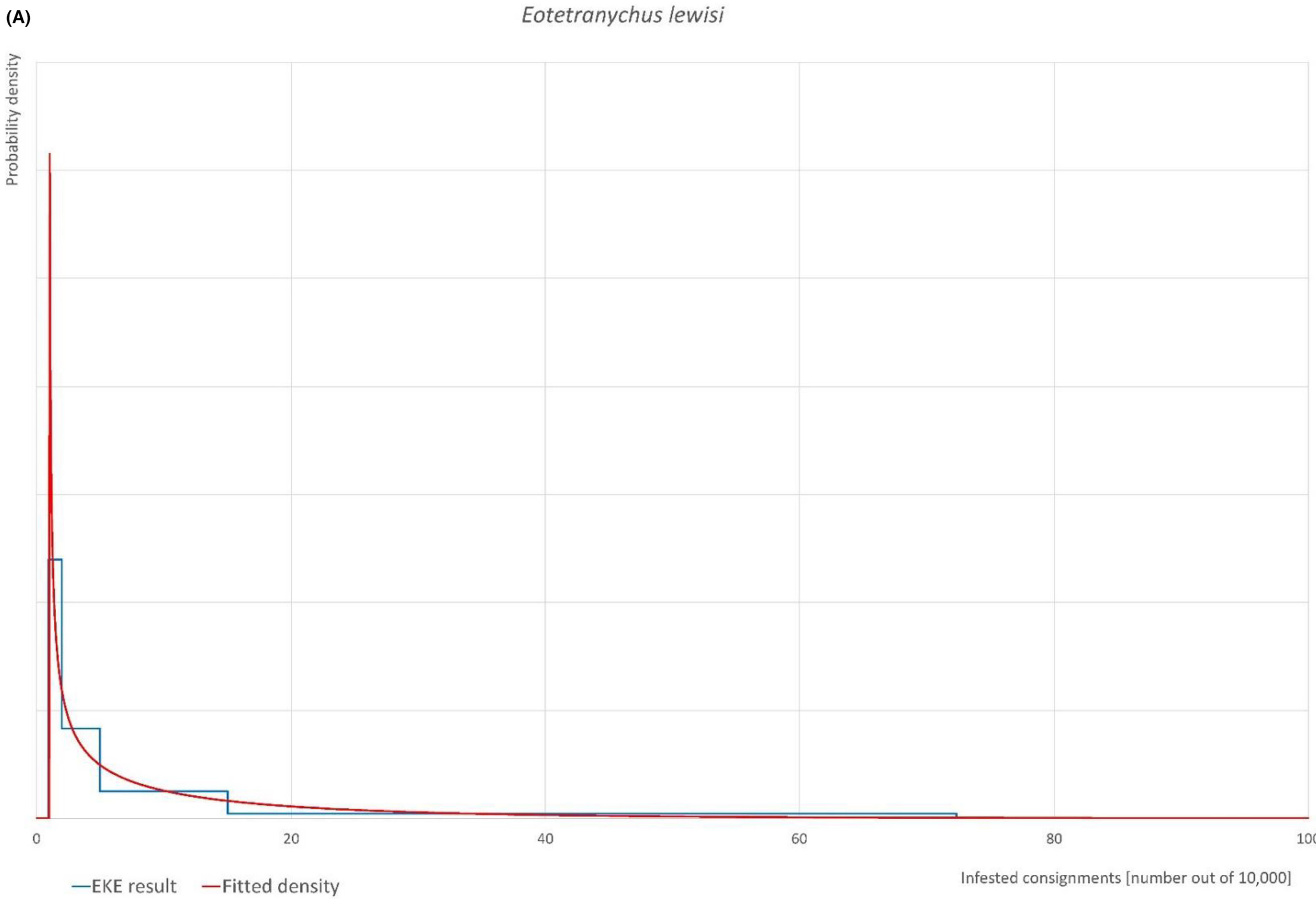

FIGURE A.5 (Continued)

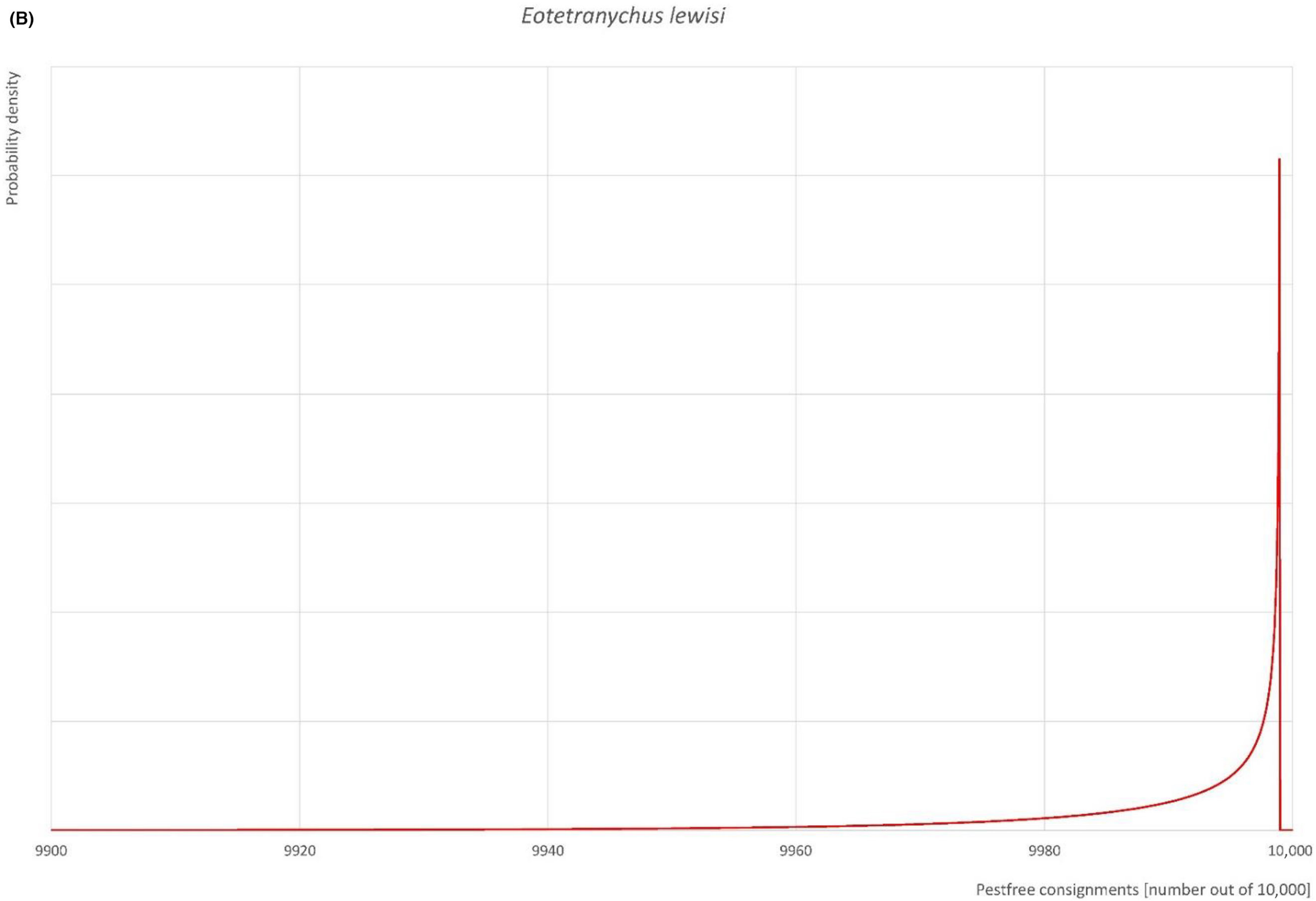

FIGURE A.5 (Continued)

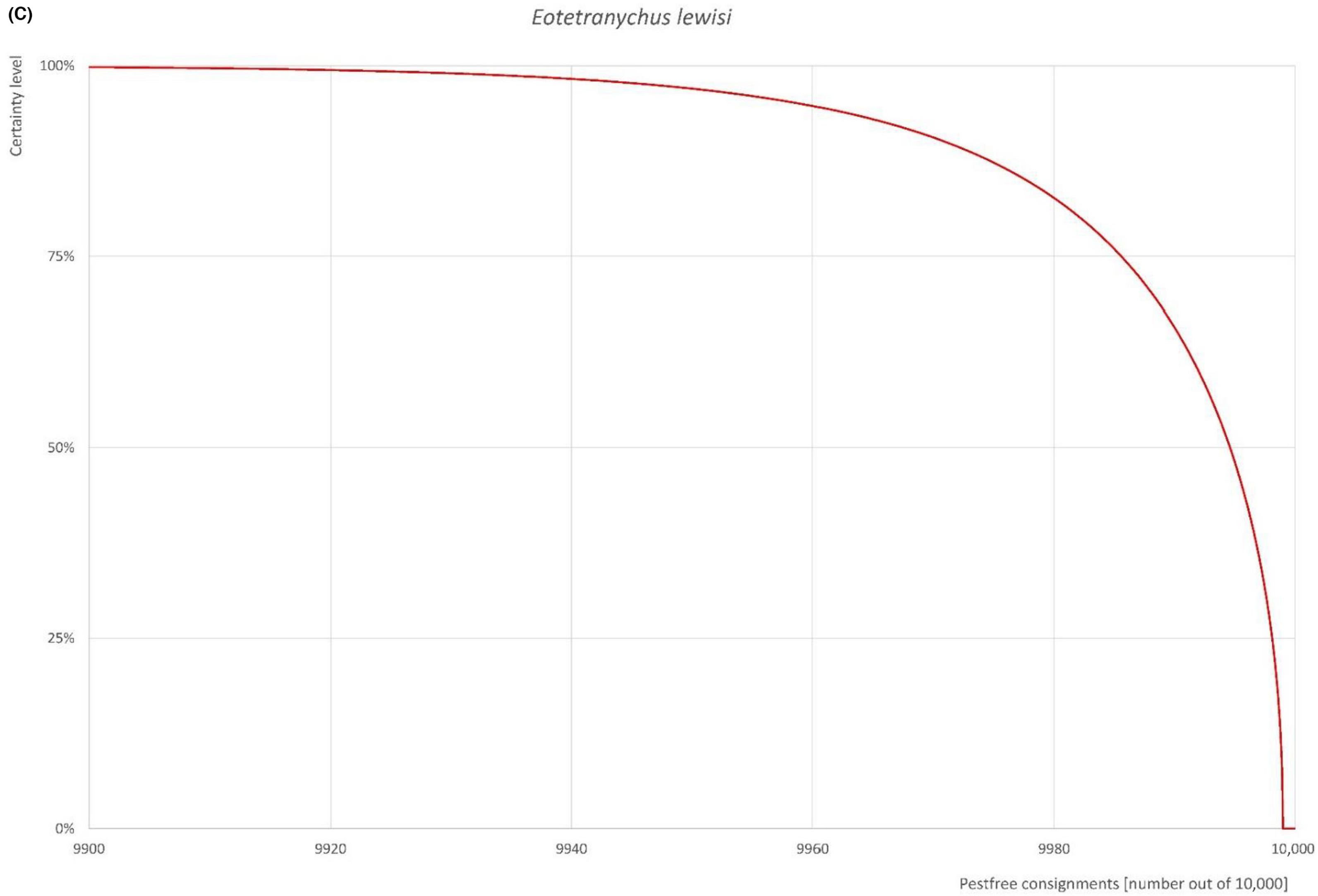

FIGURE A.5 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *Eotetranychus lewisi* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (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.

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A.6 | *EPITRIX* SPP.

A.6.1 | Organism information

Taxonomic information	*Epitrix cucumeris* EPIXCU *Epitrix tuberis* EPIXTU Reasons for clustering: The life cycle of the *Epitrix* species that are pests on potatoes is similar (Eyre and Giltrap, 2013). Class: Insecta Order: Coleoptera Family: Chrysomelidae		
Regulated status	*E. cucumeris* and *E. tuberis* 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 *E. cucumeris* (Harris), *E. similaris* (Gentner), *E. subcrinita* (Lec.) and *E. tuberis* (Gentner).		
Host status on *Petunia* spp./*Calibrachoa* spp.	**Species**	***Petunia* spp./*Calibrachoa* spp. host status**	**Solanaceae host plants**
	Epitrix cucumeris	*E. 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*
	Epitrix tuberis	*E. tuberis* is a pest of *Petunia* 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*, *Lycopersicum*, *Physalis* and *Nicotiana* and *Capsicum*
	Uncertainties: the host status of *Calibrachoa* spp.		
Pest status in Costa Rica	*Epitrix cucumeris* and *Epitrix tuberis* are present in Costa Rica (EPPO, online).		
PRA information	Available Pest Risk Assessments: Two pest risk analyses on *Epitrix* species are available (EPPO, 2010; VKM, 2019)		
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. **Host range and distribution of host plants in the environment:** The most significant host of *E. cucumeris* and *E. tuberis* 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* spp. 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).		

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	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. **Ecology and biology:** *Epitrix* spp. are small flea beetles 1.6–2.2mm long. The hind femurs are enlarged, adapted to jumping. 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 (EPPO, 2005; Eyre and Giltrap, 2013; Boavida et al., 2019). 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). *E. 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 (VKM, 2019). **Symptoms on Petunia spp./Calibrachoa spp.:** 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). 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.
Surveillance information	There are no targeted surveys for *Epitrix* spp. in Costa Rica.

A.6.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description:** The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation:** 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 regularly checks the integrity of the netting. **Uncertainties:** Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description:** Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation:** If implemented correctly, these hygiene measures could be effective in reducing the risk of introduction and/or spread of *Epitrix* spp. **Uncertainties:** The strictness of the measures applied.

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Treatment of growing media	Y	**Description:** The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option. **Evaluation:** Growing substrate is kept free from eggs and larvae of *Epitrix* spp.
Quality of source plant material	Y	**Description:** All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1. for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation:** *E. cucumeris* and *E. tuberis* cannot be introduced with the described certified material used to start a new production cycle.
Crop rotation	N	**Description:** In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
Disinfection of irrigation water	N	**Description:** Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description:** To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation:** The applied insecticides are effective against *Epitrix* spp. adults. **Uncertainties:** The efficacy of the applied insecticide and its timing is not known.
Pest monitoring and inspections	Y	**Description:** Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation:** The monitoring can detect the presence of *Epitrix* spp. adults. Feeding damage by adults is easy to detect. **Uncertainties:** The efficiency of monitoring and inspection.
Sampling and testing	N	**Description:** In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, 1 square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).

(Continues)

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Official Supervision by NPPO	Y	**Description:** Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: The monitoring can detect the presence of *Epitrix* spp. Adults. **Uncertainties**: The efficiency of monitoring and inspection is not known.
Surveillance of production area	Y	**Description**: No details are given for the surveillance of possible pests/pathogens in the surrounding environment. **Evaluation**: There is no information on the pest pressure in the surrounding environment. **Uncertainties**: There is no information on the pest pressure in the surrounding environment.

A.6.3 | Possibility of pest presence in the nursery

A.6.3.1 | Possibility of entry from the surrounding environment

E. cucumeris and *Epitrix tuberis* are pests of many plants of Solanaceae and of other plant families and are reported to be present in Costa Rica. 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. Adults of *E. cucumeris* do not fly and this may hamper the possibility of entering the greenhouse. Defects in the insect proof structure of the production greenhouses could enable adults to enter.

Uncertainties

- Presence of defects in the greenhouse structure.
- Presence of suitable host plants in the surrounding environment.
- Abundance of *Epitrix* spp. in the surrounding environment.

A.6.3.2 | Possibility of entry with new plants/seeds

The certified plant material used to start a new production cycle is not an introduction pathway for *Epitrix* spp.

A.6.3.3 | Possibility of spread within the nursery

Other solanaceous and non-solanaceous host plants could be present in the same nursery. When present, flying adults searching for food sources can spread from infested host plants species within the nursery. *Petunia* spp. plants for export are produced in a separate unit with hygienic standards (thrips-proof netting, double doors, clean uniforms) with no mixing with the other ornamentals. It is unlikely that *Epitrix* spp. can spread to the production unit of *Petunia* spp. plants if all hygienic standards are correctly applied.

Uncertainties

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

A.6.4 | Information from interceptions

There are no interceptions of *Epitrix* spp. from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.6.5 | Overall likelihood of pest freedom

Epitrix spp. was already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of *Epitrix* spp. in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- External environment/land use (Costa Rica, coffee is the dominant cultivation in the surrounding of the nurseries).
- The official testing regime of the starting material is less strict in Guatemala than in Costa Rica (certification system).
- Source of water used for irrigation (surface water for Guatemala, sealed wells in Costa Rica).
- In Guatemala there were more production cycles (with disinfection of growing media with metamsodium) per year and in Costa Rica one cycle with new growing media.

Because no major differences were identified the Panel decided to use the same values elicited for *Epitrix* spp. on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA PLH Panel, 2024).

A.6.5.1 | 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. have never been intercepted on produce from Costa Rica.
- Dispersal capacity of *Epitrix* spp. 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 unlikely.
- The scouting monitoring regime is effective, adult feeding damage is expected to be easily detected.
- Application of the insecticides have a good efficacy against *Epitrix* spp. adults.
- At harvest and packing, cuttings with symptoms will be detected.

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

- *E. cucumeris* and *E. tuberis* are present throughout Costa Rica and they have a wide host range, mainly Solanaceaus plants, including *Petunia* spp. (*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. tuberis* are present and abundant (e.g. near potato fields).
- Presence of *E. cucumeris* and *E. tuberis* 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. tuberis*.

A.6.5.3 | 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.

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 *Epitrix* spp. in the surrounding environment.

A.6.6 | Elicitation outcomes of the assessment of the pest freedom for *Epitrix* spp.

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 *E. tuberis* 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.12.

TABLE A.12 The uncertainty distribution of plants free of *E. tuberis* and *E. cucumeris* per 10,000 bags 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	9995					9997		9998		9999					10,000
EKE results	9995.0	9995.3	9995.6	9996.0	9996.5	9997.0	9997.4	9998.0	9998.7	9999.0	9999.3	9999.5	9999.7	9999.8	9999.9

Note: The EKE results are the fitted values.

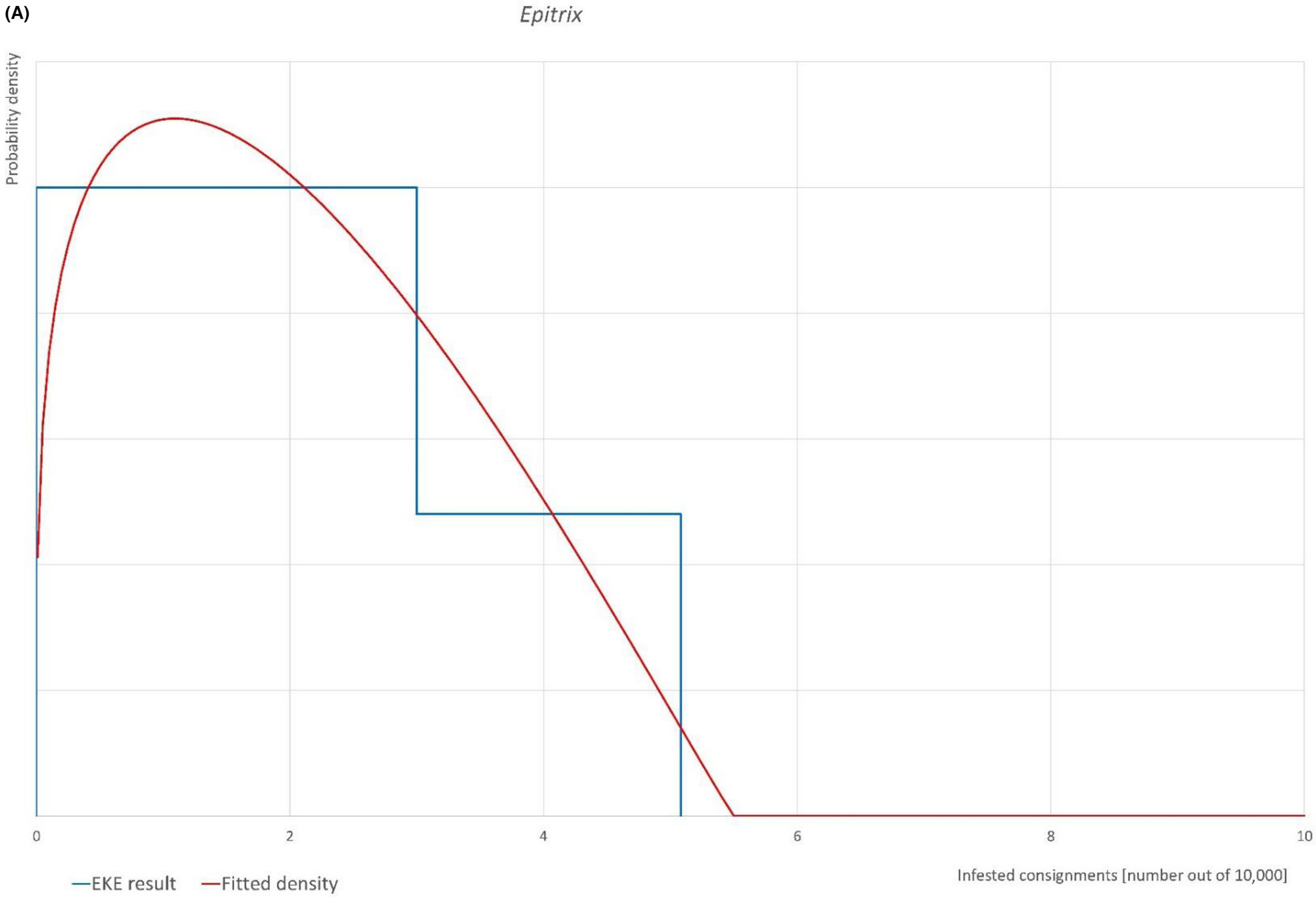

FIGURE A.6 (Continued)

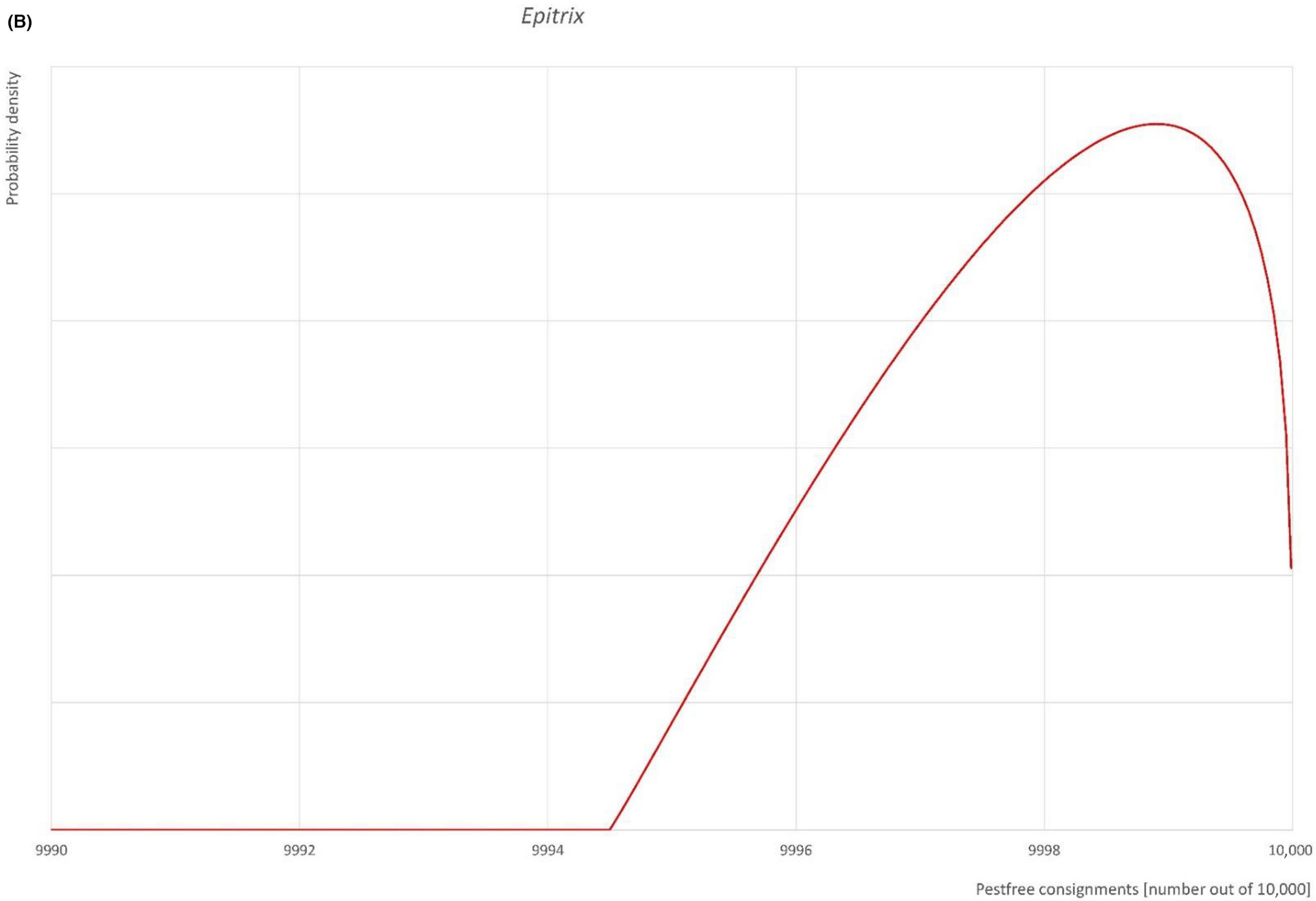

FIGURE A.6 (Continued)

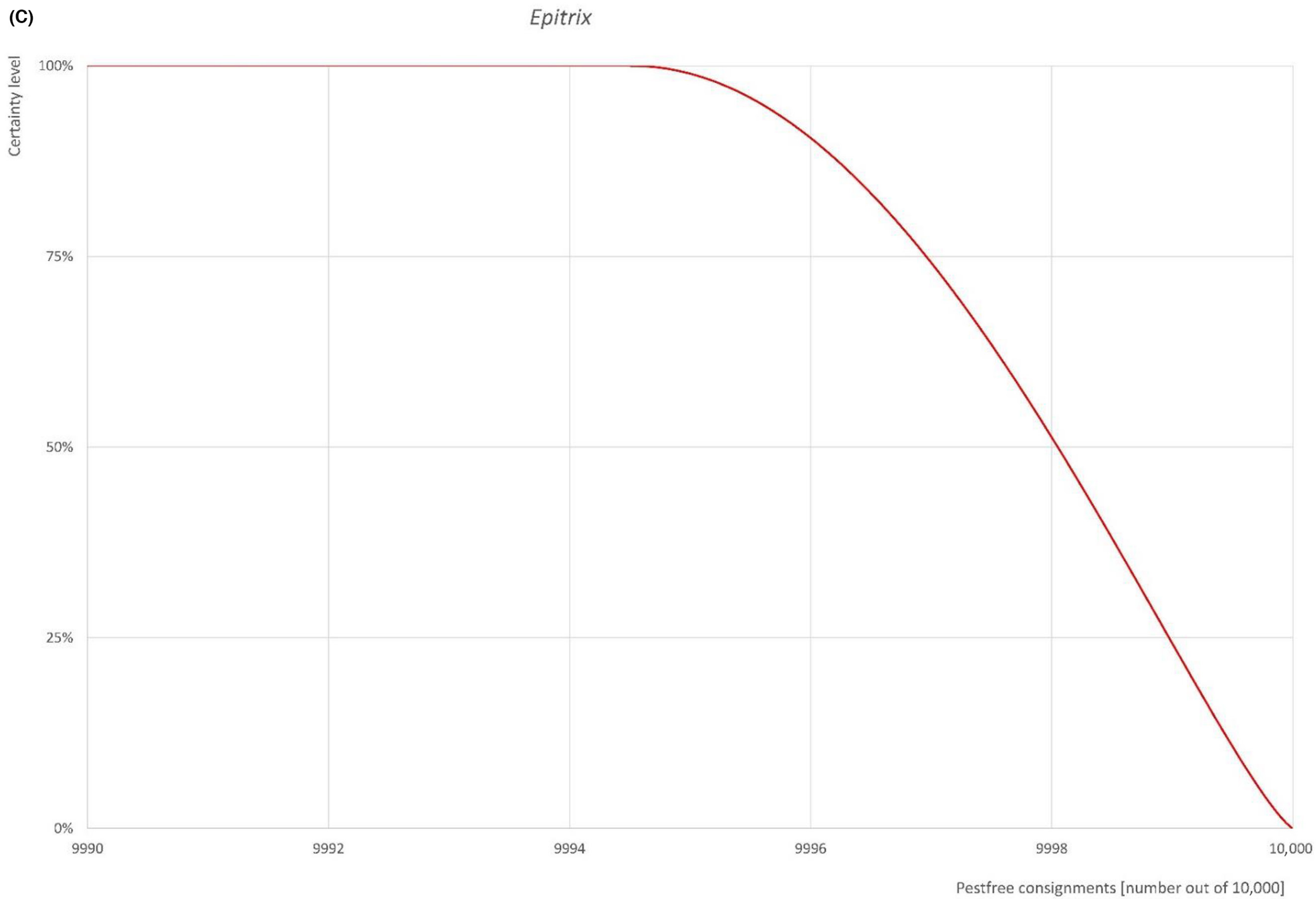

FIGURE A.6 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *Epitrix tuberis* and *Epitrix cucumeris* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional 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.

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A.7 | LEAFMINERS

A.7.1 | Organism information

Taxonomic information	*Liriomyza huidobrensis* (Blanchard) (LIRIHU) *Liriomyza sativae* (Blanchard) (LIRISA) *Liriomyza trifolii* (Burgess) (LIRTR) Reasons for clustering: The three leafmining species have a very similar biology and are therefore evaluated as a group. Class: Insecta Order: Diptera Family: Agromyzidae		
Regulated status	The three leafminer are regulated in the EU (Implementing Regulation (EU) 2019/2072) as follows: *L. huidobrensis* is regulated as a Protected Zone Quarantine pest (Annex III) *L. sativae* is regulated as a Quarantine pest (Annex II A) *L. trifolii* as a Protected Zone Quarantine pest (Annex III)		
Host status on *Petunia* spp./*Calibrachoa* spp.	**Pest name**	***Petunia* spp./ *Calibrachoa* spp. host status**	**Solanaceae host plants**
	L. huidobrensis	*Petunia* spp.	Pepper, Tomato
	L. sativae	*Petunia* spp.	Potato, Tomato
	L. trifolii	*Petunia* spp.	Pepper, Tomato
Pest status in Costa Rica	*L. huidobrensis, L. sativae* and *L. trifolii* are present in Costa Rica (EPPO, online).		
PRA information	Available Pest Risk Assessments: Scientific Opinion on the risks to plant health posed by *L. huidobrensis* (Blanchard) and *Liriomyza trifolii* (Burgess) to the EU territory with the identification and evaluation of risk reduction options (EFSA PLH Panel, 2012)		
Other relevant information for the assessment			
Biology	**Host range and distribution of host plants in the environment:** *L. huidobrensis* is a highly polyphagous species and develops in many different vegetable and flower crops inside as well as outside the greenhouse (Weintraub and Horowitz, 1995). Major host plants of *L. huidobrensis* are *Apium graveolens, Capsicum annuum, Chrysanthemum x morifolium, Cucumis melo, C. sativus, Lactuca sativa, Phaseolus vulgaris, S. lycopersicum* and *Verbena* hybrids (EPPO, online). *Liriomyza sativae* is a highly polyphagous species, with more than 60 host plants in 18 different botanical families (EFSA PLH Panel, 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 PLH Panel, 2020). Major host plants of *L. sativae* are *Cucurbita pepo, Solanum lycopersicum* and *S. tuberosum* (EPPO, online).		

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	L. 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 PLH Panel, 2012). Major host plants of *L. trifolii* are *Apium graveolens* and *Chrysanthemum x morifolium* (EPPO, online). **Characteristics of the pests:** Size of adults: the wing length of the *Liriomyza* species is between 1.3 and 2.25 mm Adult leafminers can naturally spread over short distances through flight or wind assisted dispersal. *Liriomyza* species are polyphagous and on Solanaceae crops can reach high populations. **Symptoms on Petunia spp./Calibrachoa spp.** The presence of *Liriomyza* at the first stage of infestation (eggs, oviposition punctures) are difficult to detect. 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). Presence of mines on leaves are easy to detect though eggs or early-stage larvae may not be easily detected.
What life stages could be expected on the commodity	*Petunia* spp. 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 leafminers in Costa Rica.

A.7.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: The insect proof netting prevents the introduction of insects from the surrounding environment. However, *Liriomyza* spp. adults may be introduced through defects in the greenhouse. Greenhouse staff is regularly checking the integrity of the netting. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: These measures could be effective in reducing the risk of introduction and/or spread of leafminers. **Uncertainties**: None.
Soil treatment	N	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1 for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: The imported material is certified, and for this reason is checked for visual symptoms and it is expected to be free from leafminers. **Uncertainties**: none.
Crop rotation	N	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation**: The products used may also have an effect on populations of *Liriomyza*. **Uncertainties**: The efficacy of the applied insecticide and its timing is not known.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: Populations of *Liriomyza* spp. may be detected through sticky traps and the presence of the pest in the nursery may be detected at an early stage **Uncertainties**: The frequency of the monitoring is not reported
Sampling and testing	N	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, one square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).

(Continued)

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: The monitoring can detect the presence of leafminers. **Uncertainties**: The efficiency of monitoring and inspection is not known.
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any possible pests/pathogens. **Evaluation**: There is no information on the pest pressure in the surrounding environment. **Uncertainties**: There is no information on the pest pressure in the surrounding environment.

A.7.3 | Possibility of pest presence in the nursery

A.7.3.1 | Possibility of entry from the surrounding environment

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

Adult leafminers can naturally spread over short distances through flight or wind assisted dispersal (EFSA PLH Panel, 2012) and could enter the greenhouse through defects in the thrips-proof netting.

A.7.3.2 | Possibility of entry with new plants/seeds

The certified plant material used to start a new production cycle of *Petunia* spp. is not an introduction pathway for *Liriomyza*.

A.7.3.3 | Possibility of spread within the nursery

Other solanaceous and non-solanaceous host plants could be present in the same nursery. When present, flying adults searching for food sources can spread from infested host plants species within the nursery. *Petunia* spp. plants for export are produced in a separate unit with hygienic standards (thrips-proof netting, double doors, clean uniforms) with no mixing with the other ornamentals. It is unlikely that *Liriomyza* can spread to the production unit of *Petunia* spp. plants if all hygienic standards are correctly applied.

<u>Uncertainties</u>

There is no information on the presence of other host plants of *Liriomyza* spp. in the nursery.

A.7.4 | Information from interceptions

For the period 2009–2020 there were seven interceptions of *Liriomyza* spp. on plants imported into the EU from Costa Rica. (EUROPHYT, online).

A.7.5 | Overall likelihood of pest freedom

Leafminers were already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of leafminers in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- External environment/land use (Costa Rica, coffee is the dominant cultivation in the surrounding of the nurseries).

- The official testing regime of the starting material is less strict in Guatemala than in Costa Rica (certification system).
- Source of water used for irrigation (surface water for Guatemala, sealed wells in Costa Rica).
- In Guatemala there were more production cycles (with disinfection of growing media with metamsodium) per year and in Costa Rica one cycle with new growing media.

Because no major differences were identified the Panel decided to use the same values elicited for leafminers on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA PLH Panel, 2024).

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

- Visible symptoms on leaves will allow to easily detect the pests.
- Low population pressure of *L. huidobrensis, L. sativae* and *L. trifolii* in the surrounding environment, because of active natural enemies or absence of preferred host plants.
- Greenhouse structure is insect proof and entrance is thus unlikely.
- The scouting monitoring regime is effective in detecting the presence of leafminers.
- At harvest and packing, cuttings with symptoms will be detected.
- The application of the indicated insecticides has a good efficacy against *Liriomyza.*

A.7.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *Petunia* spp. is a host plant for *L. huidobrensis, L. sativae* and *L. trifolii*.
- *L. huidobrensis, L. sativae* and *L. trifolii* are present throughout Costa Rica and they have a wide host range, mainly Solanaceaus 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* and *L. trifolii* is present and abundant (e.g. on pepper, tomato production) 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
- Insecticide treatments are not specifically targeting *Liriomyza*

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.

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 leafminers in the surrounding environment.

A.7.6 | 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.13) and pest freedom (Table A.14).

TABLE A.13 Elicited and fitted values of the uncertainty distribution of pest infestation by *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	1.00	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.14.

TABLE A.14 The uncertainty distribution of plants free of *Liriomyza huidobrensis, Liriomyza sativae* and *Liriomyza trifolii* per 10,000 bags 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	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.

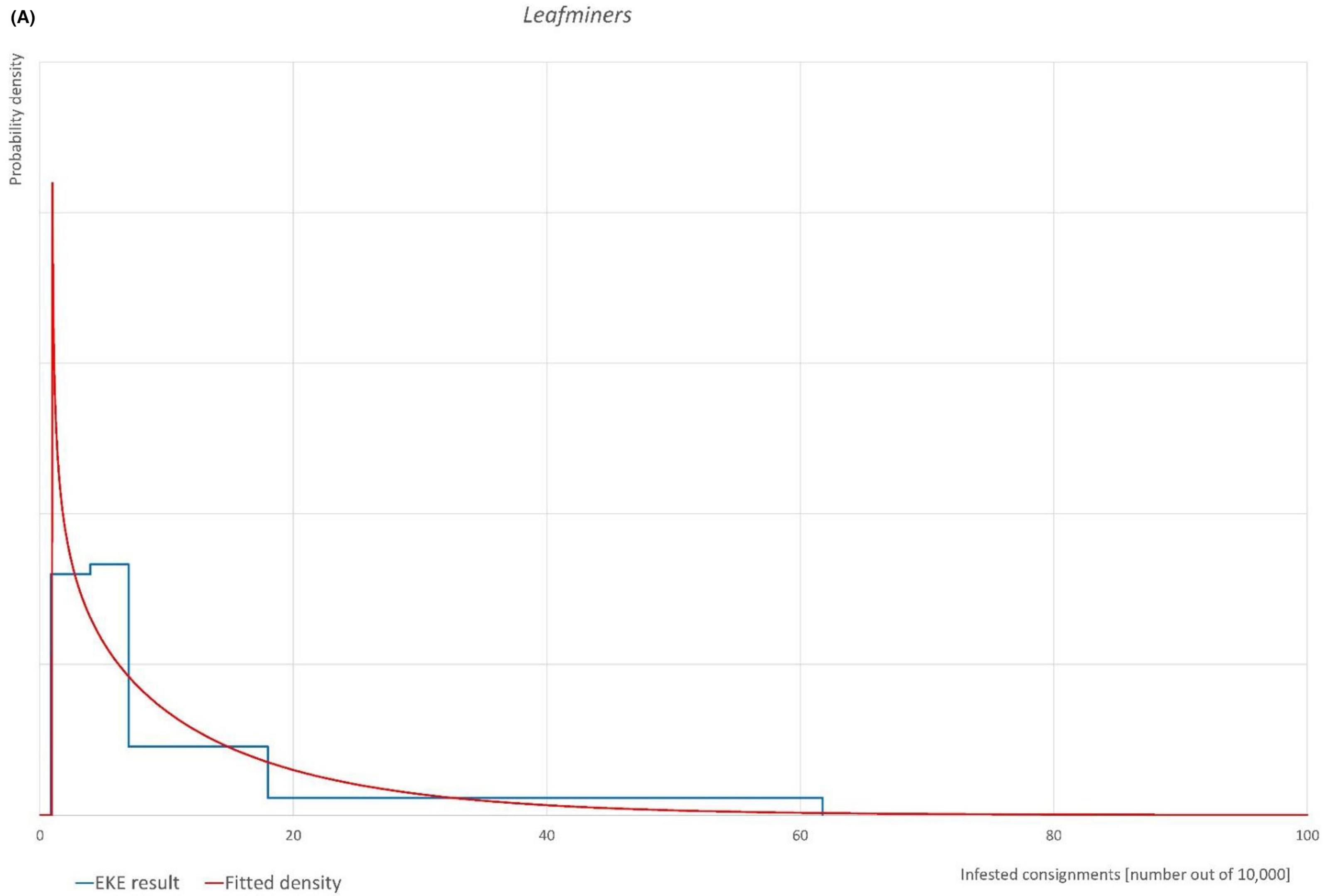

FIGURE A.7 (Continued)

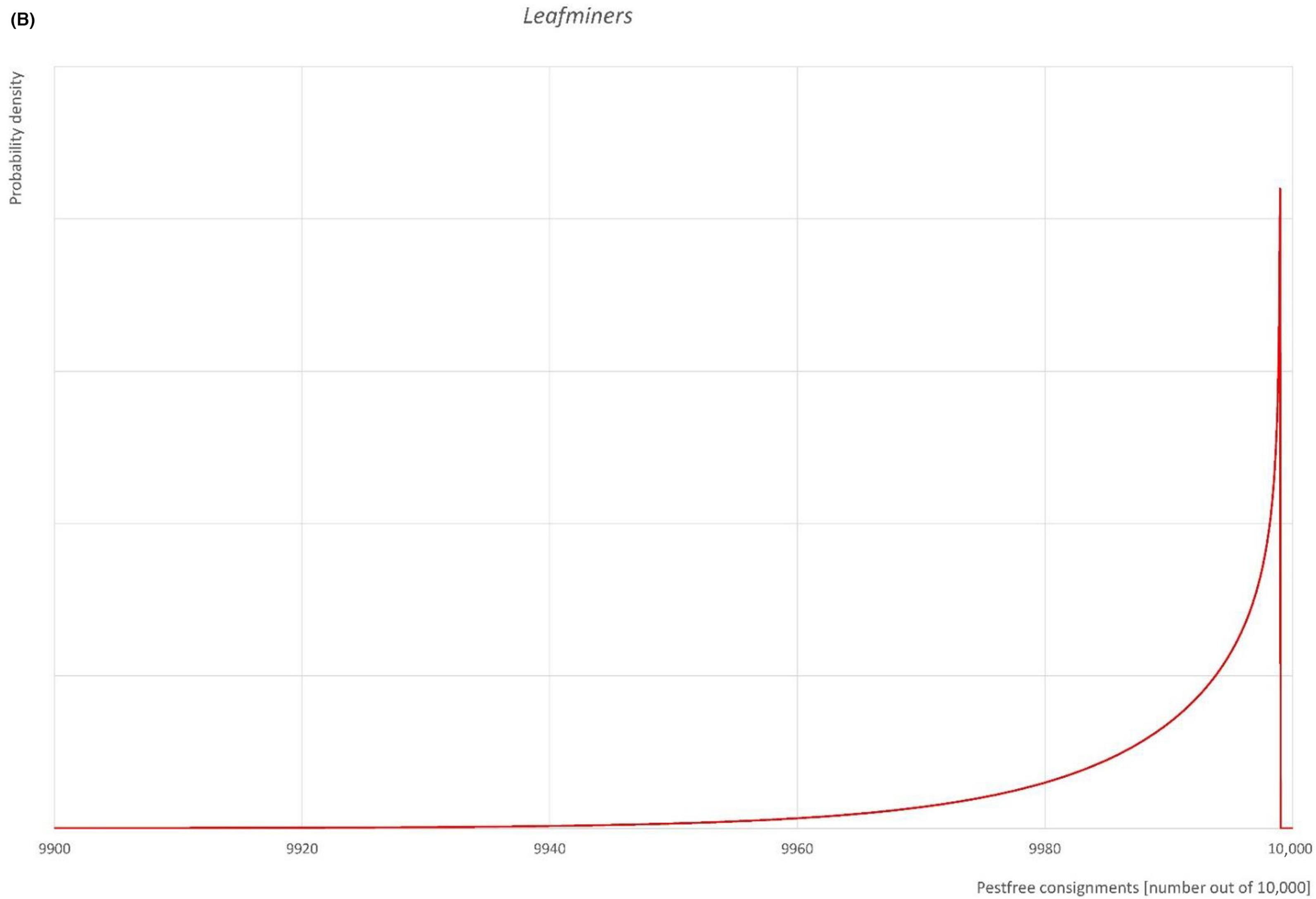

FIGURE A.7 (Continued)

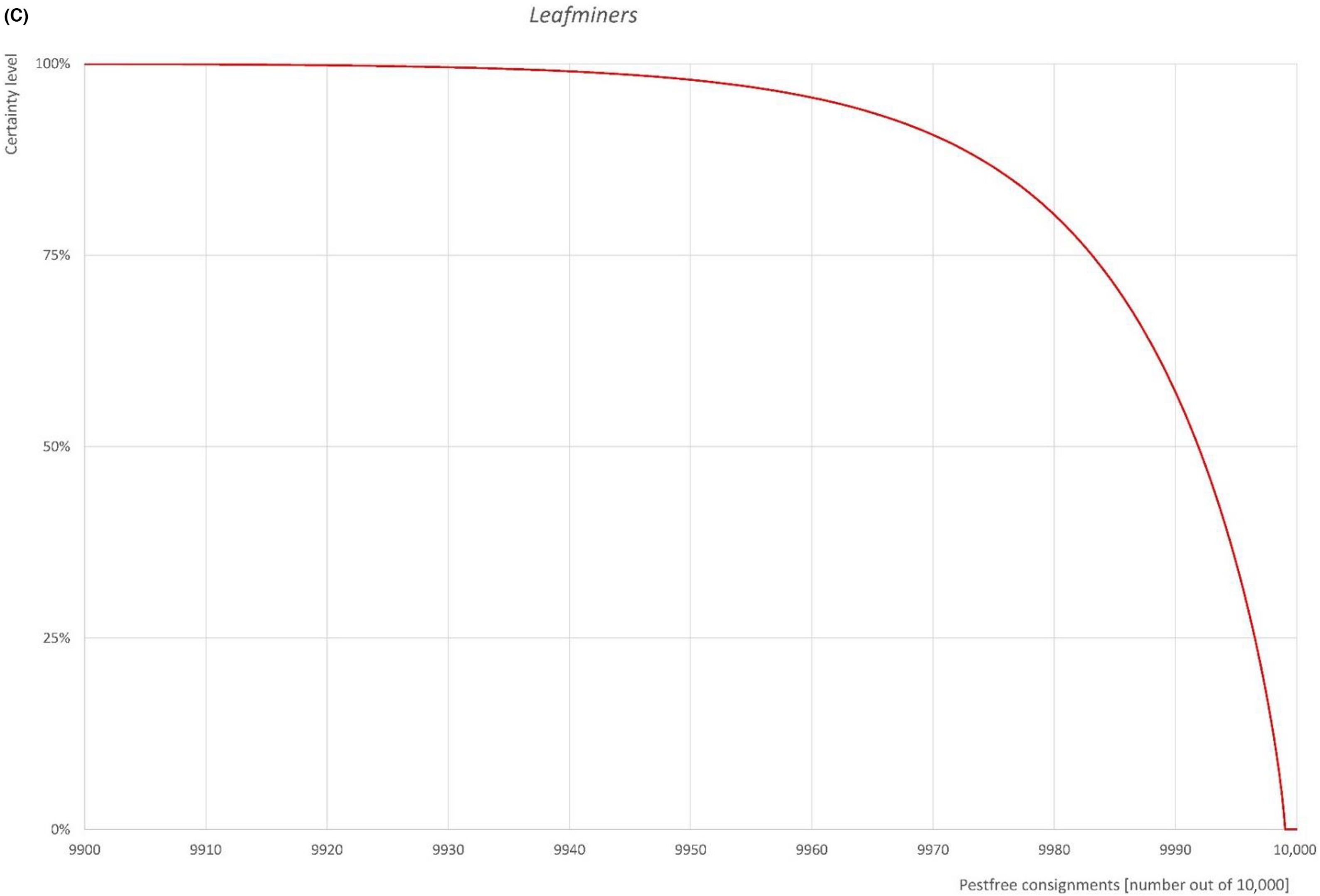

FIGURE A.7 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *Liriomyza huidobrensis, Liriomyza sativae* and *Liriomyza trifolii* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 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.

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A.8 | MOTHS

A.8.1 | Organism information

Taxonomic information	*Helicoverpa zea* (Boddie) (HELIZE) *Chloridea virescens* (Fabricius) (HELIVI) *Spodoptera ornithogalli* (Guenée) (PRODOR) Reasons for clustering: The three moth species have a very similar biology and are therefore evaluated as a group. Class: Insecta Order: Lepidoptera Family: Noctuidae		
Regulated status	*Helicoverpa zea:* Commission Implementing Regulation (EU) 2019/2072, Annex II, Part A *Chloridea virescens* and, *Spodoptera ornithogalli*: Emergency measures		
Host status on *Petunia* spp./ *Calibrachoa* spp.	**Pest name**	***Petunia* spp./*Calibrachoa* spp. host status**	**Solanaceae host plants**
	H. zea	No records	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* spp./*Calibrachoa* spp. However, *H. zea* is highly polyphagous (see biology section) and among the host plants there are several solanaceous host plants. Therefore, the panel assumes that *Petunia* spp./*Calibrachoa* spp. are likely as a host plant species. Uncertainties: the host status of *Petunia* spp. and *Calibrachoa* spp. for H.zea		
Pest status in Costa Rica	*H. zea, C. virescens* and *S. ornithogalli* are present in Costa Rica (EPPO, online).		
PRA information	Available Pest Risk Assessments: 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:** *H. 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 PLH Panel, 2020; EPPO online). *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; Karpinski et al., 2014) for *C. viresecens*. 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), *P. vulgaris* (common bean), *Solanum lycopersicum* (tomato) and *Zea mays* (maize) (EPPO, online). *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; Capinera, 2008).		

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	Ecology: The adult moths have a wingspan ranging from 32 to 45 mm and live over 30 days in optimal conditions. They are nocturnal and hide in vegetation during the day. Females can lay up to 2500 eggs in their lifetime. **Symptoms and characteristic of the pest:** Feeding holes of *H. zea* larvae can be seen in tomato fruits, cotton bolls, cabbage and lettuce hearts, and flower heads (EPPO, 2023) The larvae of *C. 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 toward and penetrate the fruit, the risk of pathogen infection increases considerably (EPPO, 2015; Capinera, 2008). The larvae of *S. ornithogalli* damage plants mainly by consumption of foliage. The small gregarious larvae tend to skeletonise 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 (Capinera, 2008; EPPO, 2015; Fernández et al. 2004).
What life stages could be expected on the commodity	Eggs and larvae could be present on harvested unrooted cuttings of *Petunia* spp./*Calibrachoa* spp.
Surveillance information	No information provided.

A.8.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: 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. The insect proof netting is regularly checked. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: These measures could be effective in reducing the risk of introduction and/or spread of moths. **Uncertainties**: none.
Treatment of growing media	N	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1. for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: The certified plant material used to start a new production cycle is not an introduction pathway for these moth species. **Uncertainties**: none.

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Crop rotation	N	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation**: The applied insecticides can be effective against Lepidoptera. **Uncertainties**: The efficacy of the applied insecticide and its timing is not known.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: If one of the moth species would be present in the greenhouse, they should be monitored with species specific pheromone traps. Some moths can be caught by yellow sticky traps. Eggs and feeding damage are easy to detect. **Uncertainties**: The efficiency of monitoring and inspection.
Sampling and testing	N	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, 1 square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11).

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
		Evaluation: All three moth species have a quarantine status in the EU and plants exported to the EU should be free of these pests. **Uncertainties:** – The efficiency of monitoring and inspection is not known.
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any possible pests/pathogens. **Evaluation**: There is no information on the pest pressure in the surrounding environment. **Uncertainties**: There is no information on the pest pressure in the surrounding environment.

A.8.3 | Possibility of pest presence in the nursery

A.8.3.1 | 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 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.

Uncertainties

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

A.8.3.2 | Possibility of entry with new plants/seeds

It is unlikely that eggs or larvae are present on imported certified propagation material.

A.8.3.3 | Possibility of spread within the nursery

Other solanaceous and non-solanaceous host plants could be present in the same nursery. When present, flying adults searching for oviposition sites can spread from infested host plants species within the nursery. Petunia spp. plants for export are produced in a separate unit with hygienic standards (thrips-proof netting, double doors, clean uniforms) with no mixing with the other ornamentals. It is unlikely that moths can spread to the production unit of *Petunia* spp. plants if all hygienic standards are correctly applied.

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.8.4 | Information from interceptions

There are no interceptions of *C. virescens*, *H. zea* and *S. ornithogalli* from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.8.5 | Overall likelihood of pest freedom

Moths were already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of moths in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- External environment/land use (Costa Rica, coffee is the dominant cultivation in the surrounding of the nurseries).

- The official testing regime of the starting material is less strict in Guatemala than in Costa Rica (certification system).
- Source of water used for irrigation (surface water for Guatemala, sealed wells in Costa Rica).
- In Guatemala there were more production cycles (with disinfection of growing media with metamsodium) per year and in Costa Rica one cycle with new growing media.

Because no major differences were identified the Panel decided to use the same values elicited for moths on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA PLH Panel, 2024).

A.8.5.1 | 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 for *H. zea*
- *Helicoverpa zea, C. virescens* and *S. ornithogalli* have never been intercepted on produce from Costa Rica.
- Low population pressure of the moth species in the surrounding environment, due to the limited presence of preferred host plants.
- Greenhouse structure is insect proof and entrance by moths is unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected.
- Application of the insecticides have a good efficacy against Lepidoptera.
- At harvest and packing, cuttings with symptoms will be detected.

A.8.5.2 | 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 Costa Rica and they have a wide host range, including Solanaceaus plant species and 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 cultivation).
- 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.8.5.3 | 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 monitoring system will detect these moth species, triggering treatments.

A.8.5.4 | 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 three moth species in the surrounding environment.

A.8.6 | 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.15) and pest freedom (Table A.16).

TABLE A.15 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.16.

TABLE A.16 The uncertainty distribution of plants free of *Helicoverpa zea, Chloridea virescens* and *Spodoptera ornithogalli* per 10,000 bags 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	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.

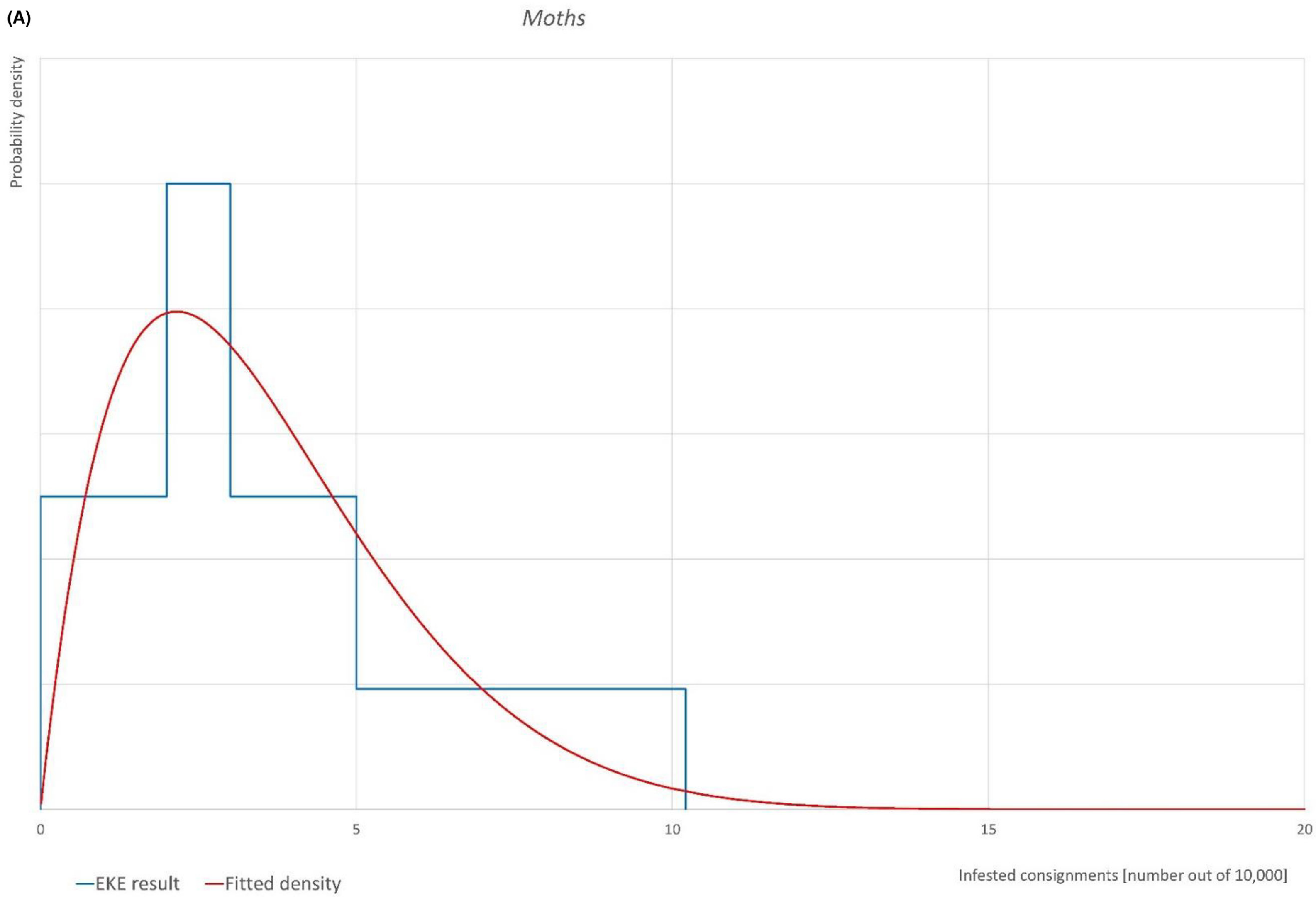

FIGURE A.8 (Continued)

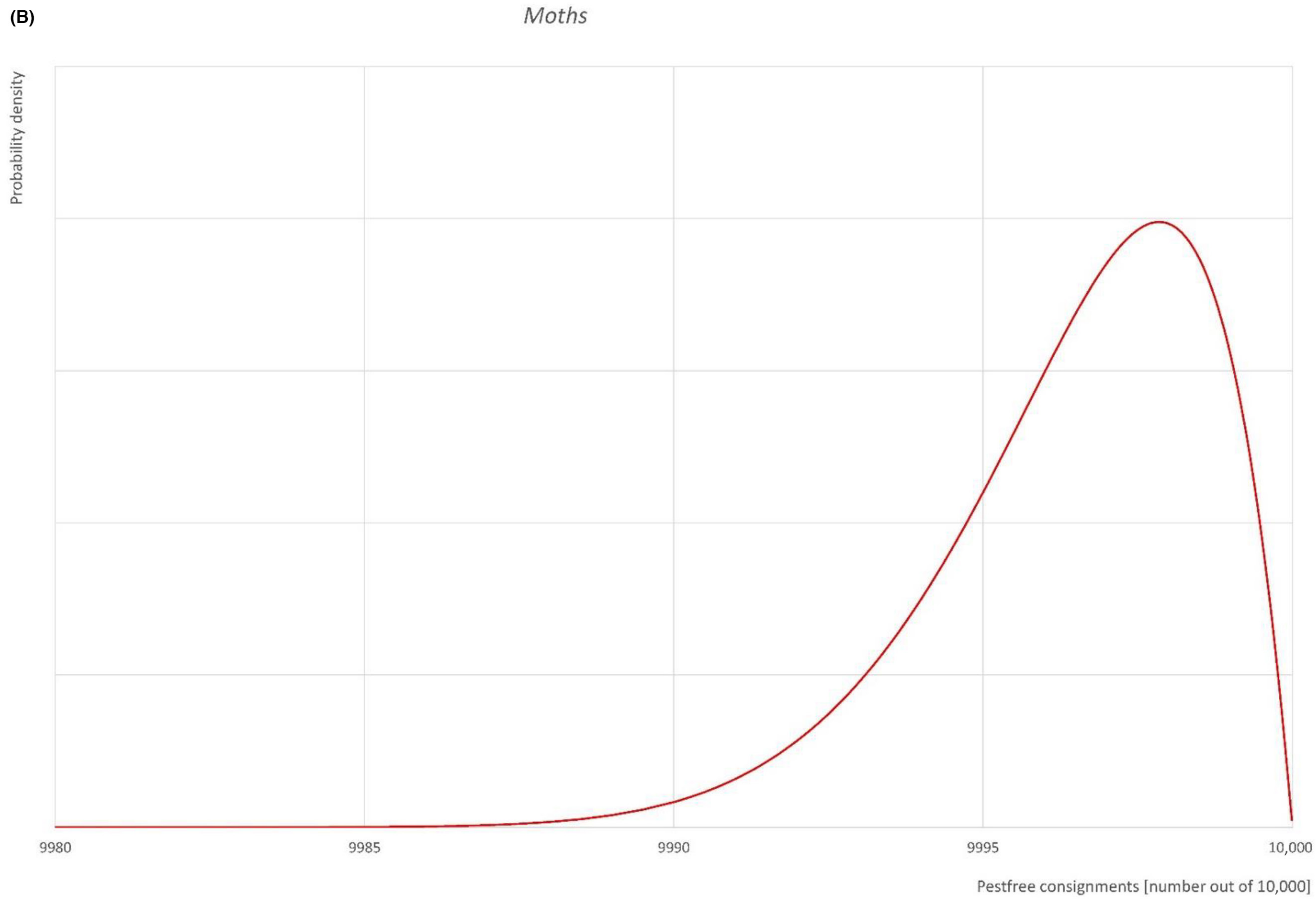

FIGURE A.8 (Continued)

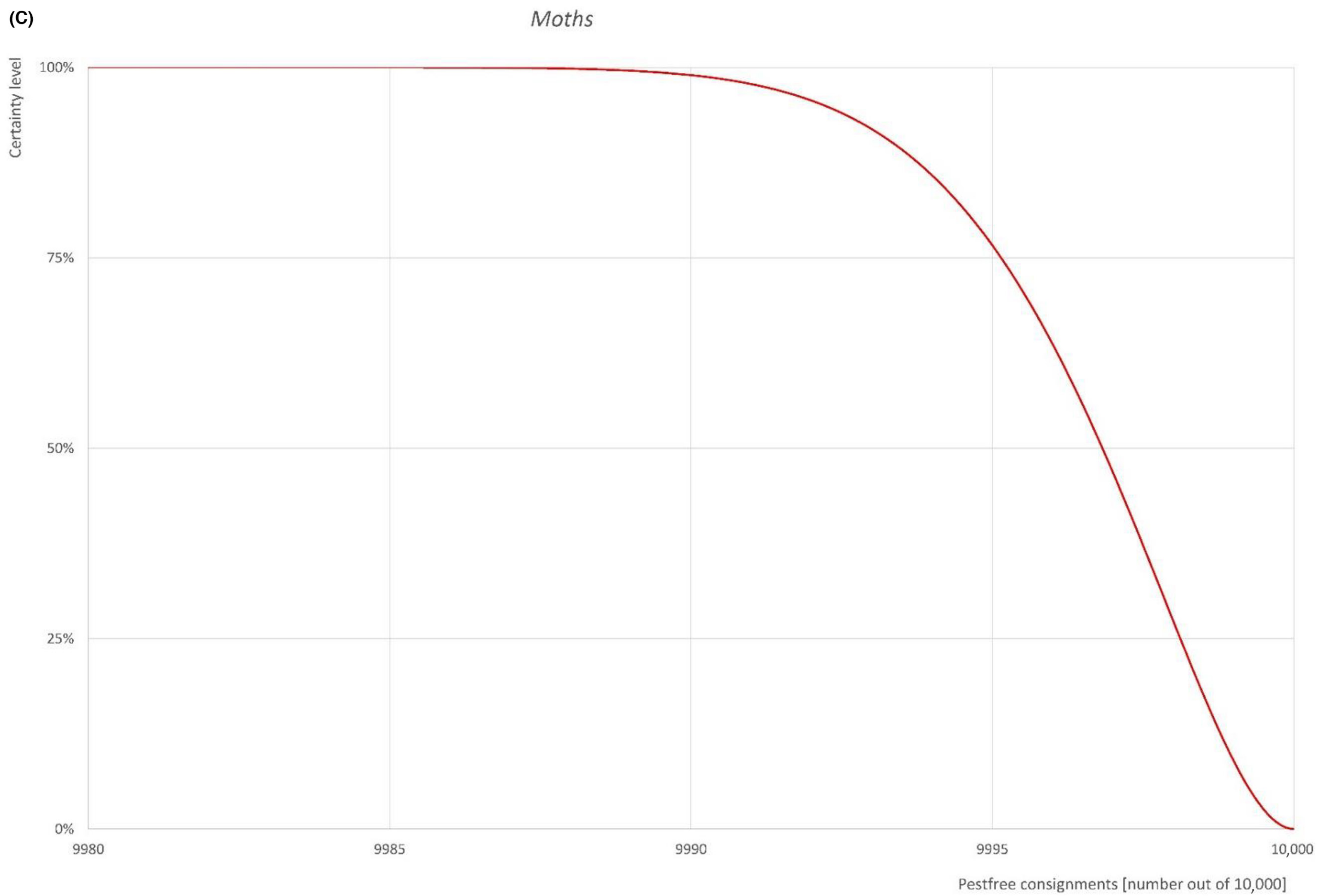

FIGURE A.8 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *Helicoverpa zea, Chloridea virescens* and *Spodoptera ornithogalli* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 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.

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A.9 | POTATO SPINDLE TUBER VIROID

A.9.1 | Organism information

Taxonomic information	Current valid scientific name: *Pospiviroid fusituberi* Previously known as: Potato spindle tuber viroid EPPO Code: PSTVD0 (International Committee on Taxonomy of Viruses, https://ictv.global/report/chapter/pospiviroidae/pospiviroidae/pospiviroid) Synonyms: Potato spindle tuber viroid; Potato gothic virus; Potato spindle tuber pospiviroid; Potato spindle tuber virus; Tomato bunchy top viroid (CABI, EPPO; online) Kingdom: Viruses and viroids Family: *Pospiviroidae* *Genus: Pospiviroid*
Regulated status	Potato spindle tuber viroid is a regulated non-quarantine pest (RNQP) included in the Commission Implementing Regulation (EU) 2019/2072 in Annex IV (Part D, Part F, Part G and Part I).
Pest status in Costa Rica	Present (EPPO, CABI, online).
Pest status in the EU	EU regulated pest
Host status on *Petunia* spp.	*Petunia* spp. plants are hosts of PSTVd (CABI, EPPO, online).
Host status on *Calibrachoa* spp.	*Calibrachoa* spp. plants are hosts of PSTVd (CABI, EPPO, online).
PRA information	Available Pest Risk Assessments: – Scientific Opinion on the assessment of the risk of solanaceous pospiviroids for the EU territory and the identification and evaluation of risk management options (EFSA PLH Panel, 2011).

(Continued)

Other relevant information for the assessment		
Biology	PSTVd was identified as the causal agent of the potato 'gothic' disease reported in USA in 1922 (Martin, 1922) and in Russia in the early 1930s in *Solanum tuberosum* (Diener and Smith, 1971). Since then, the viroid is spread in all continents where potato plants grow (CABI, EPPO; online). In central Africa PSTVd is reported to be present in Kenya, Nigeria and Ghana (CABI, online). PSTVd can be experimentally transmitted to many plant species essentially by contact and cutting tools, especially at temperatures above 25°C. In addition, PSTVd can be spread by vegetative propagation and transmission via seeds (Matsushita and Tsuda, 2016). However, lack of seed transmission has also been reported (Faggioli et al., 2015, Verhoeven et al., 2020) and a recent report (Verhoeven et al., 2021) suggests that the role of seed transmission in the spread of pospiviroids (including PSTVd) in pepper and tomato may have been overestimated. Horizontal transmission through infected pollen has been documented for PSTVd (Kryczyński et al., 1988, Singh et al., 1992, Yanagisawa and Matsushita 2018). It has been reported that PSTVd can be transmitted by insect vectors under specific ecological conditions (Salazar et al., 1995), however in some cases it cannot be excluded that cross-contamination (such as contact transmission) could have occurred. PSTVd has been reported to be transmitted by aphids when trans-encapsidated in particles of potato leafroll virus (Querci et al., 1997), with the virion acting as a carrier of the viroid RNA (Syller et al., 1997).	
Symptoms	**Main type of symptoms**	Symptoms induced by PSTVd depend on the isolate, the affected host and the environmental conditions (temperature and light conditions). In general, in the early stages of pospiviroid infection, a growth reduction and chlorosis in the upper leaves and reduced fruit size are generally observed (Verhoeven et al., 2004). In addition, other types of symptoms such as rugosity and irregular ripening might occur. Growth reduction may develop into stunting and bunchy growth, and the chlorosis may become more severe, turning into reddening, purpling and/or necrosis. However, PSTVd infection of solanaceous ornamental plants is usually symptomless (Verhoeven et al., 2008).
	Presence of asymptomatic plants	PSTVd infection of solanaceous ornamental plants is usually symptomless (Verhoeven et al., 2008).
	Confusion with other pathogens/pests	Symptoms induced by PSTVd can be confused with those induced by other pospiviroids (Verhoeven et al., 2004).
Host plant range	PSTVd has a broad host range (EPPO, online) including numerous solanaceous (tomato, pepper, potato, tobacco) and herbaceous species, including ornamentals (Petunia spp. and Calibrachoa spp. are reported as natural hosts). The host plant range of PSTVd includes the following species: *Anisodus stramoniifolius* (experimental), *Anisodus tanguticus* (experimental), *Argyranthemum frutescens*, *Atriplex semilunaris* (wild, weed), *Atropa belladonna* (experimental), *Atropanthe sinensis* (experimental), *Browallia americana* (experimental), *Browallia viscosa* (experimental), *Brugmansia* sp., *Brugmansia sanguinea*, *Brugmansia suaveolens*, ***Calibrachoa* spp.,** *Campanula medium* (experimental), *Capsicum annuum*, *Capsicum baccatum* (experimental), *Cardiospermum halicacabum* (experimental), *Cerastium tomentosum* (experimental), *Cestrum aurantiacum*, *Cestrum elegans*, *Cestrum endlicheri*, *Cestrum nocturnum*, *Chenopodium eremaeum*, *Convolvulus tricolor* (experimental), *Conyza bonariensis*, *Dahlia* sp., *Datura leichhardtii*, *Datura* sp. (wild/weed), *Dianthus barbatus*, *Diascia* sp., *Erigeron bonariensis*, *Gomphrena globosa*, *Gynura aurantiaca* (experimental), *Hevea brasiliensis*, *Ipomoea batatas*, *Jaltomata contorta* (experimental), *Jaltomata procumbens* (experimental), *Lycianthes rantonnetii*, *Myosotis sylvatica* (experimental), *Nicandra physalodes*, *Nicotiana* sp. (experimental), *Penstemon richardsonii* (experimental), *Persea americana*, ***Petunia* spp.,** *Physalis* sp., *Physalis angulate*, *Physalis peruviana*, *Physochlaina physaloides* (experimental), *Rhagodia eremaea*, *Salpiglossis sinuate* (experimental), *Salpiglossis spinescens* (experimental), *Scabiosa japonica* (experimental), *Schizanthus pinnatus* (experimental), *Schizanthus retusus* (experimental), *Scopolia carniolica* (experimental), *Solanum americanum*, *Solanum anguivi* (wild/weed), *Solanum aviculare* (experimental), *Solanum betaceum* (experimental), *Solanum chacoense*, *Solanum coagulans* (wild/weed), *Solanum dasyphyllum* (wild/weed), *Solanum dulcamara* (wild/weed), *Solanum laxum*, *Solanum lycopersicum*, *Solanum melongena*, *Solanum multiinterruptum*, *Solanum muricatum*, *Solanum nigrum*, *Solanum pseudocapsicum*, *Solanum sisymbriifolium*, *Solanum sucrense*, *Solanum tuberosum*, *Solanum verrucosum*, *Streptoglossa* sp., *Streptosolen jamesonii*, *Valeriana officinalis* (experimental) (CABI, EPPO, online)	
Evidence that the commodity can be a pathway	*Petunia* spp. and *Calibrachoa* spp. plants are systemic hosts of PSTVd therefore their cuttings can serve as pathways of entrance of the viroid in the EU territory.	
Surveillance information	PSTVd is tested on imported mother stock plants from Germany. There are no targeted surveys for PSTVd in Costa Rica.	

A.9.2. | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: There is anecdotal evidence that insects may facilitate the mechanical transmission of PSTVd, therefore not the main mean of transmission. The insect proof netting prevents the introduction of insects from the surrounding environment. However, insects may be introduced through defects in the greenhouse or as hitchhiking on workers. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description:** Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: Hygiene measures are in place to prevent mechanical transmission of PSTVd by contact and infected tools and debris. The double door system with the expeller fan at the door can be effective in preventing the entry of insects that may facilitate spread of PSTVd. As PSTVd is not found during surveys, the above-mentioned measures are appropriate. **Uncertainties**: The strictness of the measures in place.
Treatment of growing media	N	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1 for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: We assume that all plants originate from EU countries (Germany). Because mother plants are tested for PSTVd as part of the certification scheme, it is assumed that the starting material is pest-free. The Panel assumes that the phytosanitary status of the intermediate stock is similar to that of the imported ELITE material. **Uncertainties**: none
Crop rotation	Y	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season. **Evaluation**: In case of introduction into the greenhouse, due to the mechanical mode of transmission and the persistence of the viroid to infected tools, surfaces and debris, inoculum may build up since the same unit is used for production of *Petunia* spp./*Calibrachoa* spp. The system of crop rotation and disinfection applied prevents the spread in between crops and between cropping periods. **Uncertainties**: The efficiency in which these measures are applied.
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation**: There is anecdotal evidence that insect may facilitate the mechanical transmission of PSTVd, therefore the application of products against a range of insect species might have a limited effect on PSTVd spread **Uncertainties**: The efficiency of the applied insecticides against insects and any possible effect on PSTVd spread.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: Routine monitoring can detect the presence of visual symptoms of PSTVd, taking weekly samples and analysing them. All plants with symptoms are tested and random samples are taken in the crop. Yellow and blue sticky traps are effective to detect the presence of insects. However, early infections cannot be detected due to the lack of symptoms. **Uncertainties**: – The efficiency of monitoring and inspection. – The length of the latent period necessary to the expression of symptoms/the likelihood of asymptomatic PSTVd infections.
Sampling and testing	Y	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, 1 square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4). **Evaluation**: Imported mother plants and propagated plants are tested for PSTVd. While the imported plants are PSTVd-free, routine testing in production plants using ELISA does not allow detection of PSTVd. The inspection will not detect any PSTVd infection that are asymptomatic. Therefore, it is highly unlikely to detect PSTVd infection in the production plant. The sampling measures will miss PSTVd-infected asymptomatic plants. **Uncertainties**: none
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11).

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
		Evaluation: The monitoring cannot detect PSTVd due to the lack of symptoms and there is no specific testing applied for PSTVd. **Uncertainties**: None
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any other possible pests/pathogens. **Evaluation**: There is no survey for PSTVd in the area of production. **Uncertainties**: none

A.9.3 | Possibility of pest presence in the nursery

A.9.3.1 | Possibility of entry from the surrounding environment

PSTVd is present in Costa Rica. Natural host range of PSTVd is wide, including weeds that can act as reservoirs of PSTVd. Therefore, PSTVd may be present in the surrounding environment of the nursery. PSTVd is mechanically (contact) transmitted therefore, it can enter the nursery by staff, insects (to a much lower extent) or tools contaminated by PSTVd. Strict hygiene measures are in place to prevent the mechanical PSTVd infection from outside the nursery. However, failures in the applied hygiene measures may allow the entry of the viroid from the surrounding environment.

Uncertainties

- Presence and distribution of host plants in the surroundings.
- Infection (viroid) pressure in the surroundings.
- Strictness of application of hygiene measures.

A.9.3.2 | Possibility of entry with new plants/seeds

Plant material (cuttings) for *Petunia* spp. and *Calibrachoa* spp. mother plants used for the production of unrooted cuttings correspond to Certified Elite Material, coming from EU countries (Germany). Molecular (RT-PCR) tests are used for Pospiviroids including PSTVd (potato spindle tuber viroid, tomato chlorotic dwarf viroid, tomato apical stunt viroid, chrysanthemum stunt viroid, Citrus exocortis viroid, Columnea latent viroid, Mexican papita viroid, tomato planta macho viroid, Iresine viroid 1 and pepper chat fruit viroid). The certification scheme in place for *Petunia* spp. and *Calibrachoa* spp. includes PSTVd and therefore it can be assumed that the starting material is free of PSTVd.

Other solanaceous and non-solanaceous plants are produced in the same nursery, even though not in the same compartments. No data are provided for the identity, proportion, origin and phytosanitary status of plants other than *Petunia* spp. and *Calibrachoa* spp. produced in the same nursery.

Uncertainties

None

A.9.3.3 | 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 PSTVd could be present in other greenhouses/compartments of the nursery. PSTVd may spread by vegetative propagation of infected mother plants. Upon the establishment of infected plants, PSTVd can spread within the nursery during agricultural practices (e.g. by cultivation practices, handling of plants, contaminated tools etc.). Strict hygiene measures are in place to prevent spread of PSTVd by mechanical transmission.

There are anecdotal evidence that insects (i.e. viruliferous *M. persicae*) could facilitate the spread of PSTVd between the different or within the same greenhouse/compartment. *Petunia* spp. and *Calibrachoa* spp. are propagated in separate units from other plants.

Uncertainties

- The presence and incidence of the PSTVd in the nursery.

- The presence and the host status for PSTVd of other plant species (solanaceous, non-solanaceous) growing in the same nursery.
- Strictness of application of hygiene measures.

A.9.4 | Information from interceptions

There are no interceptions of PSTVd from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.9.5 | Overall likelihood of pest freedom

PSTVd was already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Kenya (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Kenya are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of PSTVd in the surrounding environment.

The differences between Costa Rica and Kenya are:

- External environment/land use (Costa Rica, coffee isyhe dominant cultivation in the surrounding of the nurseries)

Because no major differences were identified the Panel decided to use the same values elicited for PSTVd on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Kenya (EFSA PLH Panel, 2024).

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

- PSTVd has not been reported on *Petunia* spp./*Calibrachoa* spp. in Costa Rica.
- PSTVd has never been intercepted on produce from Costa Rica.
- Low infection pressure (prevalence of host plants) of PSTVd in the surrounding environment.
- No infection pressure (prevalence of host plants) of PSTVd in other greenhouses/compartments of the nursery.
- At harvest and packing, cuttings with symptoms are easy to be detected.
- Efficient isolation measures of lots in case of infestation.

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

- *Petunia* spp./*Calibrachoa* spp. are very sensitive to PSTVd infections.
- PSTVd is reported in Costa Rica in potato. Infested potato crops could be present in the vicinity of the nursery.
- Presence of PSTVd in the environment is not monitored.
- It cannot be excluded that PSTVd is introduced by staff in the nursery by contaminating tools.
- Transmission of PSTVd via vegetative propagated material increases the probability of their entry and establishment in the nursery on *Petunia* spp./*Calibrachoa* spp. or other host plant species.
- PSTVd infections are asymptomatic, therefore PSTVd infections are not detected.
- Sanitization measures are not efficient against PSTVd.

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

- Starting material is PSTVd-free, all PSTVd infection can only originate from staff contamination.
- Solanaceous are sensitive/generic hosts for PSTVd species.
- There are no records of interceptions from Costa Rica.

A.9.5.4 | 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.9.5.5 | Elicitation outcomes of the assessment of the pest freedom for potato spindle tuber viroid

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 potato spindle tuber viroid 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		20					100
EKE	0.00250	0.0152	0.0594	0.233	0.647	1.46	2.64	6.41	13.1	18.4	26.5	37.4	53.0	69.1	91.1

Note: The EKE results is the *BetaGeneral* (0.50797, 365.55, 0, 10,000) 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 potato spindle tuber viroid per 10,000 bags of unrooted cuttings calculated by Table A.17.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Values	9900					9980		9995		9998					10,000
EKE results	9909	9931	9947	9963	9973	9982	9987	9994	9997	9998.5	9999.4	9999.8	9999.94	9999.98	9999.998

Note: The EKE results are the fitted values.

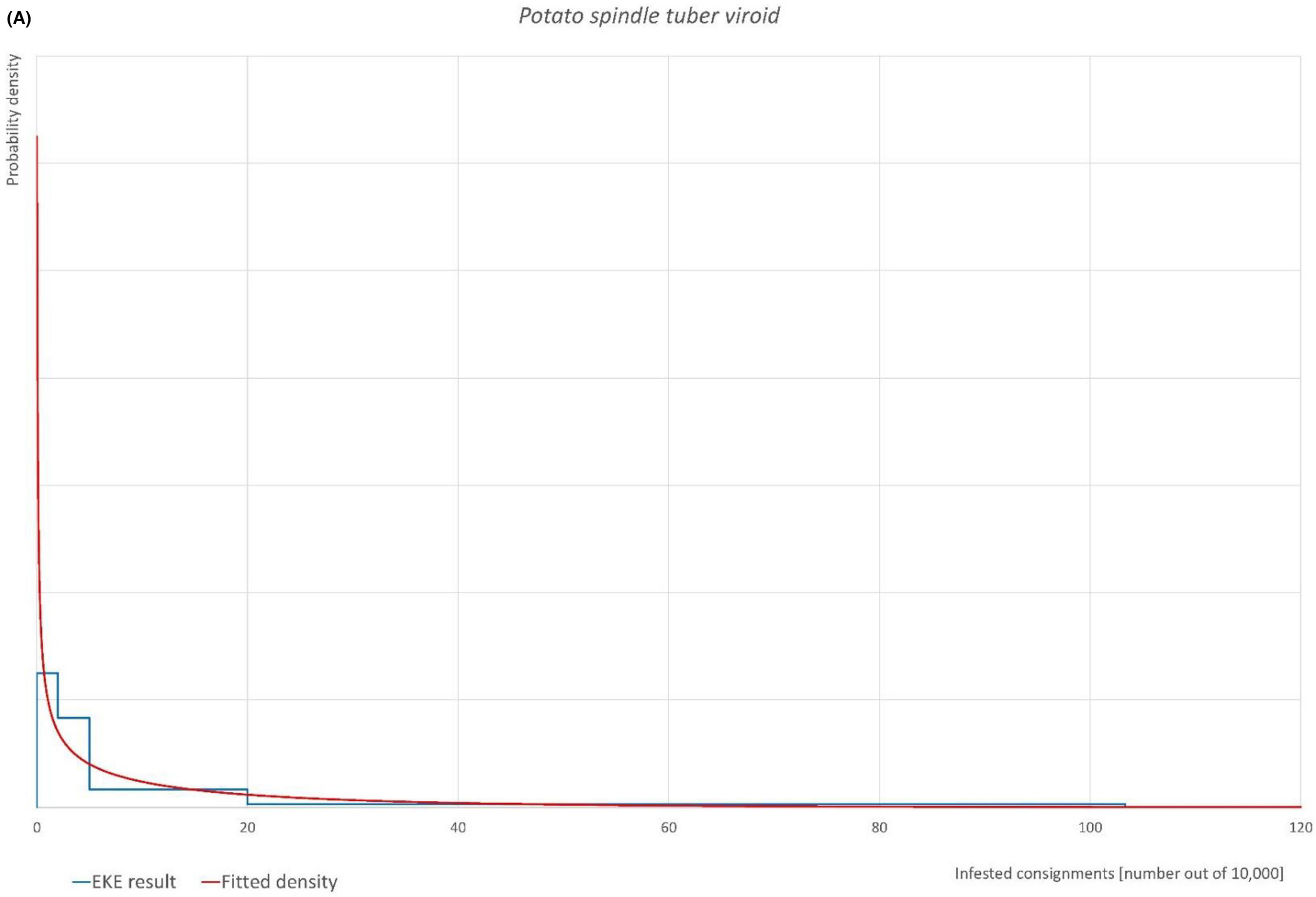

FIGURE A.9 (Continued)

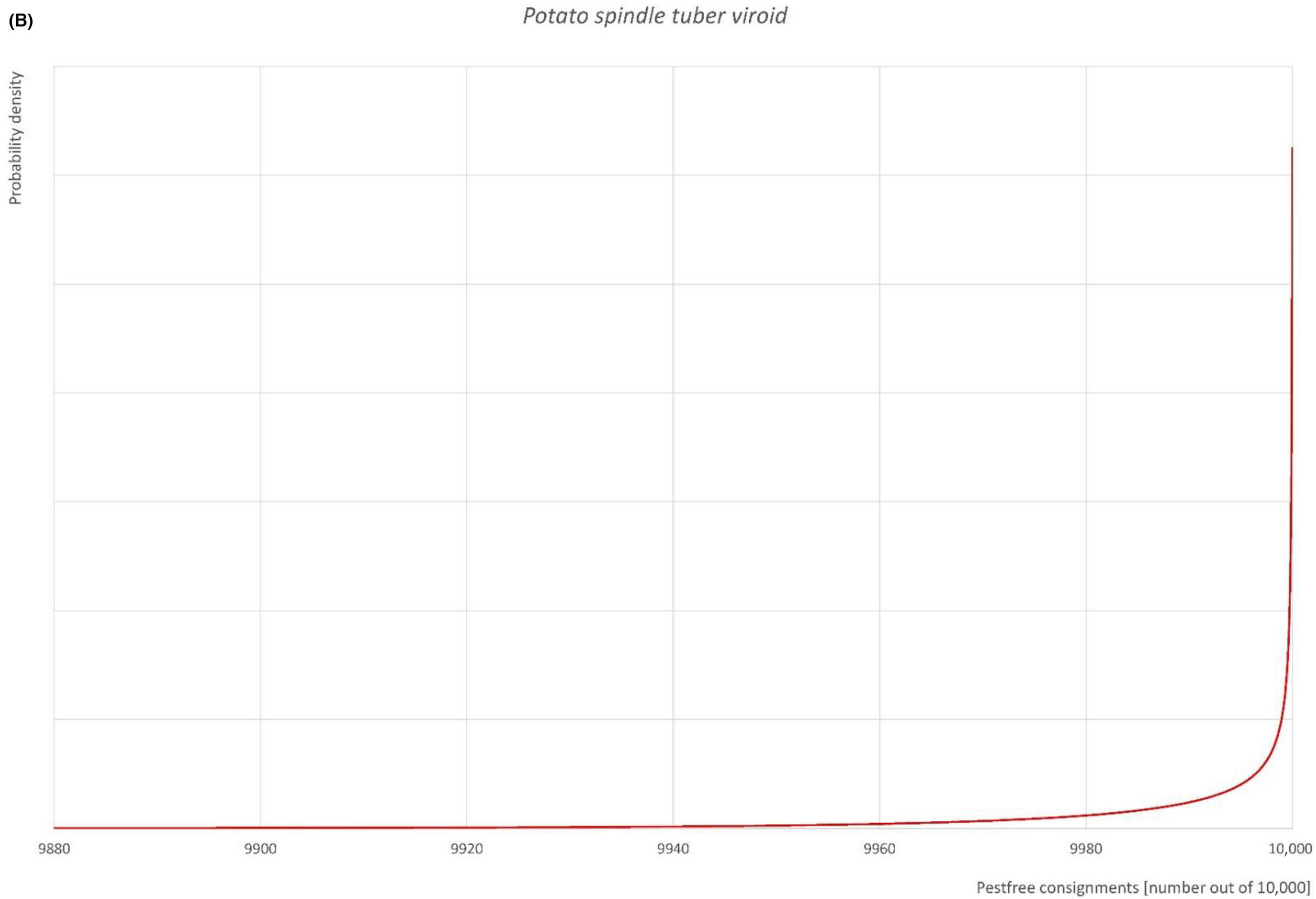

FIGURE A.9 (Continued)

(C)

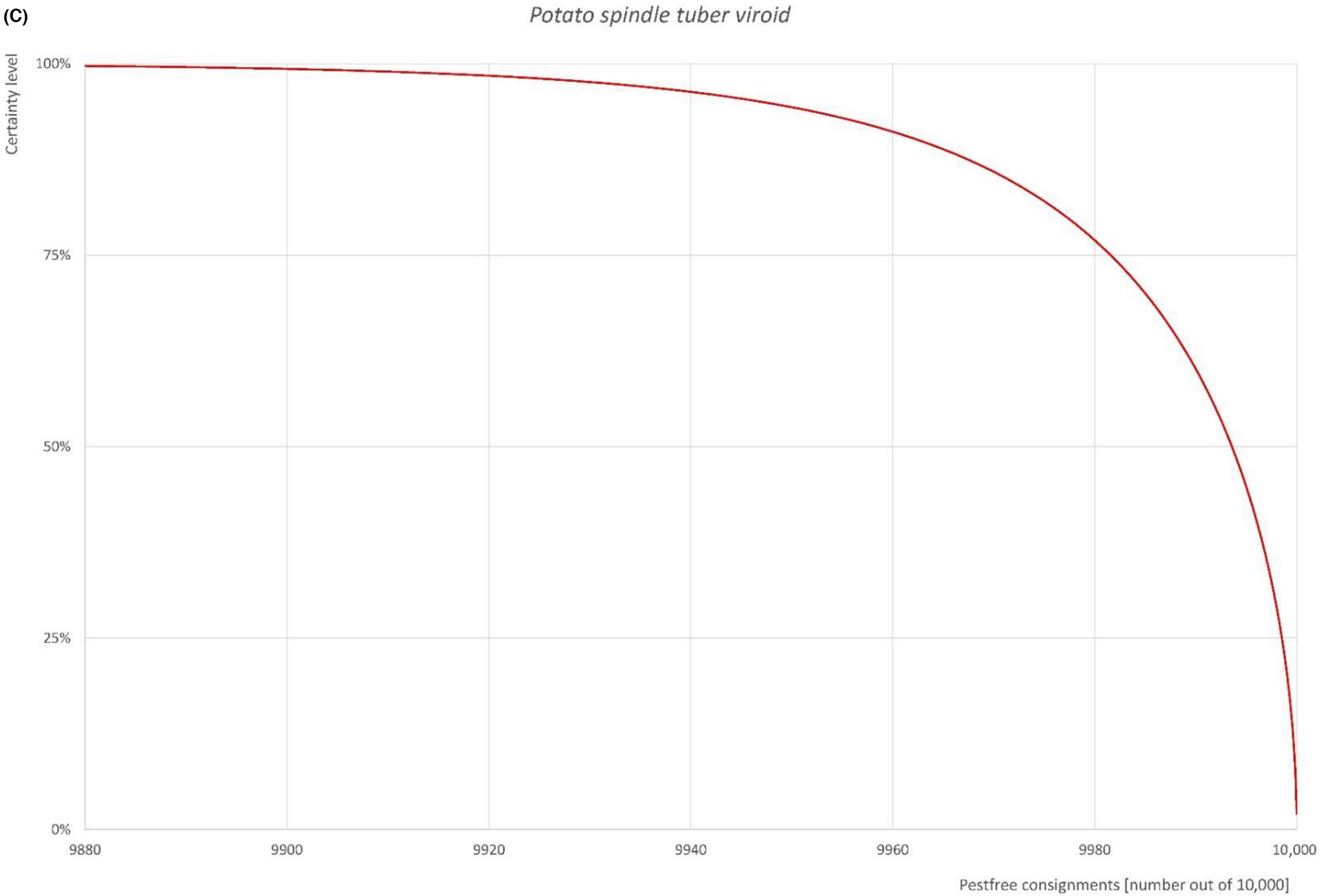

FIGURE A.9 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for potato spindle tuber viroid (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (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.

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A.10 | *RALSTONIA SOLANACEARUM* SPECIES COMPLEX

A.10.1 | Organism information

Taxonomic information	*Ralstonia solanacearum* [RALSSL] *Ralstonia pseudosolanacearum* [RALSPS] Kingdom: Bacteria Order: Burkholderiales Family: Burkholderiaceae Reasons for clustering: These two species belong to the same species complex and share a lot of biological traits.		
Regulated status	*R. solanacearum (Smith)* Yabuuchi et al. emend. Safni et al. [RALSSL] is listed as a Quarantine Pest in Annex II/B of Commission Implementing Regulation (EU) 2019/2072. *R. pseudosolanacearum*, Safni et al. [RALSPS] is listed as a Quarantine Pest in Annex II/A of Commission Implementing Regulation (EU) 2019/2072.		
Host status on *Petunia* spp./*Calibrachoa* spp.	**Bacterium name**	***Petunia* spp./*Calibrachoa* spp. host status**	**Solanaceae host plants**
	Ralstonia solanacearum	*Petunia* spp. *hybrida* and *Calibrachoa* spp. are listed as host plants (CABI 2020).	*Capsicum* spp., *Solanum* spp., *Datura stramonium*
	Ralstonia Pseudosolanacearum	Experimental host	*Capsicum* spp., *Solanum* spp.
	R. solanacearum and *R. pseudosolanacearum* have a wide host range including solanaceous host plants, and therefore the Panel assumes that *Petunia* spp./*Calibrachoa* spp. could be a natural host for *R. pseudosolanacearum*. It is probable that isolates of *R. pseudosolanacearum* were identified as *R. solanacearum* before 2017. Uncertainties: The host status of *Petunia* spp./*Calibrachoa* spp. for *R. solanacearum*.		

(Continued)

Pest status in Costa Rica	*R. solanacearum* and *R. pseudosolanacearum* according to EPPO/CABI is present in Costa Rica. *R. solanacearum* is endemic in rain forest and reported as moko disease on banana and brown rot on potato (Blomme et al., 2017; EPPO, online).
PRA information	Available Pest Risk Assessments: – Scientific Opinion on the pest categorisation of *Ralstonia solanacearum* species complex (EFSA PLH Panel, 2019).
Other relevant information for the assessment	
Biology	**Transmission:** *R. solanacearum* and *R. pseudosolanacearum* are soil-borne bacteria. Transmission does not involve any vector. 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. Disease severity generally increases if the bacteria are found in association with root nematodes. **Host range and distribution of host plants in the environment:** *R. solanacearum* and *R. pseudosolanacearum* infect numerous cultivated solanaceous and non-solanaceous plants and are present on numerous wild host plants species. **Symptoms on *Petunia* spp./*Calibrachoa* spp.:** Bacteria cause wilting of the whole plant when the infection occurs at the root level. It can cause a hypersensitive reaction on resistant cultivars. 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* spp. and *Calibrachoa* spp. can be systemically infected. The bacteria colonise the xylem vessels.
Surveillance information	There is no information of a surveillance programme for *R. pseudosolanacearum* and *R. solanacearum* in Costa Rica.

A.10.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: The isolated greenhouses with polythene roof and sidewalls fitted with insect proof nets as well as double door prevent passive introduction of *R. solanacearum* and *R. pseudosolanacearum* by air movements (e.g. stormy weather). **Uncertainties**: Presence of unnoticed defects in the greenhouse structure.
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: Hygienic procedures described prevent the introduction of bacteria from the surrounding environment via contaminated clothes and tools. Disinfection of pruning tools prevents the spread of bacteria within the greenhouse in case of the introduction of *Ralstonia*. **Uncertainties**: none.

(Continues)

(Continued)

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Treatment of growing media	Y	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option. **Evaluation**: Sterilisation by steam is reported to be efficient to reduce bacterial populations in volcanic pumice. **Uncertainties**: It is not known if the heat treatment is applied homogeneously to the all substrate.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1. for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: The certified material originating from EU is highly unlikely to be infected with *Ralstonia* spp. **Uncertainties**: none.
Crop rotation	N	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season.
Disinfection of irrigation water	Y	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected. **Evaluation**: *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. The disinfection of irrigation water is effective in eliminating the presence of *Ralstonia* in the irrigation water. There is no information if irrigation water is tested for the presence of *Ralstonia*. **Uncertainties**: – Unnoticed failures in the water treatment and storage system. – Inclusion of *Ralstonia* in the weekly testing.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Evaluation**: No bactericidal treatments are applied during the process. **Uncertainties**: none.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: Monitoring tests for the presence of *R. solanacearum* and *R. pseudosolanacearum* are not mentioned. Visual inspection of the crop could detect symptoms of *Ralstonia*, however due to the long latent period some infections may go undetected. **Uncertainties**: – The efficiency of monitoring and inspection. – The length of the latent period necessary to the expression of symptoms.

(Continued)

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Sampling and testing	Y	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, one square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4). **Evaluation**: No sampling and testing targeting *R. solanacearum* and *R. pseudosolanacearum* are reported to be done during production process and at the exporting step. **Uncertainties**: none.
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: No tests specific to *R. solanacearum* and *R. pseudosolanacearum* are reported to be done during production process and at the exporting step. **Uncertainties**: none.
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any other possible pests/pathogens. **Evaluation**: There is no specific surveillance for the presence of *Ralstonia* species in the areas surrounding the nurseries. **Uncertainties**: none.

A.10.3 | Possibility of pest presence in the nursery

A.10.3.1 | Possibility of entry from the surrounding environment

The natural host range of *Ralstonia* includes many host plant species which could be present in the surrounding environment of the nurseries producing unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. The main pathway of entrance of the bacteria from the surrounding environment in the nursery is through infested soil and irrigation water. Failure 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

- Unnoticed failures in the water treatment and storage system.
- Inclusion of *Ralstonia* in the weekly testing.

A.10.3.2 | Possibility of entry with new plants/seeds

Foundation stock used to establish mother plants for unrooted cuttings production originate mostly from Germany. *Ralstonia solanacearum* and *R. pseudosolanacearum* are present in Germany. In Germany a certification scheme is in place for *Petunia* spp./*Calibrachoa* spp., and tests are reported to be performed for *Ralstonia*. It is unlikely that the imported certified (Elite) material from the Germany is infected with *Ralstonia*.

Uncertainties: none.

A.10.3.3. | Possibility of spread within the nursery

Ralstonia could be present on other host plants in the nursery. Bacteria are efficiently transmitted by tools during pruning and cutting production. There is no information on the presence of other host plants (e.g. *Pelargonium* spp. and rose) of *R. solanacearum* and *R. pseudosolanacearum* in the nurseries. However, the strict hygiene measures in place in production sites can prevent the spread of *Ralstonia* within the nursery.

<u>Uncertainties</u>

– Failure in the application of the strict hygiene measures.

A.10.4 | Information from interceptions

There are no interceptions of *R. pseudosolanacearum* or any other species member of the *R. solanacearum* species complex from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.10.5 | Overall likelihood of pest freedom

Ralstonia spp. was already assessed for the commodity risk assessment of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of *Ralstonia* spp. in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- Source of water used for irrigation (surface water for Guatemala, sealed wells in Costa Rica).
- External environment/land use (Costa Rica, coffee is the dominant cultivation in the surrounding of the nurseries).

The decision was to lower the upper values of the elicited values for *Ralstonia* spp. on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA PLH Panel, 2024) as the source of the water imply, even in case of malfunctioning of the disinfection system, lower extreme values are expected (pathogen/microbial load will be lower).

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

- *Petunia* spp. and *Calibrachoa* spp. are not preferred hosts.
- *Ralstonia solanacearum* and *R. pseudosolanacearum* has never been intercepted on produce imported in the EU from Costa Rica.
- 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 filtration and UV treatment 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. New substrates are used for each cycle of production.
- 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

- *Ralstonia solanacearum* and *Ralstonia pseudosolanacearum* are present throughout Costa Rica 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*.
- Sensitivity of cultivars of *Petunia* spp. and *Callibrachoa* spp. to *R. solanacearum* and *R. pseudosolanacearum* is not known. Some of these could be resistant and asymptomatic but infected.

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

The certified starting material and the hygiene measure in place prevents the introduction of *Ralstonia*.

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

There are uncertainties on the population pressure of *Ralstonia* spp. in the surrounding environment.

A.10.6 | Elicitation outcomes of the assessment of the pest freedom for *Ralstonia solanacearum* species complex

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* species complex 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					100
EKE	2.71	3.67	4.75	6.41	8.31	10.6	12.9	18.4	26.3	32.1	40.8	52.9	71.4	92.5	125

Note: The EKE results is the *Lognorm* (25.852, 25.46) 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 A0.1.2.

TABLE A.20 The uncertainty distribution of plants free of *Ralstonia solanacearum* species complex per 10,000 bags 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	9900					9970		9980		9990					9999
EKE results	9875	9907	9929	9947	9959	9968	9974	9982	9987	9989	9992	9994	9995	9996	9997

Note: The EKE results are the fitted values.

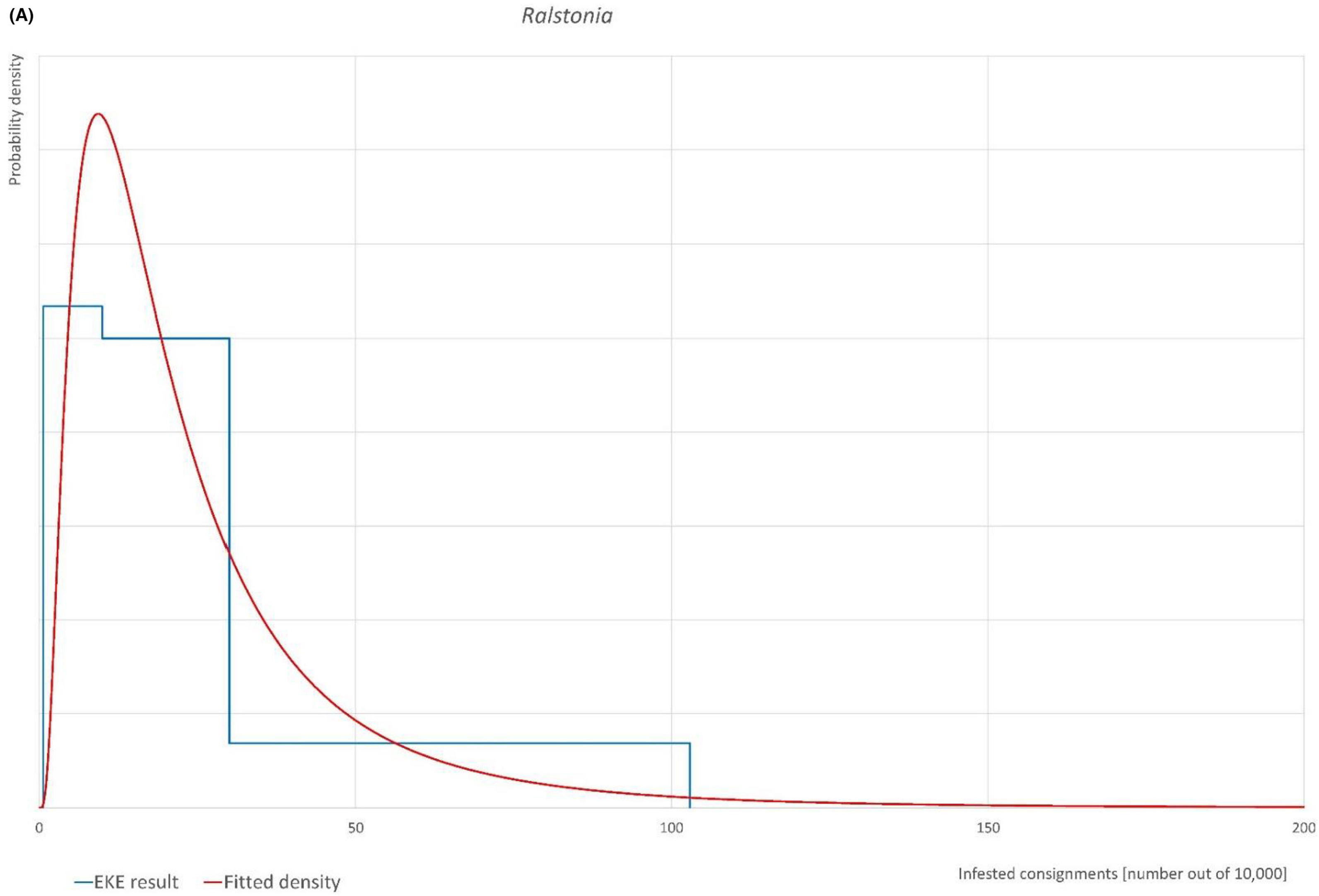

FIGURE A.10 (Continued)

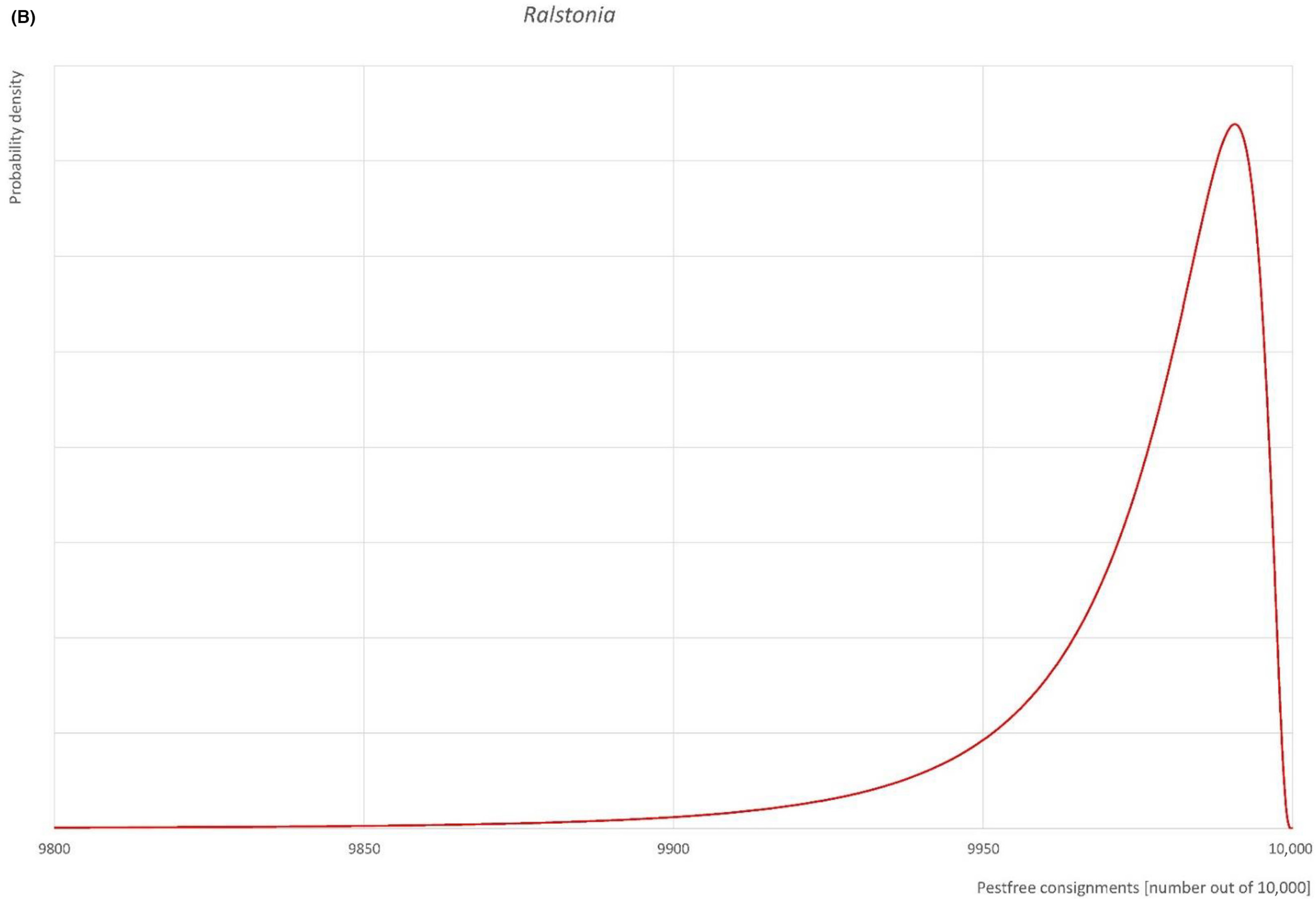

FIGURE A.10 (Continued)

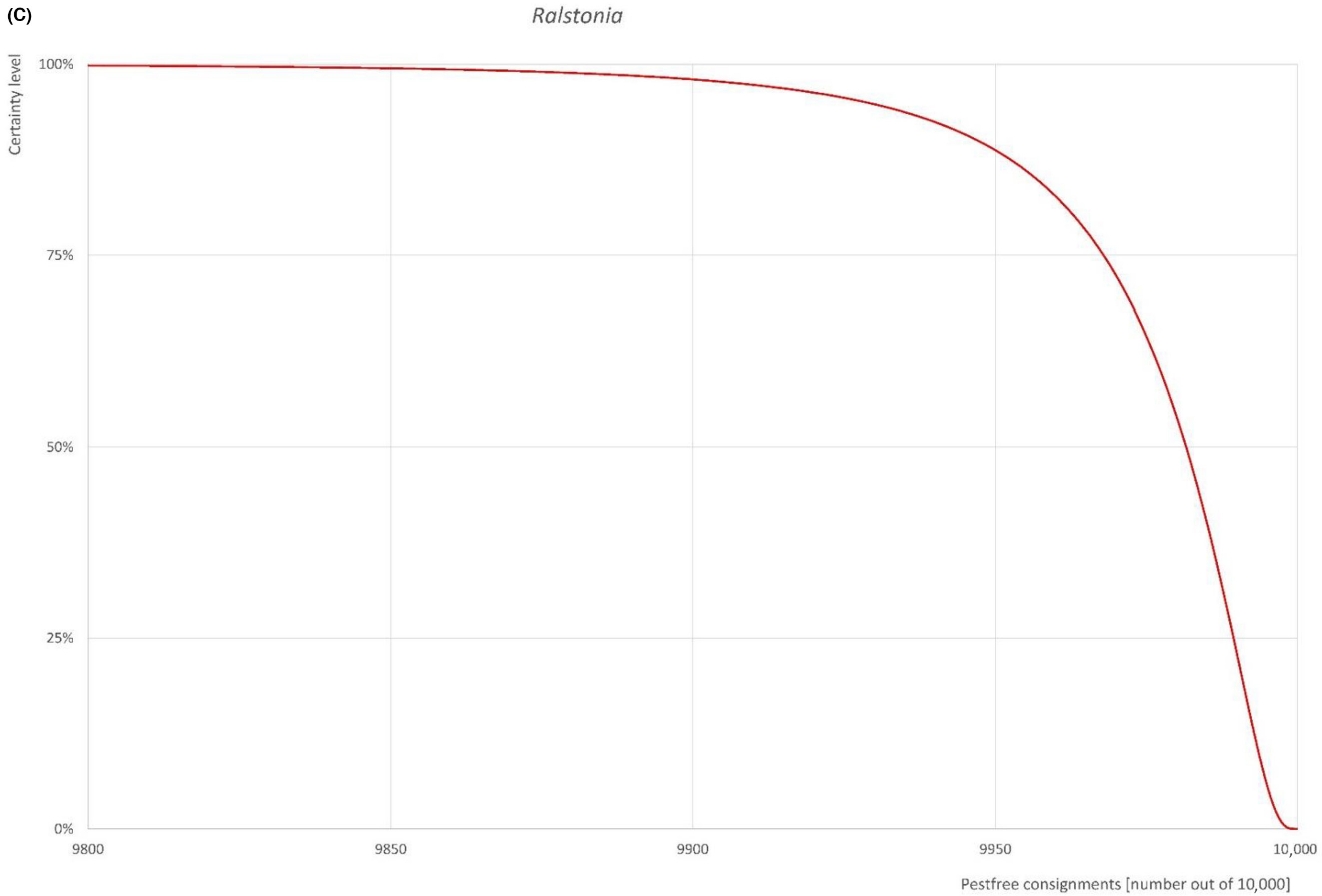

FIGURE A.10 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *Ralstonia solanacearum* species complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional 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

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A.11 | *THRIPS PALMI*

A.11.1 | Organism information

Taxonomic information	*Thrips palmi* Karny [THRIPL] Class: Insecta Order: Thysanoptera Family: Thripidae Common name: oriental thrips, palm thrips, southern yellow thrips	
Regulated status	The pest is an EU union quarantine pest listed in Annex II/A of Regulation (EU) 2019/2072 as *T. palmi* Karny [THRIPL].	
Pest status in Costa Rica	Present, restricted distribution (EPPO, online), widespread and under official control (NPPO Costa Rica, Dossier Section 1.0).	
Pest status in the EU	Not relevant for EU Quarantine pest.	
Host status on *Petunia* spp. and *Calibrachoa* spp.	*T. palmi* is a polyphagous pest with a wide host range including several solanaceous plant species. Although *T. palmi* has not been reported to feed on *Petunia* spp. and *Calibrachoa* spp. plants, given its polyphagous nature including Solanaceous host plants, the Panel assumes that *Petunia* spp./*Calibrachoa* spp. are suitable host plants. Uncertainties: the host status of *Petunia* spp. and *Calibrachoa* spp. plants to *T. palmi*.	
PRA information	Available Pest Risk Assessments: – Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports (Australian Government Department of Agriculture and Water Resources, 2017) – Pest categorisation of *T. palmi* (EFSA Scientific Opinion, 2019) – Commodity risk assessment of *Momordica charantia* fruits from Honduras (EFSA, 2020) – Commodity risk assessment of *Momordica charantia* fruits from Suriname (EFSA, 2021a) – Commodity risk assessment of *Momordica charantia* fruits from Sri Lanka (EFSA, 2021b) – Commodity risk assessment of *Momordica charantia* fruits from Thailand (EFSA, 2021c) – Commodity risk assessment of *Momordica charantia* fruits from Mexico (EFSA, 2021d)	
Other relevant information for the assessment		
Biology	The life cycle lasts 17.5 days, at 25°C. The adults emerge from the pupa in the soil and consequently, they lay their eggs on the leaves or flowers of the plant. The second-stage larva goes in the soil and completes its cycle by developing and pupating. They preferably lay their eggs in young growing tissue of leaves, and also the flowers and fruit of a wide range of host plants, especially Cucurbitaceae, Solanaceae and Leguminosae. *T. palmi* is reported to be a vector of several (ortho)tospoviruses (EPPO, 2023).	
Symptoms	**Main type of symptoms**	*T. palmi* is a small sized insect that is difficult to detect. Adults are about 1.3 mm length. However, the symptoms they cause can be detected. On plant material, at inspection, silvery feeding scars on the leaf surface, especially alongside the midrib and veins, can be seen (Cannon et al., 2007). Heavily infested plants are characterised by a silvered or bronzed appearance of the leaves, stunted leaves and terminal shoots. At high densities, feeding by *T. palmi* may cause damage to fruits (Kawai, 1986) as well, such as scarring, discoloration and deformation in developed fruits or fruit abortion in an early stage. Cucumber, eggplant and pepper fruit are damaged when thrips feed in the blossoms. Symptoms may be found on all parts of a wide range of plant species (Sakimura et al., 1986).
	Presence of asymptomatic plants	Eggs and early stages of infestation may be difficult to detect.

(Continued)

Symptoms	**Confusion with other pathogens/pests**	*T. palmi* can be mistaken with other similar species such as *T. flavus* Schrank, which is a common, flower thrips, found worldwide. For the distinction between the two species microscopic examination is required (EPPO, 2018).
Host plant range	Polyphagous pest with a wide host range including several solanaceous plant species.	
Evidence that the commodity can be a pathway	Eggs, larvae and adults of *T. palmi* could be present on the leaves of *Petunia* spp./*Calibrachoa* spp. unrooted cuttings.	
Surveillance information	*T. palmi* is reported to be widespread in Cost Rica. There is no official surveillance for the regional presence of *T. palmi* in Costa Rica.	

A.11.2 | Risk Mitigation Measure applied in the nurseries

Risk reduction option	Effect Y/N	Evaluation and uncertainties
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: The thrips-proof netting and double doors prevent the introduction of *T. palmi* from the surrounding environment. However, *T. palmi* adults may be introduced through defects in the greenhouse. The monitoring data indicate that thrips are present in the greenhouse, but it is unknown if *T. palmi* was among the reported thrips species. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Y	**Description:** Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation:** *T. palmi* could hitch hike on clothing of staff. If correctly applied, the hygiene measures could prevent the entrance and spread in the nursery of *T. palmi* by nursery staff. **Uncertainties**: The strictness of the application of the hygiene measures.
Treatment of growing media	Y	**Description:** The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option. **Evaluation:** Thrips pupate in the soil. The use of new growing media prevents thrips pupating in the substrate and being transferred to the new crop. **Uncertainties**: none.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1. for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation:** All plants used to start a new production cycle of *Petunia* spp./*Calibrachoa* spp. are Elite certified and originate from Germany. It is highly unlikely that thrips are present on this certified plant material, furthermore *T. palmi* is not present in Germany. **Uncertainties:** None.

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Crop rotation	Y	**Description:** In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season. **Evaluation:** Greenhouses used for the production of *Petunia* spp./*Calibrachoa* spp. are emptied for 3 months and disinfected and may prevent the build up of a population. The crop rotating plants *Chrysanthemum* is a host for *T. palmi*. However, the disinfection of the greenhouse is expected to prevent the build up of a population. **Uncertainties**: None.
Disinfection of irrigation water	N	**Description:** Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description:** To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. **Evaluation**: Some of the products used may have an effect on populations of *T. palmi*. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export. **Uncertainties**: The efficacy of the plant protection products against the specific insect pest is not known.
Pest monitoring and inspections	Y	**Description:** Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation:** Populations of *T. palmi* could be detected with the monitoring system targeted at *F. occidentalis* in place. Yellow sticky traps are not very effective to monitor thrips species. Early infestation of *T. palmi* in the crop may be difficult to detect. **Uncertainties**: The efficiency of detecting the early infestations of *T. palmi*.
Sampling and testing	N	**Description:** In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, 1 square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4).

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Risk reduction option	Effect Y/N	Evaluation and uncertainties
Official Supervision by NPPO	Y	**Description:** Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: Inspections for *F. occidentalis* may help in the detection of populations of *T. palmi*. A high level of expertise is needed to identify thrips to species level. The panel assumes, although not described, that in case of a finding of *T. palmi* in a production unit, official measures are taken to guarantee pest freedom before export to the EU. **Uncertainties**: The efficiency of detecting the early infestations of *T. palmi*.
Surveillance of production area	Y	**Description:** No details are given for the surveillance of any other pests/pathogens. **Evaluation:** There is no specific surveillance for *T. palmi*, therefore the pest pressure level in the surrounding environment is uncertain. **Uncertainties**: There is no information on the pest pressure in the surrounding environment.

A.11.3 | Possibility of pest presence in the nurseries

A.11.3.1 | Possibility of entry from the surrounding environment

In Costa Rica *T. palmi* is reported to be widespread. Given the wide host range of this pest it is possible that local populations of *T. palmi* are present in the neighbouring environment of the greenhouses with *Petunia* spp./*Calibrachoa* spp. plants destined for the production of unrooted cuttings for the export. There is no evidence that the nurseries are located in a pest-free area for *T. palmi,* so the Panel assumes that *T. palmi* can be present in the production areas of *Petunia* spp./*Calibrachoa* spp. destined for export to the EU.

Petunia spp./*Calibrachoa* spp. plants destined for export to the EU are grown in a protected environment (i.e. greenhouse). Introduction of thrips into a greenhouse is possible through holes in the netting or roof of the greenhouse structure or by flying or passive wind transfer through an open door or as a hitchhiker on clothing of nursery staff, however hygienic procedures are in place to prevent this. The success rate of one of these events is only likely to occur in case of a high (local) density of *T. palmi* in the neighbouring environment of the greenhouse. The monitoring data indicate that thrips are present in the greenhouse, but it is unknown if *T. palmi* was among the reported thrips species. The panel assumes, although not described, that in case of a finding of *T. palmi* in a production unit, official measures are taken to guarantee pest freedom before export to the EU.

Uncertainties

- There is no surveillance information on the presence of host plants and population pressure of *T. palmi* in the area where the greenhouse is located.
- The presence of defects in the greenhouse structure.

A.11.3.2 | Possibility of entry with new plants/seeds

The probability that *T. palmi* is present on the starting material is very low/negligible as the imported material is Elite certified and originates from Germany where *T. palmi* is absent.

A.11.3.3 | Possibility of spread within the nursery

T. palmi can be present on other host plants (e.g. perennials, bedding plants and succulents) in other production units of the nursery. When present, hitchhiking life stages of thrips 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) with no mixing with the other ornamentals.

Uncertainties

- The presence of host plants of *T. palmi* other than *Petunia* spp. in the nursery.
- Presence of defects in the structure of the greenhouse compartments.

A.11.4 | Information from interceptions

There are no interceptions of *T. palmi* from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online).

A.11.5 | Overall likelihood of the pest freedom

A.11.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- *Petunia* spp./*Calibrachoa* spp. is not a preferred host.
- *T. palmi* is not able to enter the greenhouse (no holes in screen), defects in the greenhouse structure are detected and repaired.
- There are targeted inspections and official control in case of finding of *T. palmi*.
- The pest population pressure in the surrounding environment is very low (suitable hosts are not widely distributed in the production area).
- Cuttings with symptoms are sorted out in the packing process.
- *T. palmi* is not a good flyer and dispersal is mainly dependent on wind or human-assisted movement.
- Hygienic procedures are effective in preventing entering and spread of the pest.

A.11.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- *T. palmi* is widespread in Costa Rica and has a wide host range, therefore it is likely that host plants are present in the surrounding environment, in close proximity to the greenhouse.
- Presence of undetected defects in the greenhouse structure.
- Pest could go undetected during inspections of the nursery (eggs, first instars) and packing of the cuttings.
- Insecticide resistant populations could be present.
- Other host plants than *Petunia* spp./*Calibrachoa* spp. could be present in the nursery.

A.11.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The protective effect of the greenhouse structure and the hygienic measures.
- *T. palmi* is an EU regulated pest, therefore it is expected that in case of finding the nursery is placed under official control.

A.11.5.4 | 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 *T. palmi* in the surrounding environment.

A.11.6 | Elicitation outcomes of the assessment of the pest freedom for *Thrips palmi*

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 *T. palmi* 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					3		5		10					40
EKE	0.687	0.947	1.25	1.72	2.26	2.92	3.61	5.27	7.70	9.53	12.3	16.2	22.3	29.4	40.5

Note: The EKE results is the *Lognorm* (7.7452, 8.3271) 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 *T. palmi* per 10,000 bags 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	9960					9990		9995		9997					9999
EKE results	9959	9971	9978	9984	9988	9990	9992	9995	9996	9997.1	9997.7	9998.3	9998.8	9999.1	9999.3

Note: The EKE results are the fitted values.

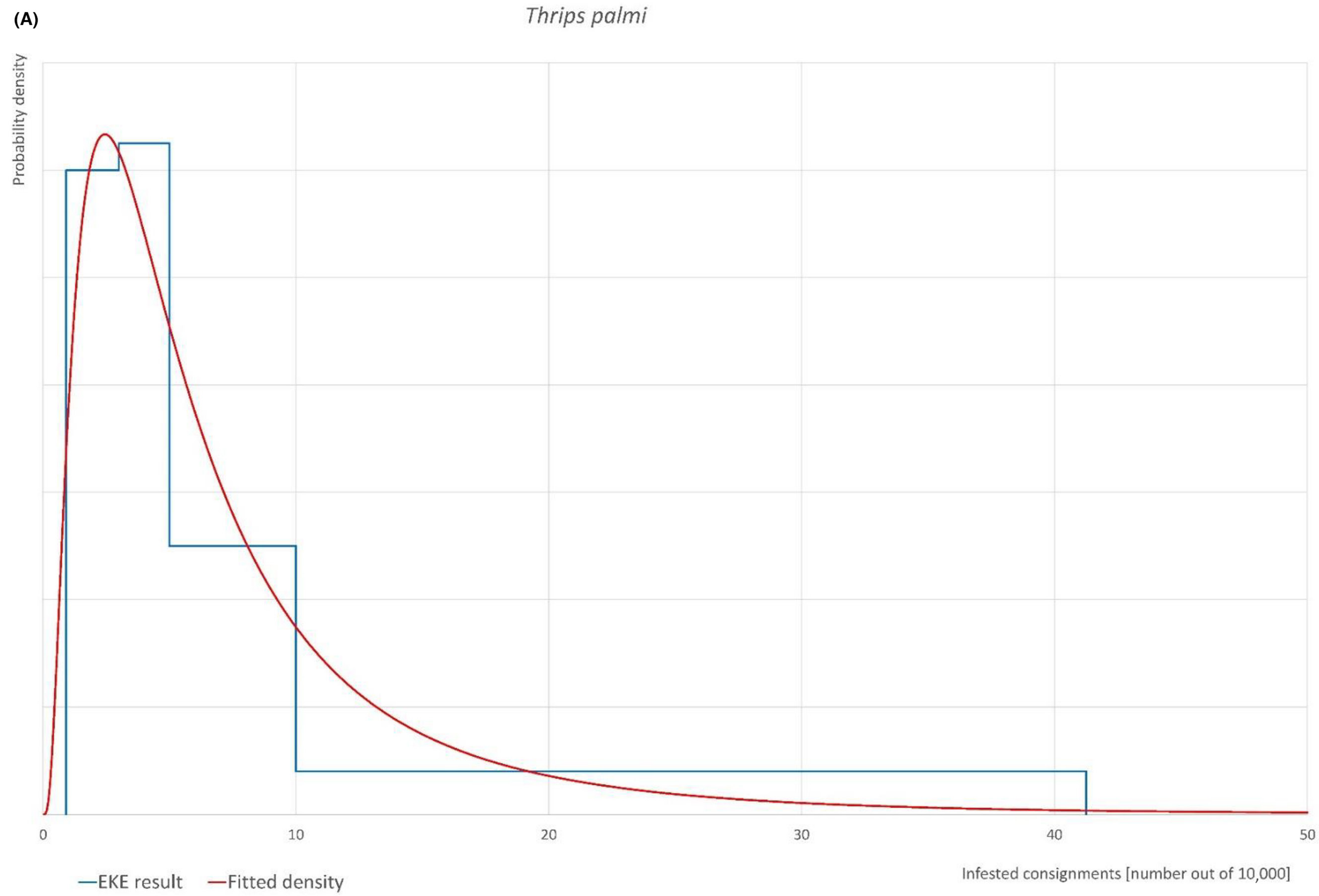

FIGURE A.11 (Continued)

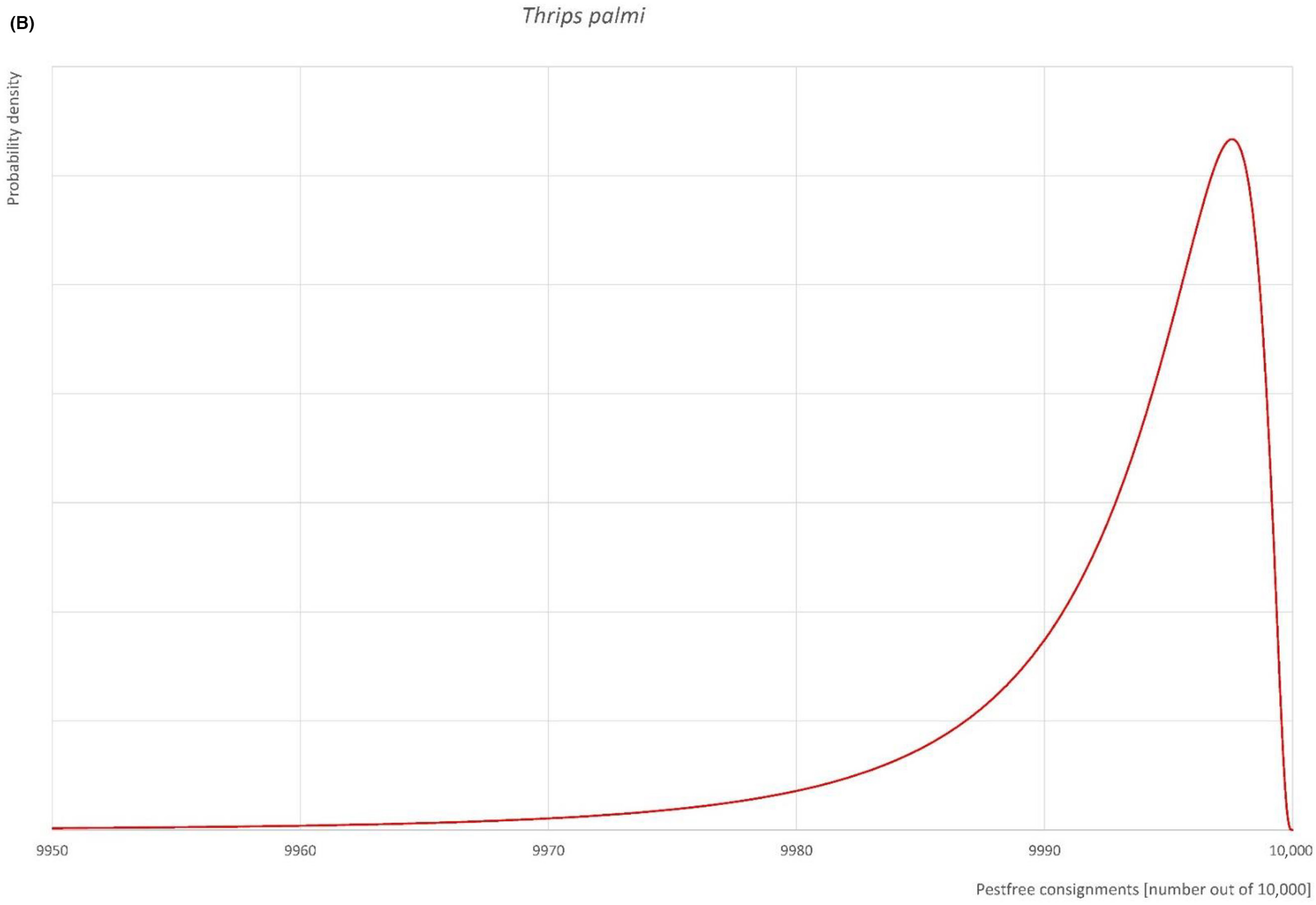

FIGURE A.11 (Continued)

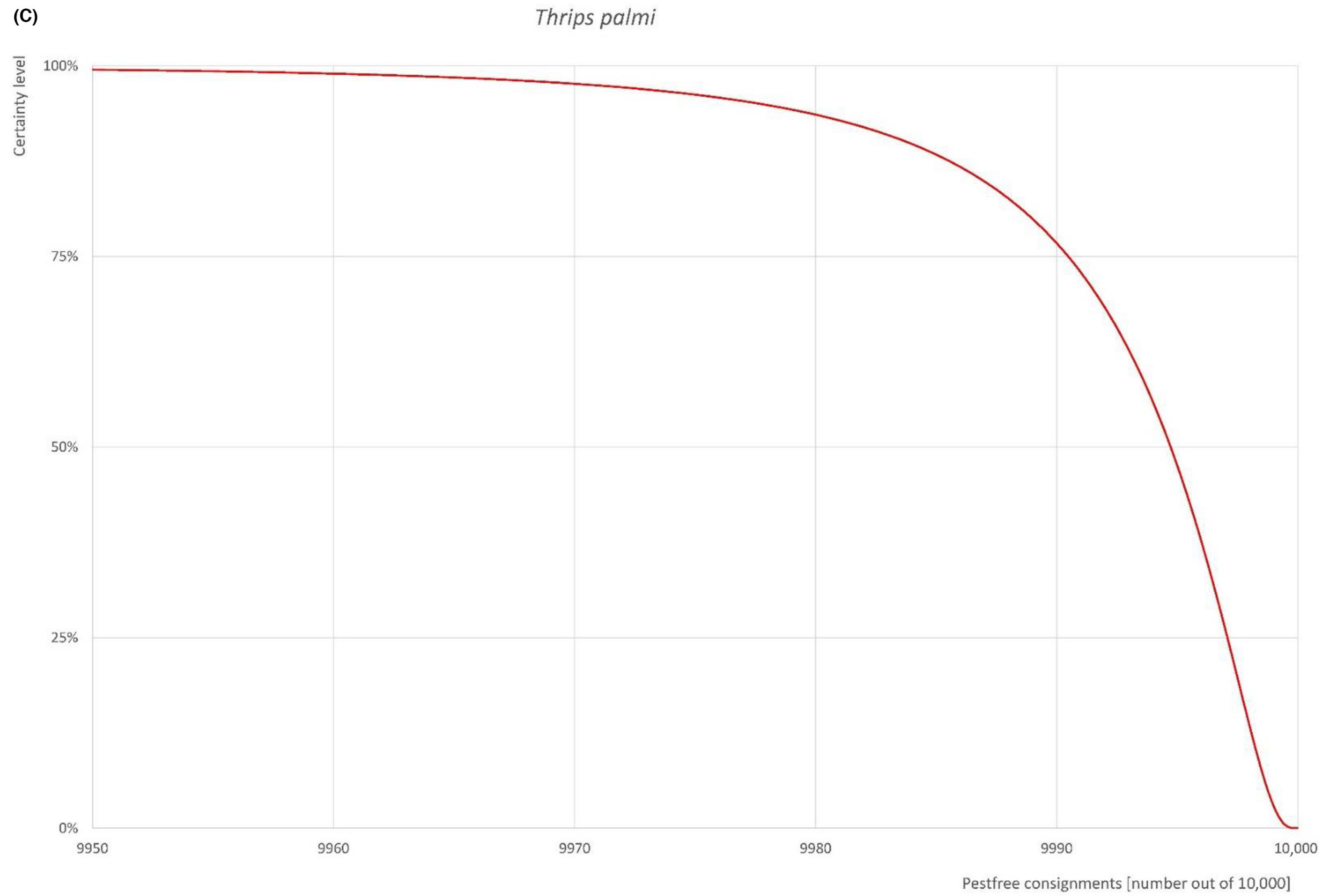

FIGURE A.11 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for *T. palmi* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty 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.11.7 | Reference list

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A.12 | TOMATO SPOTTED WILT VIRUS

A.12.1 | Organism information

Taxonomic information	Tomato spotted wilt virus (TSWV) Species: *Orthotospovirus tomatomaculae* (*proposed binomial nomenclature by ICTV*) EPPO code: TSWV00 Kingdom: Viruses and Viroids Order: *Bunyavirales* Family: *Tospoviridae* Genus: *Orthotospovirus*
Regulated status	Tomato spotted wilt virus (TSWV) 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. TSWV is also 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* spp./*Calibrachoa* spp.	TSWV (EPPO Bulletin 2020) infect *Petunia* spp., tomato, pepper and potato in nature. There are no records that *Calibrachoa* spp. is a host of TSWV. Uncertainties: The host status of *Calibrachoa* spp. to TSWV. The ability of TSWV to systemically infect *Petunia* spp. and *Calibrachoa* spp.
Pest status in Costa Rica	TSWV is present in Costa Rica (CABI, online)
PRA information	Available Pest Risk Assessments: – 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 PLH Panel, 2012).

(Continues)

(Continued)

Other relevant information for the assessment	
Biology	**Transmission** TSWV is 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 for its spread in ornamental and vegetable crops. TSWV can be also very efficiently transmitted by *Thrips tabaci* populations. Transmission parameters have been studied in detail for the vector *F. occidentalis*. Only thrips that acquire TSWV as instars (L1 and L2) are able to transmit TSWV. The first instar (L1) are the most efficient at acquiring the virus which can be then transmitted by second instar (L2) and adults after a latent period that is negatively correlated with temperature. The minimum acquisition access period and inoculation access period range 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 adult thrips than crawling larvae (Chatzivassiliou, et al., 2002; Wijkamp and Peters 1993; Wijkamp et al., 1993, 1995, 1996; Ullman et al., 1993). As all plant viruses when systemically infecting their host, TSWV can be also transmitted via the vegetative propagation material and it is considered not to be seed-transmitted (EFSA PLH Panel, 2012). **Uncertainty on biology** The vector ability of additional thrips species for TSWV. **Host range and distribution of host plants in the environment** 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 (Parrella et al., 2003). The natural crop-hosts of TSWV include most of the major horticultural crops such as tomato, pepper, tobacco, legumes and many ornamentals (Parrella et al., 2003). TSWV also infects many weed species which may contribute significantly to its epidemiology as virus reservoirs (Chatzivassiliou et al., 2001). **Uncertainty on host range** The actual host range of TSWV is continuously growing therefore it remains unknown. The host status of *Calibrachoa* spp. to TSWV. **Ecology and biology of the vectors** *F. occidentalis* is present in Costa Rica (EPPO GD) with no information on its distribution. *F. occidentalis* is a highly polyphagous invasive species and a highly 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 (Robb et al., 1988). *Thrips tabaci* is also present in Costa Rica (CABI, online). This thrips species presents a high variability in TSWV transmission among different population or biotypes depending on their reproductive strategy and host origin (Chatzivassiliou et al., 1999, 2002; Loredo Varela and Fail, 2022). However, populations of the species have been reported as very efficient vectors of TSWV (Chatzivassiliou et al., 2002). *Thrips tabaci* infests and thrives on a high number of species including also major solanaceous hosts (Loredo Varela and Fail, 2022). **Uncertainty on ecology and biology of the vectors** The presence and distribution of other vector species **Symptoms on *Petunia* spp./*Calibrachoa* spp.** Torpoviruses-infected *Petunia* spp. plants in general and for TSWV (Daughtrey et al., 1997) in particular exhibit necrotic spots on the inoculated leaves with no systemic infection. Symptoms usually appear within a few days after feeding of a viruliferous thrips. These spots are not easy to detect by an inspector, especially in high densities of the plant canopy. 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). **Uncertainties on symptoms on *Petunia* spp./*Calibrachoa* spp.** The host status of *Calibrachoa* spp. to TSWV. The ability of TSWV to systemically infect some *Petunia* spp. and *Calibrachoa* spp. varieties.
Evidence that the commodity can be a pathway	Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. can be infected by TSWV and/or infested by viruliferous thrips.
Surveillance information	There are no targeted surveys for TSWV (or tospoviruses in general) and thrips in Costa Rica.

A.12.2 | Risk mitigation measures applied in the nurseries

Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Growing plants in isolation	Y	**Description**: The unrooted cuttings are produced in dedicated greenhouses and isolated from other crops. The greenhouses are covered on top by polythene and the sidewalls are fitted with thrips-proof netting. The entrance of the greenhouse has a double door. *Petunia* spp. and *Calibrachoa* spp. are produced in separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. A preventive maintenance programme is conducted every 2 weeks. It includes the inspection of the greenhouse structure and the conditions of the greenhouse cover. **Evaluation**: The insect proof netting prevents the introduction of insects including thrips from the surrounding environment. However, thrips may be introduced through defects in the greenhouse or as hitchhikers on workers. **Uncertainties**: Presence of unnoticed defects in the greenhouse structure

(Continued)

Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Dedicated hygiene measures	Y	**Description**: Inside each greenhouse, there are concrete corridors and walls; plants are kept on metal benches, which are placed on 'ground cover'. All tools and equipment used in each harvest are disinfected. The staff has a hand and footwear disinfection area, for entry clean clothes, disposable gloves; apron, hair mesh and a bottle with disinfectant are used. After each production cycle, the greenhouses are washed: the floors and meshes with pressurised water, the tables and the irrigation system are disinfected, and then fumigation is carried out. There are three different levels of sanitation in the greenhouses. Level A being the highest level of sanitation and level C the lowest. These levels correspond to the susceptibility of the crops to viruses and other pathogens. *Petunia* spp. and *Calibrachoa* spp. are worked under level A sanitation. In Level A greenhouses, to enter the sanitation room, shoes must first be disinfected, then hands and forearms should be washed, and a coat, plastic apron, latex gloves and hair net should be worn. Inside the greenhouse, shoes should be disinfected again, as well as gloves and work tools with a hand spray with 4% MENNO-Florades. The harvesting blades must be rotated and kept in a disinfectant solution. The greenhouses have marks on the floor and/or posts that indicate the harvester when to change the blade for disinfection. **Evaluation**: The insect proof net can be effective in preventing the entry of thrips vectors via active flying and entry and spread of TSWV. Protective clothes prevent also the entrance of vectors via hitchhiking. The fact that during 2023 thrips were detected in yellow sticky traps although in low numbers (in three traps with an average of 0.19 individuals per day during the affected week) and visual monitoring detected their presence in two occasions on the crop indicates that the above-mentioned measures in combination with the others are efficiently applied however, there may be some failures. **Uncertainties**: The strictness of the measures applied.
Treatment of growing media	Y	**Description**: The growing media used for the mother plants is composed of 15% wood fibre, 25% perlite and 60% peat moss (trade name 'Pindstrup') and new growing media is used in each production cycle, which lasts 5–6 months. However, at the time of export, no type of growing media would be used, so it could be considered a risk management option. **Evaluation**: The use of new growing media prevents (viruliferous) thrips from pupating in the substrate and being transferred in the new crop. **Uncertainties**: none.
Quality of source plant material	Y	**Description**: All mother plants used for the production of unrooted *Petunia* spp. and *Calibrachoa* spp. material originate from Certified Elite Material, coming from Germany and tested for several viruses and bacteria (see Section 3.3.1 for full list). As stated in Dossier section 1.11, an intermediate stock is created with the material received. According to the planning, the necessary quantities are reproduced to create the stock of mother plants. **Evaluation**: It is assumed that all plants originate from EU countries (Germany). Therefore, it is highly unlikely that the starting material is infected with TSWV as it is included in the testing scheme. **Uncertainties**: none.
Crop rotation	Y	**Description**: In the dossier it is stated that Greenhouse #3, where *Petunia* spp. and *Calibrachoa* spp. plants are produced, does not rotate with any other plant and it is emptied for 3 months a year, while Greenhouse #19.1 is alternated between season, when needed, with chrysanthemums. Both greenhouses are washed and then disinfected with 4% Florades, prior to the arrival of the new Elite material each season. **Evaluation**: In the case of introduction into the greenhouse, populations of the vector *F. occidentalis* and *T. tabaci* may build up, since the same unit is used for production of *Petunia* spp. and *Calibrachoa* spp. However, cleaning and disinfection in addition with keeping the greenhouse empty for 3 months (when used) is considered efficient to eliminate thrips population when alternate crops between seasons. **Uncertainties**: none
Disinfection of irrigation water	N	**Description**: Drip irrigation is used with water coming from a sealed well which is tested every year, and there is a water purification system with chlorine dioxide. After each production cycle, the irrigation systems are disinfected.
Treatment of crop during production	Y	**Description**: To control insects, mites and fungi in the greenhouse chemical pesticides and biological control agents are used. There are 16 insecticides/acaricides applied against aphids, mites and whiteflies, thrips and seven fungicides are applied against powdery mildew, *Botrytis cinerea*, *Corynespora cassiicola*. There are six biological control agents used against insects. Broad spectrum and preventive products are used, with weekly or biweekly applications. In the case that monitoring detect symptomatic plants, the products and frequency are changed to control the specific pests. In the EU audit of the official plant health system in Costa Rica (EU-HAFA, 2016) it is stated that in Costa Rica nurseries producing plants for export consider the presence of any pest or disease symptom as a quality issue and all possible measures are applied to ensure that the exported plants are free from any known pest. These measures include monitoring inspections and frequent use of pesticides during the growing period and prior to export.

(Continued)

Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
		Evaluation: The applied insecticides are effective against thrips. However, thrips are known for having developed resistance to some insecticides. The fact that during 2023 thrips were detected in yellow sticky traps although in low numbers (in three traps with an average of 0.19 individuals per day during the affected week) and visual monitoring detected their presence in two occasions on the crop indicates that the above-mentioned measures in combination with the others are efficiently applied however, there may be some minor failures. **Uncertainties**: The efficacy and timing of the applied insecticide are not known.
Pest monitoring and inspections	Y	**Description**: Yellow sticky traps at a density of 40–60 per ha (depending on the susceptibility of the crop) are used to monitor *Myzus persicae, Aphis gossypii, Bemisia tabaci* and *Frankliniella occidentalis*. They are changed weekly. Visual monitoring that consists of the inspection of the plants by trained monitoring personnel for the detection and identification of pests or other problems in crops. At least once a week, a general inspection of the plants is carried out, lower leaves are taken, the foliage is shaken, the presence of pests is tested, their levels determined and everything that is observed is reported. • All the monitoring data are collected using a tablet and stored using dedicated software. • Plants with visual symptoms are sent to the laboratory for diagnostic analysis. Testing results are stored. • Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. All plants with symptoms are tested and random samples are taken in the crop. **Evaluation**: Sticky traps can monitor flying thrips however, TSWV can be transmitted also by unnoticed larvae that are also difficult to notice in low populations. The fact that during 2023 thrips were detected in yellow sticky traps although in low numbers (in three traps with an average of 0.19 individuals per day during the affected week) and visual monitoring detected their presence in two occasions on the crop. 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* spp. (and possible of *Calibrachoa* spp.) to TSWV infection. Especially in some varieties the developing local lesions are more difficult to visually detect than others. **Uncertainties**: None.
Sampling and testing	Y	**Description**: In the case of detection of infestation, coloured clips are placed according to the problem on the cultivation table and marked, indicating the limits of the detected problem. Plants suspected of having a disease are sent to the Bioanalysis laboratory for phytosanitary diagnostic. Routine monitoring is carried out in the cultures to detect the presence of viruses, taking weekly samples and analysing them using ELISA. For them, the monitoring staff first look for any virus-like symptom, if no symptoms are observed, they take random samples according to the number of pots. A label is placed on the sampled plant to be able to locate it in case of a positive finding and to be further able to remove the plant and surrounding ones, as well as perform further analysis (Dossier section 3.7). Sampling and testing (in vitro culture) for fungi are applied when necessary. For viruses sampling and testing (ELISA) are carried out every week for CMV, TMV, ToMV, RMV, Tospoviruses (TOSPO kit from Loewe: TSWV, INSV, TCSV, GRSV, CSNV), Potyviruses (POTY kit from Agdia), TMGMV, CBMV (Annex 1 reply, section 4). In general, the tests are carried out in the companies' own laboratories, or they hire the services of laboratories of the Universities (Dossier section 3.11). In the case of a positive finding the affected area is quarantined, 1 square meter around is discarded and more tests are done on the periphery, in addition to disinfecting the area (Annex 1 reply, section 4). **Evaluation**: TSWV is 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. **Uncertainties**: The efficiency of serological techniques for the detection of TSWV in *Petunia* spp./*Calibrachoa* spp. (local lesion host)
Official Supervision by NPPO	Y	**Description**: Every exporter, packer, producer and marketer should be officially registered. There are phytosanitary requirements in place for imported *Petunia* spp. and *Calibrachoa* spp. All imported plants have to be Elite certified. Nurseries are under the supervision of NPPO and inspected on a regular basis. When appropriate, samples of soil or plant material are analysed in the diagnostic laboratory. The phytosanitary certificates for the exported commodities are issued at the processing and packaging facilities, as well as at the exit points. In case of detection of a regulated pest during routine testing of the mother plants, the University Laboratories inform the NPPO. Official NPPO inspectors may request the results of the routine test analysis during visits to production sites to verify phytosanitary conditions (Dossier section 3.11). **Evaluation**: 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 larva to more than one plant, some infections may occur before the development of a detectable thrips infesting population. Infected *Petunia* spp. and *Calibrachoa* spp. 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. **Uncertainties**: The efficiency of monitoring and inspection

(Continued)

Risk mitigation measure	Effect Y/N	Current measures in Costa Rica
Surveillance of production area	Y	**Description**: No details are given for the surveillance of any other possible pests/pathogens. **Evaluation**: 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. **Uncertainties**: – The intensity and the design of the surveillance scheme.

A.12.3 | Possibility of pest presence in the nursery

A.12.3.1 | Possibility of entry from the surrounding environment

TSWV is present in Costa Rica (CABI; online). Recent studies suggest that the virus may not be so widespread (Montero-Astúa, 2023). It is transmitted by thrips (*T. tabaci* and *F. occidentalis),* which are also present in Costa Rica (CABI; online). TSWV has a large host range, including many vegetables, ornamentals and also weeds (EPPO GD; online). Therefore, hosts and vectors are expected to be present and possibly widespread in Costa Rica. The main pathway of entrance of TSWV from the surrounding environment in the nursery is through viruliferous thrips. Defects in the insect proof structure of the production greenhouses could enable thrips to enter, as well as hitchhikers on persons or materials entering the greenhouse.

Uncertainties

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

A.12.3.2 | Possibility of entry with new plants/seeds

Plant material (cuttings) for *Petunia* spp. and *Calibrachoa* spp. mother plants used for the production of unrooted cuttings originate from Germany. TSWV is widespread in the EU (TSWV) (EPPO GD). However, only 'Elite planting material' is imported and certification scheme in place for *Petunia* spp. and *Calibrachoa* spp. includes TSWV (Dossier Section 1.0).

A.12.3.3 | Possibility of spread within the nursery

Petunia spp. and *Calibrachoa* spp. are cultivated in compartments dedicated for their cultivation without mixing with other crop/plants (Dossier Section 1.0). 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. *F. occidentalis* is the most efficient vector of TSWV occurring in greenhouses and a major pest of ornamentals, 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 origin, the host status for TSWV and the phytosanitary status of other plant species (solanaceous, non-solanaceous) than *Petunia* spp. and *Calibrachoa* spp. entering the same nursery (although other compartments).
- The presence and density of the TSWV and thrips vectors in the nursery.
- The level of physical separation (with thrips-proof netting) of the *Petunia* spp. and *Calibrachoa* spp. production units with other production units.

A.12.4 | Information from interceptions

There are no interceptions of tomato spotted wilt virus (TSWV00) from Costa Rica on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. from all origins (EUROPHYT and TRACES, online). TSWV vectors, *F. occidentalis* and *T. tabaci,* are not regulated, therefore it is not expected to have any interception records.

A.12.5 | Overall likelihood of pest freedom

TSWV was already assessed included in the orthotospovirus group for the commodity risk assessment of *Petunia* spp./ *Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). The similarities between the dossiers of Costa Rica and Guatemala are:

- The type of commodity exported: unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. of similar size and age.
- The production system: insect proof greenhouse, dedicated units for *Petunia* spp./*Calibrachoa* spp., strict hygiene measures for staff.
- Monitoring, sampling and testing process in place.
- Official Supervision by the NPPO.
- The uncertainty of pest pressure of thrips and TSWV in the surrounding environment.

The differences between Costa Rica and Guatemala are:

- For Costa Rica there is no random testing at specific stages and especially before export.
- For Costa Rica there is no uncertainty that all the initial starting material is Elite certified and declared free of specified viruses and bacteria.

Because no major differences were identified the Panel reused the results and reasonings of the Expert Elicitation of pest freedom of TSWV/orthotospoviruses on unrooted cuttings of *Petunia* spp./*Calibrachoa* spp. from Guatemala (EFSA PLH Panel, 2024).

A.12.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested consignments

- TSWV has not been reported to infect *Calibrachoa* spp.
- TSWV have has not been reported on *Petunia* spp. and *Calibrachoa* spp. in Costa Rica.
- TSWV has have never been intercepted on produce from Costa Rica
- 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 viruliferous thrips from virus-sources (infected host plants) in the surrounding environment to the greenhouse plants is very difficult because of insect proof structure, 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 (substances and schedule) have a good efficacy against thrips and TSWV spread.
- The inspection regime is effective (detection and treatment).
- Physical separation of different lots offers in case of infestation the restriction of the affected plants.
- At harvest and packing, cuttings with symptoms can be detected with careful observation.

A.12.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- Even if there is no evidence that *Calibrachoa* spp. is a host plant for TSWV, given its polyphagous nature especially among ornamentals it is likely that *Calibrachoa* spp. is also a suitable host plant
- Solanaceous species are very sensitive to TSWV infections
- *Petunia* spp. and *Calibrachoa* spp. are preferable hosts for thrips vectors of TSWV
- Presence of TSWV in the environment is not monitored.
- Considering the wide host range of TSWV it is likely that host plants are present in the surrounding environment.
- High thrips population pressure (e.g. abandoned infected field) in highly preferable TSWV host close to the greenhouse.
- 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 its entry and establishment in the nursery on *Petunia* spp. and *Calibrachoa* spp. or other host plant species.
- The major thrips species in ornamental nurseries is *F. occidentalis* that it is the most efficient vector of TSWV.
- Other thrips species vectoring TSWV are also present and widely distributed in Costa Rica.
- The insecticide treatments are moderately effective against thrips (insecticide resistance).
- Symptoms from thrips feedings 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.12.5.3 | 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 infect many solanaceous species especially ornamentals, therefore *Calibrachoa* spp. is expected to be also a host.
- *Petunia* spp. and *Calibrachoa* spp. are preferable hosts for thrips.
- The major thrips species in ornamental nurseries is *F. occidentalis* that it is the most efficient vector of TSWV.
- The protective effect of the greenhouse structure.
- The insecticides treatments are expected to have moderately effective against thrips (insecticide resistance).
- The high density of the mother plants in the nurseries before harvesting cuttings may prevent the detection of thrips and infested plants.
- *Petunia* spp. plants when infected by TSWV exhibit local lesions on the leaves difficult to visually detect especially in high canopy densities.

A.12.5.4 | 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.12.6 | 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.23) and pest freedom (Table A.24).

TABLE A.23 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.24.

TABLE A.24 The uncertainty distribution of plants free of tomato spotted wilt virus per 10,000 bags of unrooted cuttings calculated by Table A.23.

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	9999.96

Note: The EKE results are the fitted values.

(A)

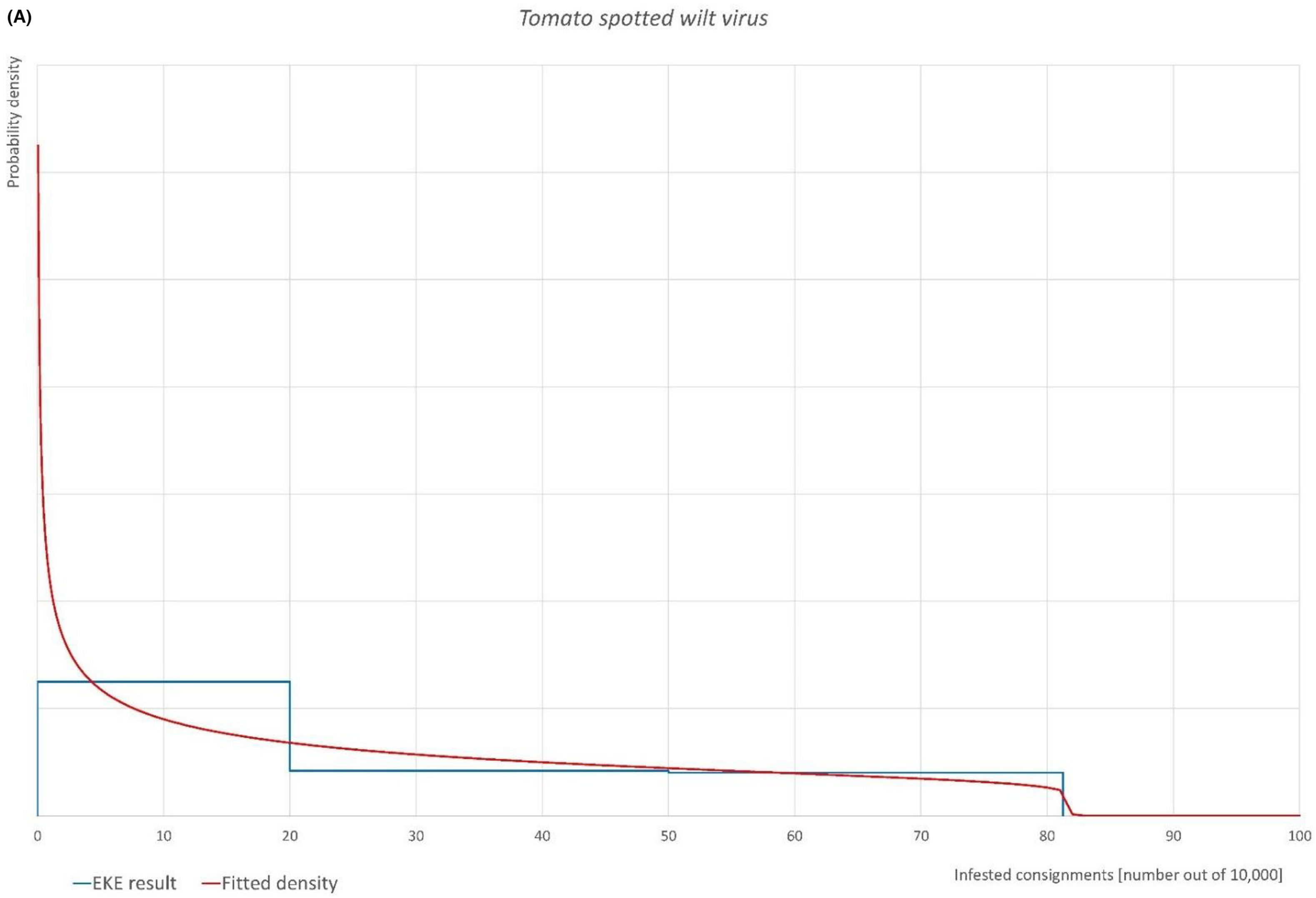

FIGURE A.12 (Continued)

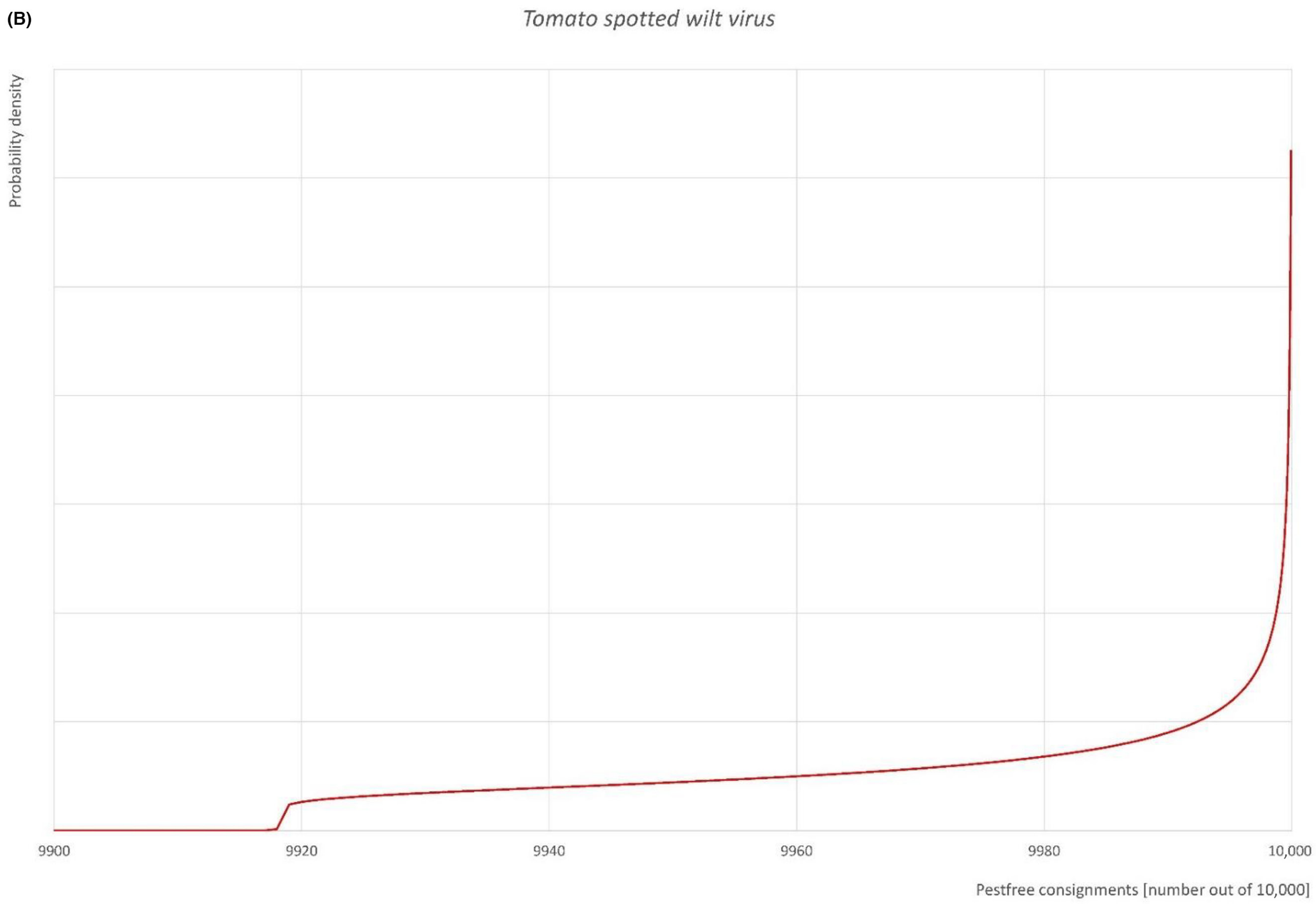

FIGURE A.12 (Continued)

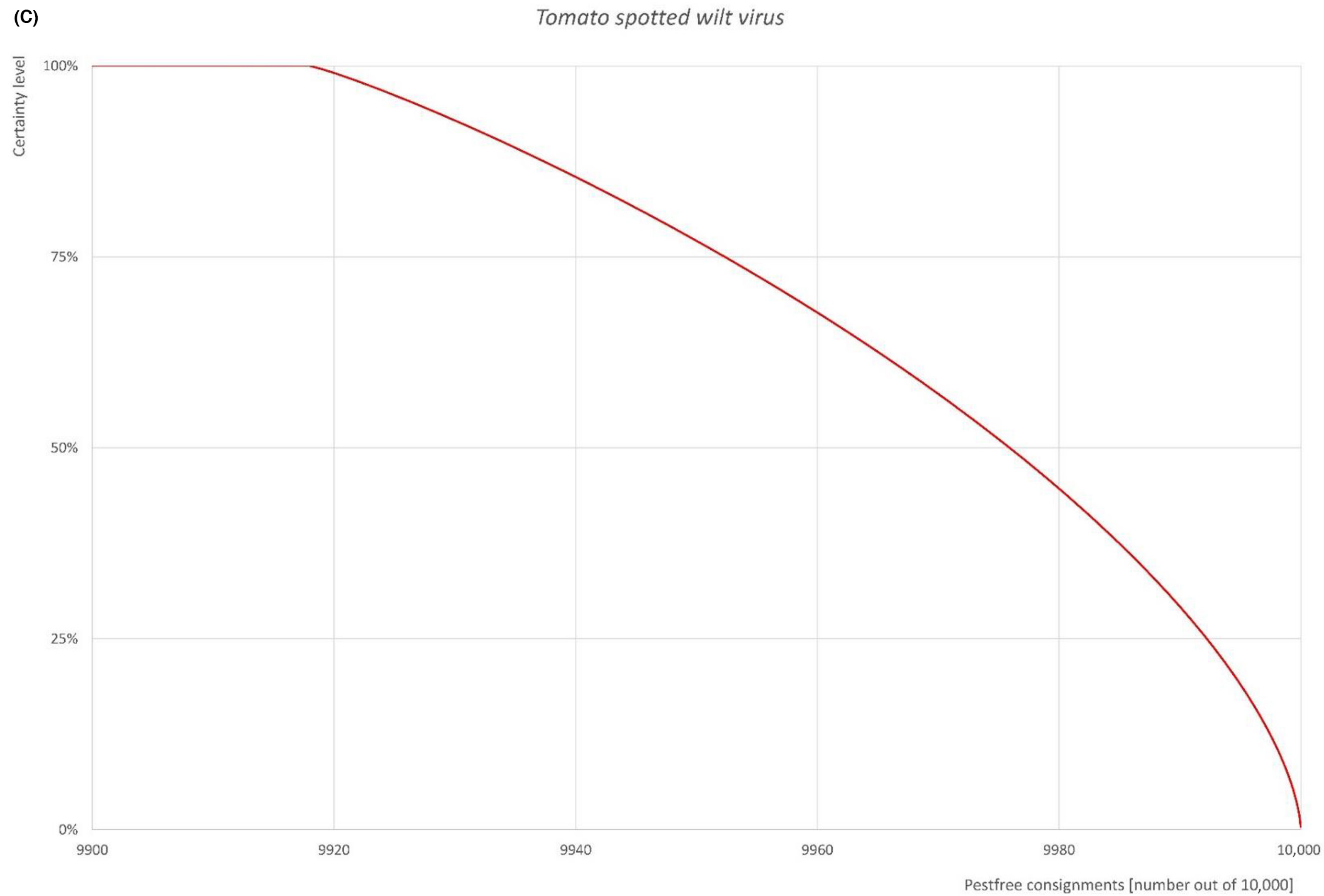

FIGURE A.12 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 52–100 unrooted cuttings per bag) for tomato spotted wilt virus (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (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.12.7 | Reference list

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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 3 pests were added to the list of pests (see Appendix D).

Web of Science All databases	TOPIC: "*Calibrachoa* spp." OR "million bells" AND TOPIC: "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" 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 "ozone sensitivity" NOT TOPIC: "*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 spp. 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 5 pests were added to the list of pests (see Appendix D).

Web of Science All databases	TOPIC: "*Petunia* spp." OR "Petunia" AND TOPIC: "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" 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 spp." 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 Petunia* spp.e" OR "*Berkeleyomyces basicola*" OR "*Botrytis cinerea*" OR "*Cercospora apii*" OR "*Cercospora canescens*" OR "*Cercospora Petunia* spp.e" OR "*Cercospora Petunia* spp.e" 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 Petunia* spp.e" 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 Petunia* spp.e" OR "*Macrophomina phaseolina*" OR "*Rhizoctonia solani*" OR "*Mycocentrospora acerina*" OR "*Paramyrothecium roridum*" OR "*Fusarium solani*" OR "*Pseudoidium neolycopersici*" OR "*Golovinomyces longipes*" OR "*Phyllosticta Petunia* spp.e" 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 Petunia* spp.e" 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 spp. 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 spp. asteroid mosaic virus" OR

(Continued)

	"Petunia spp. chlorotic mottle virus" OR "Petunia spp. vein banding virus" OR "Petunia spp. 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 not further assessed (Reserve List)

In this list pest species are included if there is any uncertainty on: (a) the pest status in Costa Rica; (b) if *Petunia* spp. or *Calibrachoa* spp. can be a host for the pest; (c) if the pest could have impact.

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

	Pest name	Synonyms/virus common names	EPPO code	Group	Status in Costa Rica	Status in the EU	EPPO/EU regulatory status	Justification for inclusion in this list
1	*Aleurotrachelus trachoides*		ALTRTR	Insects & Mites	Present	Absent	Non regulated	*Petunia* spp. as host uncertain
2	*Bactericera cockerelli*		PARZCO	Insects & Mites	Present in Costa Rica	Absent	Quarantine pest (Annex II A)	Uncertainty on pest status in Costa Rica
3	*Begomovirus solanumhavanaense**	Tomato mosaic Havana virus	THV000	Viruses and viroids	Present in Costa Rica	Absent	Quarantine pest (Annex II A)	Uncertainty of pest status in Costa Rica
4	*Brachyplatys subaeneus*		BRAPSU	Insects & Mites	Present in Costa Rica	Absent	Non regulated	*Petunia* spp. as host uncertain
5	*Comovirus andesense**	Andean potato mottle virus	APMOV0	Viruses and viroids	Present in Costa Rica	Absent	Quarantine pest (Annex II A)	*Petunia* spp. as host unlikely -Taxonomic issues with species
6	*Ferrisia virgata*		PSECVI	Insects & Mites	Present in Costa Rica	Limited	Non regulated	Polyphagus unregulated pest - *Petunia* spp. as host uncertain
7	*Maconellicoccus hirsutus*		PHENHI	Insects & Mites	Present in Costa Rica	Limited	Non regulated	Polyphagus unregulated pest - *Petunia* spp. as host uncertain
8	*Megalurothrips usitatus*		MEGTUS	Insects & Mites	Present in Costa Rica	Absent	Non regulated	*Petunia* spp. as host uncertain
9	*Paracoccus marginatus*		PACOMA	Insects & Mites	Present in Costa Rica	Absent	Non regulated	Polyphagus unregulated pest - *Petunia* spp. as host uncertain
10	*Phenacoccus parvus*		PHENPA	Insects & Mites	Present in Costa Rica	Absent	Non regulated	Polyphagus unregulated pest - *Petunia* spp. as host uncertain
11	*Planococcus minor*		PLANMI	Insects & Mites	Present in Costa Rica	Limited	Non regulated	Polyphagus unregulated pest - *Petunia* spp. as host uncertain
12	Potato leafroll virus*	Potato leafroll virus	PLRV00	Viruses and viroids	Present in Costa Rica	Present	Quarantine pest (Annex II A)	*Petunia* spp. as host uncertain
13	*Pseudocercospora trichophila*			Fungi & Chromista	Present in Costa Rica	Absent	Non regulated	*Petunia* spp. as host uncertain
14	*Pseudococcus jackbeardsleyi*		PSECJB	Insects & Mites	Present in Costa Rica	Absent	Non regulated	Polyphagus unregulated pest - *Petunia* spp. as host uncertain
15	*Puccinia paulensis*		PUCCPA	Fungi & Chromista	Present in Costa Rica	Absent	Non regulated	*Petunia* spp. as host uncertain

TABLE C.1 (Continued)

	Pest name	Synonyms/virus common names	EPPO code	Group	Status in Costa Rica	Status in the EU	EPPO/EU regulatory status	Justification for inclusion in this list
16	*Puccinia pittieriana*		PUCCPT	Fungi & Chromista	Present in Costa Rica	Absent	Quarantine pest (Annex II A)	*Petunia* spp. as host uncertain
17	*Spodoptera eridania*		PRODER	Insects & Mites	Present in Costa Rica	Limited	Quarantine pest (Annex II A)	*Petunia* spp. as host uncertain
18	*Spodoptera frugiperda*		LAPHFR	Insects & Mites	Present in Costa Rica	Limited	Quarantine pest (Annex II A)	*Petunia* spp. as host uncertain
19	*Tepovirus tafsolani**	Potato virus T	PVT000	Viruses and viroids	Present in Costa Rica	Absent	Quarantine pest (Annex II A)	*Petunia* spp. as host uncertain
20	*Thecaphora solani*		THPHSO	Fungi & Chromista	Present in Costa Rica	Absent	Quarantine pest (Annex II A)	Uncertainty of pest status in Costa Rica
21	*Xanthomonas hortorum pv. gardneri*		XANTGA	Bacteria	Present in Costa Rica	Limited	RNQP (Capsicum, Solanum)	*Petunia* spp. as host uncertain
22	*Xylella fastidiosa*		XYLEFA	Bacteria	Present in Costa Rica	Present	Quarantine pest (Annex II B)	*Petunia* spp. as host uncertain

* According to ICTV rules (https://talk.ictvonline.org/information/w/faq/386/how-to-write-a-virus-name), common names of viruses are not italicised. The new binomial 'genus-species' format which is adopted by the International Committee on Taxonomy of Viruses (ICTV) in 2021 and it is gradually implemented for viruses/viroids species.

APPENDIX D

Excel file with the list of potentially relevant pests for *Petunia* spp. or *Calibrachoa* spp. exported from Costa Rica

This list contains all the pests that were reported to infect/infest *Petunia* spp. or *Calibrachoa* spp. based on thematic databases and systematic literature searches.

Additional relevant pests, with a broad host range, including solanaceous host plants were included in the list, if there was evidence of presence in the country of export.

All viruses and viroids infecting major solanaceous crops (tomato, pepper, potato and cultivated tobacco) retrieved from CABI and recent review articles on the subject were included.

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

Footnotes

The *Petunia* spp./*Calibrachoa* spp. 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 spp. 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* spp. *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* spp.). Viruses belonging to the *Amalgavirus*, *Deltapartitivirus* and *Alphaendornavirus* genera 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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