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SCIENTIFIC OPINION

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

EFSA Panel on Plant Health (PLH) | Claude Bragard | Paula Baptista | Elisavet Chatzivassiliou | Francesco Di Serio | Paolo Gonthier | Josep Anton Jaques Miret | Annemarie Fejer Justesen | Alan MacLeod | Christer Sven Magnusson | Panagiotis Milonas | Juan A. Navas-Cortes | Stephen Parnell | Philippe Lucien Reignault | Emilio Stefani | Hans-Hermann Thulke | Wopke Van der Werf | Antonio Vicent Civera | Jonathan Yuen | Lucia Zappalà | Raghavendra Reddy Manda | Olaf Mosbach Schulz | Antigoni Akrivou | Spyridon Antonatos | Despoina Beris | Jane Debode | Christos Kritikos | Maria Kormpi | Christophe Lacomme | Charles Manceau | Dimitrios Papachristos | Chrysavgi Reppa | Ciro Gardi | Roel Potting

Correspondence:
plants@efsa.europa.eu

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 Kenya. The relevance of any pest for this opinion was based on evidence following defined criteria, based on the methodology used for High-Risk Plants adapted for the specificity of this assessment. Fourteen EU-regulated pests (*Bemisia tabaci*, cowpea mild mottle virus, *Liriomyza huidobrensis*, *Liriomyza sativae*, *Liriomyza trifolii*, potato leafroll virus, potato spindle tuber viroid, *Ralstonia pseudosolanacearum*, *R. solanacearum*, *Scirtothrips dorsalis*, tomato mild mottle virus, tomato spotted wilt virus, tomato yellow leaf curl virus and *Xanthomonas vesicatoria*) and six EU non-regulated pests (*Aleurodicus dispersus*, pepper veinal mottle virus, *Nipaecoccus viridis*, *Phenacoccus solenopsis*, *Tetranychus neocaledonicus* and tomato yellow ring virus) fulfilled all relevant criteria and were selected for further evaluation. For these pests, the risk mitigation measures proposed in the technical dossier from Kenya were evaluated, taking into account the possible limiting factors. 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 *T. neocaledonicus* being the pest most frequently expected on the imported cuttings. The Expert Knowledge Elicitation indicated, with 95% certainty, that between 9942 and 10,000 bags containing unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. per 10,000 would be free of *T. neocaledonicus*.

KEYWORDS

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

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1 | INTRODUCTION

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

1.1.1 | Background

The introduction of plants for planting of Solanaceae other than seeds into the European Union (EU) is prohibited from certain origins, including the countries that have requested this derogation, as they are listed in point 18 of Annex VI to Regulation (EU) 2019/2072. In August 2021, Germany sent a request for derogation to import unrooted cuttings of 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 non-regulated pests, associated with unrooted cuttings of the genera *Petunia* and *Calibrachoa* produced under physical isolation in Costa Rica, Guatemala, Kenya and Uganda.

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

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

1.2 | Interpretation of the Terms of Reference

This opinion refers only to the Kenya 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 Kenya following the Guidance on commodity risk assessment for the evaluation of high-risk plant dossiers (EFSA PLH Panel, 2019), taking into account the available scientific information, including the technical information provided by Kenya.

Following an exchange with 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 (Kenya Plant Health Inspectorate Service (NPPO of Kenya)) 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* and/or *Calibrachoa*), or to major solanaceous crops (tomato, pepper, potato and cultivated tobacco).

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

- Included in the assessment, pests with host plant records for *Petunia* 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 Kenya.

2 | DATA AND METHODOLOGIES

2.1 | Data provided by the NPPO of Kenya

The Panel considered all the data and information provided by the NPPO of Kenya in response to EFSA's request, which was received on 28 December 2022. Further additional information was submitted by the NPPO of Kenya in response to EFSA's request on 27 November 2023. The Dossier is managed by EFSA.

The structure and overview of the Dossier are 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.	*Calibrachoa* and *Petunia* technical, information for EFSA DEC 2022.pdf
2.0	Answers to request of additional information on *Petunia* spp. and *Calibrachoa* spp.	*Calibrachoa* technical information for EFSA 26 Nov 2023.pdf
3.0	Table with status of *Petunia* spp. and *Calibrachoa* spp. pests in Kenya	Annex 2 – pest status specific requests to KenyaX.xlsx
4.0	Map of the nursery in Kenya intending to export *Petunia* spp. and *Calibrachoa* spp. to the EU	Company map Selecta Kenya Q1 2024.pdf

2.2 | Literature searches performed by the NPPO of Kenya

The data and supporting information provided by the NPPO of Kenya formed the basis of the commodity risk assessment. The database shown in Table 2 and the resources and references listed below are the main sources used by the NPPO of Kenya 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 Kenya.

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

Other resources used by the NPPO of Kenya

- Curnutte, L. B., Simmons, A. M., & Abd-Rabou, S. (2014). Climate change and *Bemisia tabaci* (Hemiptera: Aleyrodidae): Impacts of temperature and carbon dioxide on life history. *Annals of the Entomological Society of America*, *107*(5), 933–943.
- German, T. L., Ullman, D. E., & Moyer, J. W. (1992). Tospoviruses: Diagnosis, molecular biology, phylogeny, and vector relationships. *Annual Review of Phytopathology*, *30*(1), 315–348.
- Hull, R. (1969). Alfalfa mosaic virus. *Advances in Virus Research*, *15*, 365–433.
- Kimaru, S. L., Kilalo, D. C., Muiru, W. M., Kimenju, J. W., & Thuku, C. R. (2020). Molecular detection of cucumber mosaic virus and tobacco mosaic virus infecting African Nightshades (*Solanum scabrum* Miller). *International Journal of Agronomy*, *2020*, 1–7.
- Kinoga, M. N., Kuria, P. K., Miano, D. W., & Wasilwa, L. A. (2021). First report of Potato spindle tuber viroid infecting tree tomato in Kenya in mixed infection with Potato virus Y. *New Disease Reports*, *44*(1), e12029.
- Kinyanjui, G., Khamis, F. M., Ombura, F. L. O., Kenya, E. U., Ekesi, S., & Mohamed, S. A. (2019). Infestation levels and molecular identification based on mitochondrial COI barcode region of five invasive Gelechiidae pest species in Kenya. *Journal of Economic Entomology*, *112*(2), 872–882.

- Kumarasinghe, N. C., Salim, N., & Wijayarathne, W. (2009). Identification and biology of two whitefly species on cassava in Sri Lanka. *Journal of Plant Protection Research*, *49*(4).
- Kunjwal, N., & Srivastava, R. M. (2018). Insect pests of vegetables. *Pests and Their Management*, 163–221.
- Macharia, I., Backhouse, D., Ateka, E. M., Wu, S. B., Harvey, J., Njahira, M., & Skilton, R. A. (2015). Distribution and genetic diversity of Tomato spotted wilt virus following an incursion into Kenya. *Annals of Applied Biology*, *166*(3), 520–529.
- McQuate, G. T., & Liquido, N. J. (2013). 0289. Annotated world bibliography of host fruits of *Bactrocera latifrons* (Hendel) (Diptera: Tephritidae). *Insecta Mundi*, 1–61.
- Mertelik, J., Kloudova, K., Cervena, G., Necekalova, J., Mikulkova, H., Levkanicova, Z., & Ptacek, J. (2010). First report of Potato spindle tuber viroid (PSTVd) in *Brugmansia* spp., *Solanum jasminoides*, *Solanum muricatum* and *Petunia* spp. in the Czech Republic. *Plant Pathology*, *59*(2), 392.
- Munguti, F. M., Kilalo, D. C., Nyaboga, E. N., Wosula, E. N., Macharia, I., & Mwango'mbe, A. W. (2021). Distribution and molecular diversity of whitefly species colonizing cassava in Kenya. *Insects*, *12*(10), 875.
- Onditi, J., Nyongesa, M., & van der Vlugt, R. (2022). Prevalence, distribution and control of potato virus Y (PVY) strains in Kenyan potato cultivars. *Tropical Plant Pathology*, *47*(5), 659–671.
- Onditi, J., Nyongesa, M., & van der Vlugt, R. (2021). Prevalence, distribution and control of six major potato viruses in Kenya. *Tropical plant pathology*, *46*, 311–323.
- Otieno, E. A. (1985). *Identification Of Tomato Mosaic Strain Of Tobacco Mosaic Virus (tmv) And Its Effects On Yield Of Tomato (lycopersicon Escuzentum) Varieties' moneymaker'And'roma Vf'In Kenya* (Doctoral dissertation, University of Nairobi). https://erepository.uonbi.ac.ke:8080/xmlui/handle/123456789/27799
- Perring, T. M., Stansly, P. A., Liu, T. X., Smith, H. A., & Andreason, S. A. (2018). Whiteflies: Biology, ecology, and management. In *Sustainable management of arthropod pests of tomato* (pp. 73–110). Academic Press.
- Sevik, M. A., & Arli-Sokmen, M. (2012). Estimation of the effect of Tomato spotted wilt virus (TSWV) infection on some yield components of tomato. *Phytoparasitica*, *40*, 87–93.
- Smith, P. E. (2009). Crop and Food Research. *Whitefly: Identification and Biology in New Zealand Greenhouse Tomato Crops; Smith, PE, Ed*, 1–8.
- Wangai, A. W., Mandal, B., Pappu, H. R., & Kilonzo, S. (2001). Outbreak of Tomato spotted wilt virus in tomato in Kenya. *Plant Disease*, *85*(10), 1123–1123.
- Wijkamp, I., Almarza, N., Goldbach, R., & Peters, D. (1995). Distinct levels of specificity in thrips transmission of tospoviruses. *Phytopathology*, *85*(10), 1069–1074.

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* and *Calibrachoa*. Two searches were combined: (i) a general search to identify pests of *Petunia* spp. and *Calibrachoa* spp. in different databases, and (ii) a tailored search to identify whether these pests are present or not in Kenya and the EU. The searches were run between 30 May 2022 and 11 June 2022. No language, date or document type restrictions were applied in the search strategy. The Panel used the databases indicated in Table 3 to compile the list of pests associated with the genera *Petunia* and *Calibrachoa*. As for Web of Science, the literature search was performed using a specific, ad hoc, established search string (see Appendix B). The string was run in 'All Databases' with no range limits for time or language filters. This is further explained in Section 2.4.2 pest list from Benaki Phytopathological Institute (Athens, Greece).

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

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://www.montpellier.inra.fr/CBGP/spmweb/advanced.php
USDA ARS Fungi Database (version 2021)	https://nt.ars-grin.gov/fungaldatabases/fungushost/fungushost.cfm

Database	Platform/link
Index Fungorum	https://www.indexfungorum.org/Names/Names.asp
MycoBank	https://www.mycobank.com
Web of Science: All Databases (Web of Science Core Collection, CABI: CAB Abstracts, BIOSIS Citation Index, Chinese Science Citation Database, Current Contents Connect, Data Citation Index, 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
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 EU non-regulated pests not known to occur in the EU were selected based on evidence of their potential impact in the EU. After the first step, all the relevant pests that may need risk mitigation measures were identified.

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

A conclusion on the likelihood of the commodity being free from each of the relevant pest was determined, and uncertainties were 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 105 unrooted cuttings.

The information provided in some sections of 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 Kenya, the characteristics of the commodity are summarised in Section 3.

2.4.2 | Identification of pests potentially associated with the commodity

To evaluate the pest risk associated with the importation of the commodity from Kenya, 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* and *Calibrachoa*, and the polyphagous pests associated with major Solanaceae plants reported to be present in Kenya based on information provided in the Dossier Sections 1.0, 2.0, 3.0 and on searches performed by the Panel. All viruses and viroids infecting major solanaceous crops (tomato, pepper, potato and cultivated tobacco) retrieved from CABI and European and Mediterranean Plant Protection Organization (EPPO) databases (CABI, online; EPPO, online) and recent review articles on the subject were 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, many, if not most, available data concerning host status for plant viruses refer to laboratory tests in which *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 systemic/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 2009–2023 (EUROPHYT, online, from 2009 to 2020 and TRACES-NT, online, from May 2020 to March 2023, Accessed: January 12 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 of *Petunia* spp. and *Calibrachoa* spp. from Kenya is prohibited. For each selected pest, it was also checked if there were notification records for Kenya (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).

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

The methodology used to establish pest presence depends in part on published literature. The limited number of publications from Kenya 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.

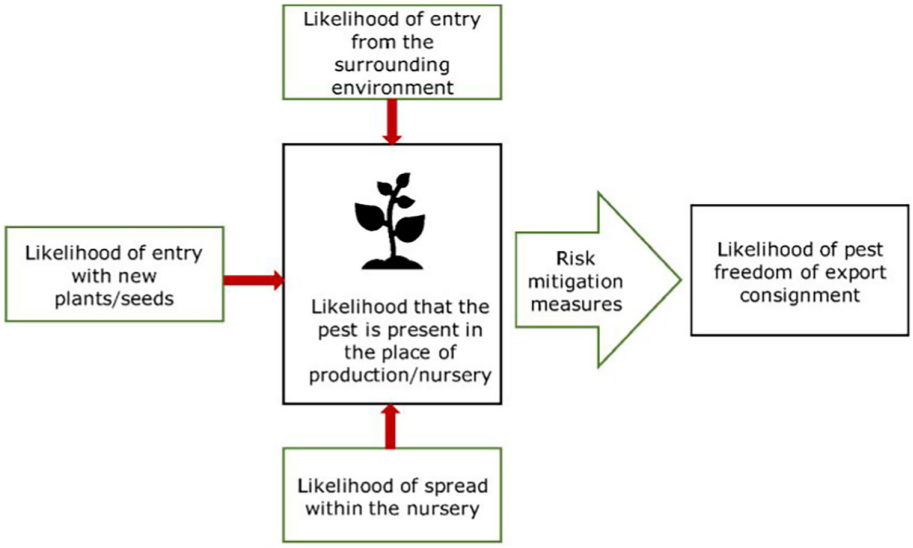

FIGURE 1 Conceptual framework to assess likelihood that plants are exported free from relevant pests (*Source*: EFSA PLH Panel, 2019).

Information on the biology, estimates of the likelihood of entry of the pest into the nursery and spread within the nursery, and the effect of the measures on a specific pest are 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. Each bag contains 105 unrooted cuttings. The following reasoning is given:

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

Before the elicitation, the pests were grouped if they had similar characteristics, such as: closely taxonomically related; 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, 2024). 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 status. When no major differences were identified, the results of the previous risk assessment were taken. When differences were identified, the EKE was based on the previous elicited values considering the necessary adaptations.

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

3 | COMMODITY DATA

3.1 | Description of the commodity

The commodities to be imported are unrooted cuttings (stem with leaves) of *Petunia* spp. (common name: petunia, garden petunia; family: Solanaceae) and/or *Calibrachoa* spp. (common name: calibrachoa, mini petunia; family: Solanaceae). These unrooted cuttings measure about 2–4 cm in length and possess 2–4 pairs of leaves (Figure 2). The cuttings are harvested from mother plants that are at least 7 weeks old (i.e. 7 weeks after cuttings to establish mother plants had been planted). The harvesting process spans until the plants reach 40 weeks of age, resulting in a total harvesting period of 33 weeks (Dossier sections 1.0 and 2.0).

According to International Standards for Phytosanitary Measures 36, 'Integrated measures for plants for planting' (FAO, 2019), the commodity can be classified as 'unrooted cuttings'.

FIGURE 2 Unrooted cuttings of (A) *Petunia* spp. and (B) *Calibrachoa* spp. intended to be exported to the EU (*Source*: Dossier section 1.0).

3.2 | Description of the production area

There are seven production sites spread across six counties in Kenya interested in exporting the unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. to the EU (Figure 3).

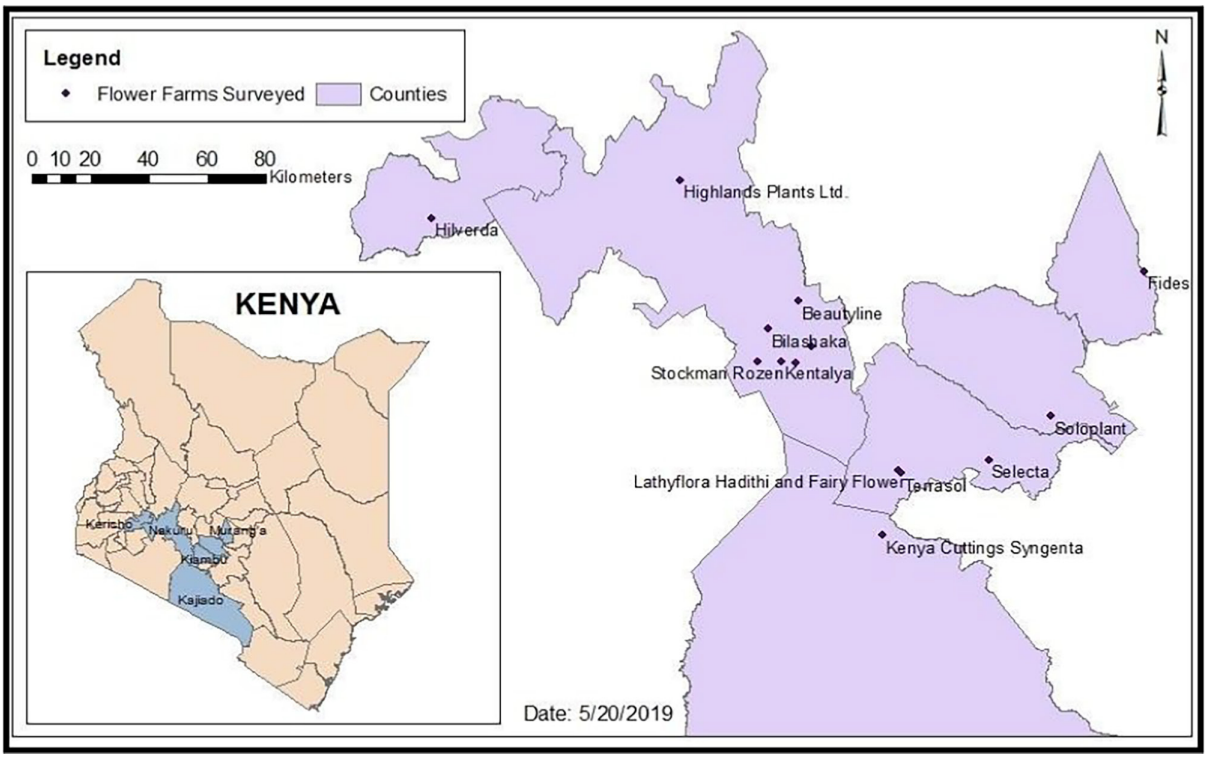

FIGURE 3 Location of the nurseries designated for export of *Petunia* spp. and *Calibrachoa* spp. to the European Union (*Source*: Dossier Section 1.0).

3.3 | Production and handling processes

3.3.1 | Source of planting material

Elite planting material (Naktuinbouw certified) in the form of tissue culture plantlets or unrooted cuttings is imported from facilities in Germany (2000 plantlets/cuttings per year), Portugal (1500 plantlets/cuttings per year), Spain (3500 plantlets/cuttings per year) and Israel (Danziger) (2000 tissue culture plantlets per year) (Dossier Section 1.0).

There are four distinct types of planting material: candidate plant, nuclear stock, foundation stock and mother stock. The candidate plants are the breeder's material, usually few in number. The unrooted cuttings from these candidate plants are raised as nuclear stock by the breeders. This nuclear stock is maintained by the breeders in three EU countries and Israel. The unrooted cuttings or tissue culture plantlets derived from the nuclear stock are exported to Kenya, and these unrooted cuttings or tissue culture plantlets, when raised in Kenya, are classified as the foundation stock. Cuttings from the foundation stock are propagated as mother plants in Kenya. The unrooted cuttings that are exported from Kenya to the EU are obtained from the mother plants (Dossier Sections 1.0 and 2.0).

As stated earlier, the unrooted cuttings or the tissue culture plantlets derived from the nuclear stock are exported to Kenya from the above three EU countries and Israel. Upon arrival in Kenya, they are held at the post entry quarantine facilities for 4 weeks. The NPPO samples and tests 10% of the planting material before lifting of the quarantine status imposed on the imports. NPPO tests the planting materials for tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA) and Calibrachoa mottle virus (CbMV). The planting material is approved for propagation by NPPO only if the test is negative for all the above-mentioned viruses and viroids. Thereafter, 3-week inspection interval is adopted by NPPO for plants in the propagation facility. Official testing is done using an enzyme-linked immunosorbent assay (ELISA) and conventional and real-time polymerase chain reaction (PCR) (Dossier Sections 1.0 and 2.0).

Furthermore, the candidate plants, nuclear stock, foundation stock and mother plants after 3–4 weeks of planting are subjected to 100% sampling and testing for the above-mentioned viruses and viroids, such that individual plants are tested (Dossier Sections 1.0 and 2.0).

3.3.2 | Production cycle and conditions

Plants of *Petunia* spp. and *Calibrachoa* spp. are grown in certified production sites for plants for planting. From the three EU countries and Israel, unrooted cuttings from the nuclear stock are exported to Kenya, and these unrooted cuttings are raised as foundation stock (also called as increase blocks) in Kenya. The cuttings from this foundation stock are raised as mother stock (also called as production blocks/houses). The foundation stock and the mother stock producing greenhouses are separated from each other. Furthermore, cuttings from several other ornamentals are produced within the same production sites. These include perennials, bedding plants and succulents, which are for exporting mainly to the EU, but not for local markets. However, specific greenhouses are designated for the production of *Petunia* spp. and *Calibrachoa* spp. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse. All propagation materials for the cuttings are imported from EU member countries and Israel. No other crops are produced in these production sites, other than cuttings destined for export markets. Moreover, there are no other solanaceous crop production areas within the vicinity of *Petunia* spp. and *Calibrachoa* spp. production sites (Dossier Sections 1.0 and 2.0).

The greenhouses are covered on top by polythene, and the sidewalls are fitted with thrips-proof netting. Plants are grown on the raised benches with height ranging from 0.6 m to 1.5 m above the ground. The floor of the greenhouses is covered by mypex (ground fabric cover), concrete or volcanic rock. The growing media used are sterilised volcanic pumice. For sterilisation, the growing media undergo steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Nurseries steam at different temperatures, with 80°C for a duration of 1 h being the minimum. New growing media are used every season, and the plants are planted in new polythene bags or sterilised pots every season. Light intensity inside the greenhouse is 5–10 M/J per day, with a temperature of 22–28°C during the day, and humidity ranging from 50% to 80% (Dossier Sections 1.0 and 2.0).

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

- Sticking of unrooted cuttings for build-up: Weeks 20–35.
- Transplanting: Weeks 26–40.
- Harvesting: Weeks 35–20 of the following year.

Pest monitoring during production: Plants are produced in insect proof greenhouses. All vents are closed by an insect proof net. Any torn areas on the insect net are repaired. There is a double door and an automated fan at the entrance to the greenhouse (Figure 4). Daily scouting is conducted by the nursery staff, and pest incidences are recorded. The traps (sticky, pheromone and light) assist the nurseries to enable pest monitoring and scouting, and they are replaced as needed. Yellow sticky traps are employed (1 trap for every 10 m^2) to trap thrips and whiteflies. Pheromone traps are placed (1 trap for every 200 m^2) to trap moths (commonly *Duponchelia* spp.). There is also a black light trap (at least one per greenhouse) to enhance monitoring of all types of moths (Dossier Sections 1.0 and 2.0).

During the active growth, routine testing of the mother plants is done throughout the production period at intervals, either weekly or biweekly depending on the growers. Also, the sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories such as Naktuinbouw, Elsner Pac, Biotek, among others. All test results are available to NPPO upon request. NPPO also conducts their own sampling and testing. There is also in-house testing by nurseries using ELISA and quick tests where applicable. In the nurseries, all plants are tested (100% sampling) for the above-mentioned viruses and viroids 3–4 weeks after planting. Further screening (10% sampling) is done at the age of 4–6 weeks, and then harvesting starts at 7–12 weeks and continues weekly for about 22–28 weeks. Any symptomatic samples observed during routine inspection are sampled and tested for an appropriate pathogen. In case any sample is tested positive for any of the pathogens, the place is quarantined and suspected plants are tagged, and then the NPPO is notified to collect samples for official confirmatory tests and pest reporting. If the samples are confirmed to be positive, infected plants, including the planting medium, are discarded by incineration or burying, and this is witnessed and documented by the NPPO, and a destruction report is issued. But if insect vectors like *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) or *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae) are identified in a greenhouse, appropriate pesticides will be applied. Furthermore, exports from the greenhouse will be temporarily suspended, and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. If tests are negative, exports of the plants will be recommended. Testing is done using molecular assays, conventional or real-time PCR. For both tospoviruses and begomoviruses, genus-specific assays are conducted, and for potyviruses, species-specific serological assays and molecular techniques are used. However, tests for tomato yellow leaf curl virus (TYLCV), tomato leaf curl virus, TSWV and INSV are also conducted. So far, no samples have been tested positive during the routine testing for begomoviruses and tospoviruses. Growers use biological control agents such as the predatory mites *Phytoseiulus persimilis* Athias-Henriot and, *Amblyseius* spp. (Mesostigmata: Phytoseiidae), the entomopathogenic fungus *Beauveria bassiana*, and chemical pesticides such as Spinosad, Flonicamid, Pyrethrins and Abamectin for managing whiteflies, thrips and aphids. In addition, benevia (cyantraniliprole) and neem oil are used to manage *F. occidentalis*. The plants are also tested at the end of the growing season before discarding to ensure that there was no contamination during the growing season (Dossier Sections 1.0 and 2.0).

Official inspection of plants for planting to the EU is conducted by NPPO at a 3-week interval. During such official inspections, NPPO inspectors check for the scouting records, and the crops including monitoring traps within and outside the production greenhouses. There are rarely incidences of thrips recorded in the scouting records or on the traps. Occasionally incidences of about 1–2 thrips in the entire greenhouse can be observed on the sticky traps. No incidence of aphids has ever been observed or documented. No samples of *Petunia* spp. and *Calibrachoa* spp. have resulted to be positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens tested (Dossier Section 2.0).

Irrigation water source and testing: Water is mainly sourced from lakes or rivers. The water undergoes sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept, and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogens (Dossier Sections 1.0 and 2.0).

Hygiene measures: Facilities have dedicated staff that handle solanaceous plants (*Petunia* spp. and *Calibrachoa* spp.). The growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols (Figure 4) include:

- Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse.
- Pruning tools are regularly disinfected and are dedicated to particular production benches. Maintenance and harvesting of crops/cuttings are done using knives. Ten knives are designated for use during the handling of plants per bed. Each knife is used on 10 plants and disinfected with an appropriate disinfectant for at least 20 mins.
- Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use.
- Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant.
- Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants.
- Traceability protocols developed and implemented.
- The production area in the greenhouse is kept weed free.
- The production benches have a side cover to avoid direct contact of the workers clothing with the plants.
- Packing of harvested cuttings is done within the production greenhouses, and quality control is done to ensure the packaged cuttings meet the required specifications.
- In case of any sample tested positive for any pathogen, facilities have decontamination procedures in place (quarantining the place and discarding the plant and the planting medium).

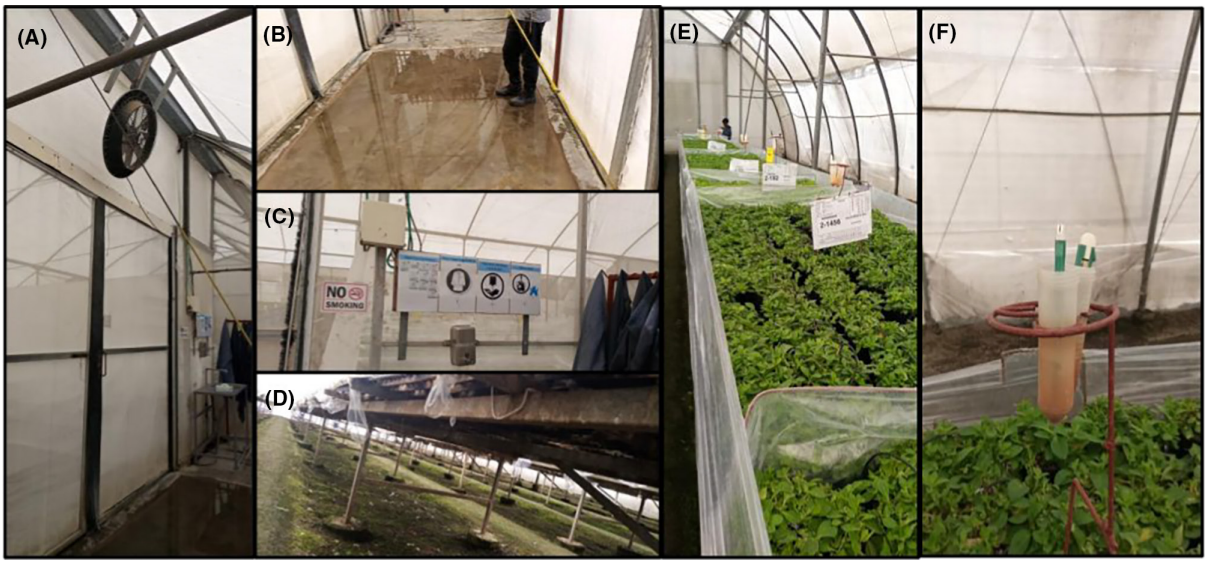

FIGURE 4 Hygienic measures in the nurseries designated for export of *Petunia* spp. and *Calibrachoa* spp. to the European Union: (A) expeller fan at the door; (B) footbath between the double doors; (C) hygiene guidelines and signage facility at the entry; (D) raised beds; (E) side cover of the beds to prevent direct contact of plants with the clothing of the operators; (F) disinfection of knives used for harvesting (*Source*: Dossier Section 1.0).

3.3.3 | Post-harvest processes and export procedure

Peak weeks for export ranges between Weeks 48 and 13 of the following year. Expected volume from an individual nursery is around 10–60 M cuttings (both *Petunia* spp. and *Calibrachoa* spp.) shipped to EU in 1 year. The volumes vary from one facility to another. There are about seven facilities interested in exporting these commodities to the EU (Dossier Sections 1.0 and 2.0).

All unrooted cuttings are harvested and packed within the production greenhouses, and quality control is done to ensure the packaged cuttings meet the required specifications. Packaging is done in perforated polythene bags. Labels with traceability information are included in the bag. The labels contain information of the commodity, variety, bed number from which harvesting was done, date of harvesting, harvester number/code, facility and customer. Each bag contains 105 cuttings. One hundred and fifty bags are placed in a box (Figure 5), hence about 15,000 cuttings per box. They are transported to cold store from greenhouse using cool boxes. Plants placed in cartons are transported in covered trucks that have a cooling system to the airport for shipping via air (Dossier Sections 1.0 and 2.0).

FIGURE 5 Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. packed for shipping (*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 463 species (see Microsoft Excel® 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) retrieved from CABI GD and recent review articles on the subject were included.

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

The EU listing of Union quarantine pests and protected zone (PZ) 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.

Fifty-three EU-regulated (QPs, RNQPs, emergency measures and PZ quarantine pests) species that are present in Kenya 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 4 and Appendix D).

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

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

For pests regulated as RNQPs, only the ones regulated for solanaceous crops were selected for further evaluation. In Table 4, an overview is given of the conclusion for the 53 EU-regulated pests that are known to use solanaceous host plants.

Of the 53 EU-regulated pest species evaluated, 16 were selected for further evaluation.

TABLE 4 Overview of the evaluation of the 53 EU-regulated pests present in Kenya (QPs, RNQPs, emergency measures and protected zone quarantine pests) known to use solanaceous host plants or specifically *Petunia* spp. and *Calibrachoa* spp. for their relevance for this Opinion.

No.	Pest species*	EPPO code	Commodity risk assessment group	EU-Q status	RNQP info	*Petunia* spp./*Calibrachoa* spp. as a host	Conclusion
1	*Aleurocanthus woglumi*	ALECWO	Insects & Mites	A1 Quarantine pest (Annex II A)		No	*Petunia* spp. and *Calibrachoa* spp. unlikely as a host
2	*Aphelenchoides besseyi*	APLOBE	Nematoda	RNQP (Annex IV)	*Oryza*, *Fragaria*	No	RNQP (not for Solanaceae)
3	*Bactrocera cucurbitae*	DACUCU	Insects & Mites	A1 Quarantine pest (Annex II A)		No	Not a pathway
4	*Bactrocera dorsalis*	DACUDO	Insects & Mites	A1 Quarantine pest (Annex II A)		No	Not a pathway
5	*Bactrocera latifrons*	DACULA	Insects & Mites	A1 Quarantine pest (Annex II A)		No	Not a pathway
6	*Bemisia tabaci*	BEMITA	Insects & Mites	A1 Quarantine pest (Annex II A)		Yes	ACTIONABLE
7	*Candidatus Liberibacter asiaticus*	LIBEAS	Bacteria	A1 Quarantine pest (Annex II A)		No	*Petunia* spp. and *Calibrachoa* spp. unlikely as a host
8	*Ceratitis rosa*	CERTRO	Insects & Mites	A1 Quarantine pest (Annex II A)		No	Not a pathway
9	Chrysanthemum stunt viroid	CSVD00	Virus	RNQP (Annex IV)	*Argyranthemum*, *Chrysanthemum*	Yes	RNQP (not for Solanaceae)
10	*Colletotrichum acutatum*	COLLAC	Fungi & Chromista	RNQP (Annex IV)	*Fragaria*	No	RNQP (not for Solanaceae)
11	*Colletotrichum gossypii*	GLOMGO	Fungi & Chromista	PZ Quarantine pest (Annex III)		No	*Petunia* spp. and *Calibrachoa* spp. unlikely as a host
12	Cowpea mild mottle virus	CPMMV0	Virus	A1 Quarantine pest (Annex II A)		Likely	ACTIONABLE
13	Cucumber mosaic virus	CMV000	Virus	RNQP (Annex IV)	*Ribes*, *Rubus*	Yes	RNQP (not for Solanaceae)
14	*Curtobacterium flaccumfaciens pv. flaccumfaciens*	CORBFL	Bacteria	A1 Quarantine pest (Annex II A)		No	*Petunia* spp. and *Calibrachoa* spp. unlikely as a host
15	*Dacus ciliatus*	DACUCI	Insects & Mites	A1 Quarantine pest (Annex II A)		No	Not a pathway
16	*Ditylenchus dipsaci*	DITYDI	Nematoda	RNQP (Annex IV)	*Medicago*, *Allium*, *Camassia*, *Chionodoxa*, *Crocus*, *Galanthus*, *Hyacinthus*, *Hymenocallis*, *Muscari*, *Narcissus*, *Ornithogalum*, *Puschkinia*, *Scilla*, *Sternbergia*, *Tulipa*, *Fragaria*, *Ribes*	No	RNQP (not for Solanaceae)
17	*Globodera pallida*	HETDPA	Nematoda	A2 Quarantine pest (Annex II B)		No	Not a pathway
18	*Globodera rostochiensis*	HETDRO	Nematoda	A2 Quarantine pest (Annex II B)		No	Not a pathway
19	*Leucinodes orbonalis*	LEUIOR	Insects & Mites	Emergency measures		No	Not a pathway
20	*Liriomyza huidobrensis*	LIRIHU	Insects & Mites	PZ Quarantine pest (Annex III)		Yes	ACTIONABLE
21	*Liriomyza sativae*	LIRISA	Insects & Mites	A1 Quarantine pest (Annex II A)		Yes	ACTIONABLE
22	*Liriomyza trifolii*	LIRITR	Insects & Mites	PZ Quarantine pest (Annex III)		Yes	ACTIONABLE
23	*Meloidogyne enterolobii*	MELGMY	Nematoda	A1 Quarantine pest (Annex II A)		Yes	Not a pathway

TABLE 4 (Continued)

No.	Pest species*	EPPO code	Commodity risk assessment group	EU-Q status	RNQP info	*Petunia* spp./*Calibrachoa* spp. as a host	Conclusion
24	*Meloidogyne hapla*	MELGHA	Nematoda	RNQP (Annex IV)	*Cydonia*, *Fragaria*, *Malus*, *Pyrus*	Yes	RNQP (not for Solanaceae)
25	*Meloidogyne incognita*	MELGIN	Nematoda	RNQP (Annex IV)	*Ficus*, *Olea*, *Prunus*	Yes	RNQP (not for Solanaceae)
26	*Meloidogyne javanica*	MELGJA	Nematoda	RNQP (Annex IV)	*Cydonia*, *Ficus*, *Malus*, *Olea*, *Prunus*	Yes	RNQP (not for Solanaceae)
27	*Phytophthora cinnamomi*	PHYTCN	Fungi & Chromista	RNQP (Annex IV)	*Castanea*	Yes	RNQP (not for Solanaceae)
28	*Phytophthora citrophthora*	PHYTCO	Fungi & Chromista	RNQP (Annex IV)	*Citrus*, *Fortunella*, *Poncirus*	Yes	RNQP (not for Solanaceae)
29	Potato leafroll virus (non-EU strains)	PLRV00	Virus	A1 Quarantine pest (Annex II A)		Likely	ACTIONABLE
30	Potato spindle tuber viroid	PSTVD0	Virus	RNQP (Annex IV)	*Capsicum*, *Solanum*	Yes	ACTIONABLE
31	*Pratylenchus penetrans*	PRATPE	Nematoda	RNQP (Annex IV)	*Cydonia*, *Ficus*, *Malus*, *Pistacia*, *Prunus*, *Pyrus*	Yes	Not a pathway
32	*Pseudaulacaspis pentagona*	PSEAPE	Insects & Mites	RNQP (Annex IV)	*Juglans*, *Prunus*, *Ribes*	No	Not a pathway
33	*Pseudomonas viridiflava*	PSDMVF	Bacteria	RNQP (Annex IV)	*Prunus*	Yes	RNQP (not for Solanaceae)
34	*Ralstonia pseudosolanacearum*	RALSPS	Bacteria	A1 Quarantine pest (Annex II A)		Likely	ACTIONABLE
35	*Ralstonia solanacearum*	RALSSL	Bacteria	A2 Quarantine pest (Annex II B)		Likely	ACTIONABLE
36	*Scirtothrips aurantii*	SCITAU	Insects & Mites	A1 Quarantine pest (Annex II A)		Uncertain	Reserve list (uncertainty on the host status)
37	*Scirtothrips dorsalis*	SCITDO	Insects & Mites	A1 Quarantine pest (Annex II A)		Likely	ACTIONABLE
38	*Sclerotinia sclerotiorum*	SCLESC	Fungi & Chromista	RNQP (Annex IV)	*Brassica*, *Helianthus*, *Sinapis*	Yes	RNQP (not for Solanaceae)
39	*Spodoptera frugiperda*	LAPHFR	Insects & Mites	A1 Quarantine pest (Annex II A)		Uncertain	Reserve list (uncertainty on the host status)
40	*Spongospora subterranea f.*sp. *subterranea*	SPONSU	Bacteria	RNQP (Annex IV)	*Solanum*	No	Not a pathway
41	*Tetranychus urticae*	TETRUR	Insects & Mites	RNQP (Annex IV)	*Ribes*	Yes	RNQP (not for Solanaceae)
42	*Thanatephorus cucumeris*	RHIZSO	Fungi & Chromista	RNQP (Annex IV)	*Solanum*	Yes	Not a pathway
43	*Thaumatotibia leucotreta*	ARGPLE	Insects & Mites	A1 Quarantine pest (Annex II A)		Uncertain	Reserve list (uncertainty on the host status)
44	Tomato black ring virus	TBRV00	Virus	RNQP (Annex IV)	*Fragaria*, *Prunus*, *Rubus*	Yes	RNQP (not for Solanaceae)
45	Tomato brown rugose fruit virus	TOBRFV	Virus	Emergency measures		Likely	Reserve list (uncertainty on the pest status in Kenya)
46	Tomato mild mottle virus	TOMMOV	Virus	A1 Quarantine pest (Annex II A)		Likely	ACTIONABLE

(Continues)

TABLE 4 (Continued)

No.	Pest species*	EPPO code	Commodity risk assessment group	EU-Q status	RNQP info	*Petunia* spp./*Calibrachoa* spp. as a host	Conclusion
47	Tomato spotted wilt virus	TSWV00	Virus	RNQP (Annex IV)	*Capsicum*, *Solanum*	Yes	ACTIONABLE
48	Tomato yellow leaf curl virus	TYLCV0	Virus	RNQP (Annex IV)	*Solanum*	Yes	ACTIONABLE
49	*Toxoptera citricida*	TOXOCI	Insects & Mites	A2 Quarantine pest (Annex II B)		No	Not a pathway
50	*Verticillium albo-atrum*	VERTAA	Fungi & Chromista	RNQP (Annex IV)	*Corylus*, *Cydonia*, *Fragaria*, *Malus*, *Pyrus*	No	RNQP (not for Solanaceae)
51	*Verticillium dahliae*	VERTDA	Fungi & Chromista	RNQP (Annex IV)	*Cynara*, *Corylus*, *Cydonia*, *Fragaria*, *Malus*, *Olea*, *Pistacia*, *Prunus*, *Pyrus*, *Humulus*	Yes	RNQP (not for Solanaceae)
52	*Xanthomonas axonopodis pv. phaseoli*	XANTPH	Bacteria	RNQP (Annex IV)	*Phaseolus*	No	RNQP (not for Solanaceae)
53	*Xanthomonas vesicatoria*	XANTVE	Bacteria	RNQP (Annex IV)	*Capsicum*, *Solanum*	Likely	ACTIONABLE

*According to ICTV rules (https://talk.ictvonline.org/information/w/faq/386/how-to-write-a-virus-name), names of viruses are not italicised.

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

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

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

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

Based on the information collected, 137 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 the Appendix D (Microsoft Excel® file). Of the evaluated EU non-regulated pests, six species were selected for further evaluation (Table 5). More information on these pest species can be found in the pest datasheets (Appendix A).

TABLE 5 Overview of other relevant pests (non-regulated in the EU) associated with the commodity selected for further revaluation.

No.	Pest species*	EPPO code	Commodity risk assessment group	*Petunia* spp/*Calibrachoa* spp. as a host	Conclusion
1	*Aleurodicus dispersus*	ALEDDI	Insects & Mites	Likely	ACTIONABLE
2	Pepper veinal mottle virus	PVMV00	Viruses and viroids	Yes	ACTIONABLE
3	*Phenacoccus solenopsis*	PHENSO	Insects & Mites	Yes	ACTIONABLE
4	*Nipaecoccus viridis*	NIPAVI	Insects & Mites	Likely	ACTIONABLE
5	*Tetranychus neocaledonicus*	TETRNC	Insects & Mites	Yes	ACTIONABLE
6	Tomato yellow ring virus	TYRSV0	Viruses and viroids	Yes	ACTIONABLE

*According to ICTV rules (https://talk.ictvonline.org/information/w/faq/386/how-to-write-a-virus-name), names of viruses are not italicised.

4.3 | Summary of pests selected for further evaluation

Twenty pests that were identified to be present in Kenya and having potential for association with unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. destined for export are listed in Table 6. The efficacy of the risk mitigation measures applied to the commodity was evaluated for these selected pests.

TABLE 6 List of relevant pests selected for further evaluation.

No.	Pest species*	EPPO code	Taxonomic information	Group	Cluster	Regulatory status
1	*Aleurodicus dispersus*	ALEDDI	Hemiptera: Aleyrodidae	Insects & Mites	–	Not regulated in the EU
2	*Bemisia tabaci*	BEMITA	Hemiptera: Aleyrodidae	Insects & Mites	–	Quarantine pest (Annex II A)
3	Cowpea mild mottle virus	CPMMV0	Tymovirales: Betaflexiviridae	Viruses and viroids	*Bemisia tabaci*–transmitted viruses	Quarantine pest (Annex II A)
4	*Liriomyza huidobrensis*	LIRIHU	Diptera: Agromyzidae	Insects & Mites	Leaf miners	Quarantine pest (Annex III)
5	*Liriomyza sativae*	LIRISA	Diptera: Agromyzidae	Insects & Mites	Leaf miners	Quarantine pest (Annex II A)
6	*Liriomyza trifolii*	LIRITR	Diptera: Agromyzidae	Insects & Mites	Leaf miners	Quarantine pest (Annex III)
7	*Nipaecoccus viridis*	NIPAVI	Hemiptera: Pseudococcidae	Insects & Mites	Mealybugs	Not regulated in the EU

(Continues)

TABLE 6 (Continued)

No.	Pest species*	EPPO code	Taxonomic information	Group	Cluster	Regulatory status
8	Pepper veinal mottle virus	PVMV00	Patatavirales: Potyviridae	Viruses and viroids	Aphid-transmitted viruses	Not regulated in the EU
9	*Phenacoccus solenopsis*	PHENSO	Hemiptera: Pseudococcidae	Insects & Mites	Mealybugs	Not regulated in the EU
10	Potato leafroll virus	PLRV00	Sobelivirales: Solemoviridae	Viruses and viroids	Aphid-transmitted viruses	Quarantine pest (Annex II A) (non-EU isolates)
11	Potato spindle tuber viroid	PSTVD0	Pospiviroidae	Viruses and viroids	–	RNQP (Annex IV)
12	*Ralstonia pseudosolanacearum*	RALSPS	Burkholderiales: Burkholderiaceae	Bacteria	*Ralstonia* species complex	Quarantine pest (Annex II A)
13	*Ralstonia solanacearum*	RALSSL	Burkholderiales: Burkholderiaceae	Bacteria	*Ralstonia* species complex	Quarantine pest (Annex II B)
14	*Scirtothrips dorsalis*	SCITDO	Thysanoptera:Thripidae	Insects & Mites	–	Quarantine pest (Annex II A)
15	*Tetranychus neocaledonicus*	TETRNC	Acarida: Tetranychidae	Insects & Mites	–	Not regulated in the EU
16	Tomato mild mottle virus	TOMMOV	Patatavirales: Potyviridae	Viruses and viroids	*Bemisia tabaci*-transmitted viruses	Quarantine pest (Annex II A)
17	Tomato spotted wilt virus	TSWV00	Bunyavirales: Tospoviridae	Viruses and viroids	(Ortho)tospoviruses	RNQP (Annex IV)
18	Tomato yellow leaf curl virus	TYLCV0	Geplafuvirales: Geminiviridae	Viruses and viroids	*Bemisia tabaci*-transmitted viruses	RNQP (Annex IV)
19	Tomato yellow ring virus	TYRSV0	Bunyavirales: Tospoviridae	Viruses and viroids	(Ortho)tospoviruses	Not regulated in the EU
20	*Xanthomonas vesicatoria*	XANTVE	Lysobacterales: Lysobacteraceae	Bacteria	–	RNQP (Annex IV)

*According to ICTV rules (https://talk.ictvonline.org/information/w/faq/386/how-to-write-a-virus-name), names of viruses are not italicised.

4.4 | List of potential pests not further assessed

From the list of pests not selected for further evaluation, the Panel highlighted 17 species (Appendix C) for which currently available evidence does not provide any reason to select these species for further evaluation in this Opinion. A specific justification of the inclusion in this list is provided for each species in Appendix C.

5 | RISK MITIGATION MEASURES

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

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

5.2 | Risk mitigation measures proposed

With the information provided by the NPPO of Kenya (Dossier sections 1.0, 2.0, 3.0 and 4.0), the Panel summarised the risk mitigation measures (Table 7) that are currently applied in the production nursery.

TABLE 7 Overview of currently applied risk mitigation measures for *Petunia* spp. and *Calibrachoa* spp. cuttings designated for export to the EU from Kenya.

	Risk mitigation measure	Current measures in Kenya
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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse
2	Dedicated hygiene measures	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants.
3	Treatment of growing media	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
4	Quality of source plant material	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non-EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication
5	Crop rotation	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp.
6	Disinfection of irrigation water	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogen
7	Treatment of crop during production	Biological control agents used to manage insect pests include *Phytoseiulus persimilis* and *Amblyseius* spp. mites and *Beauveria bassiana*. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis*
8	Pest monitoring and inspections	Daily scouting is conducted by nursery staff and pest incidents are recorded. Yellow and blue sticky traps are used to monitor the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment
9	Sampling and testing	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have been tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques
10	Official Supervision by NPPO	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended

(Continues)

TABLE 7 (Continued)

	Risk mitigation measure	Current measures in Kenya
11	Surveillance of production area	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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	9988 out of 10,000 bags	9995 out of 10,000 bags	9997 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	3 out of 10,000 bags	5 out of 10,000 bags	12 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *A. dispersus* 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. Furthermore, *A. dispersus* can also 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. Moreover, flying adults of *A. dispersus* 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. 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. **Measures taken against the pest and their efficacy** The imported plant material from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). The mother plants used for producing the cuttings are grown in dedicated greenhouses, enclosed with thrips-proof nets. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit. Daily scouting is conducted by nursery staff and sticky traps are used for monitoring the pests in and outside the greenhouses. Biological pest control methods and the application of pesticides are implemented when necessary. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses **Shortcomings of current measures/procedures** No major shortcomings were identified in the evaluation. If all the measures described 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 surveillance scheme.				

5.3.2 | Overview of the evaluation of aphid-transmitted viruses

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	9990 out of 10,000 bags	9995 out of 10,000 bags	9997 out of 10,000 bags	9999 out of 10,000 bags	10,000 out of 10,000 bags
Proportion of infected bags	0 out of 10,000 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

(Continued)

Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** The aphid-transmitted pepper veinal mottle virus (PVMV) and potato leafroll virus (PLRV) are present in Kenya. *Petunia* spp. are reported to be hosts of PVMV. There are no records for *Petunia* spp. as hosts for PLRV, and *Calibrachoa* spp. for PLRV and PVMV. However, given their broad host range among solanaceous plants, they are likely to be hosts as well. The main pathway of entrance of these viruses from the surrounding environment in the nursery is through viruliferous aphids **Measures taken against the pest and their efficacy** The imported plant material (in vitro tissue cultures and unrooted cuttings) from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). This material is held in post entry quarantine facilities where monthly inspected by NPPO and plants are tested for specific viruses before being approved for further multiplication. The mother plants used for the producing of cuttings to be exported are then grown in dedicated greenhouses, enclosed with thrips-proof nets (vector control). 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 for monitoring insects in and outside the greenhouses. Biological control methods and the application of pesticides are implemented when necessary for insect vector control. Three to four weeks after planting, and before the start of harvesting mother plants are sampled and tested at 100%, following during active growth by additional routine sampling (at 10%–25%) by farmers, weekly or biweekly and testing in EU-accredited laboratories. Furthermore, once every 3 weeks, NPPO performs an official inspection in the greenhouses. In the case of *B. tabaci* or *F. occidentalis* occurrence, export is suspended and 10% of the mother plants are sampled and tested for begomoviruses or tospoviruses presence and export is recommended, only when tests are negative **Shortcomings of current measures/procedures** PLRV is not included in the testing scheme of the mother plants **Main uncertainties** • The efficiency of detecting early aphid infestations and virus presence, especially in low infection levels. • The intensity and the design of surveillance scheme for aphids and the aphid-transmitted viruses (if any). • Infection (PVMV and PLRV) and infestation (aphids) pressure in the environment of the nursery (presence and distribution of host plants in the surroundings).

5.3.3 | Overview of the evaluation of *Bemisia tabaci*

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	9977 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	23 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 present in Kenya and reported to occur in many horticultural crops. Certain *Petunia* species (*Petunia* sp., *P. axillaris*, *P. grandiflora*, *P. integrifolia* and *P. hybrida*) and *Calibrachoa* sp. 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 nymphs are difficult to detect and may be present on the harvested cuttings **Measures taken against the pest and their efficacy** The imported plant material from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). The mother plants used for producing the cuttings are grown in dedicated greenhouses, enclosed with thrips-proof nets. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit. Daily scouting is conducted by facilities and sticky traps are used for monitoring the pests in and outside the greenhouses. Biological pest control methods and the application of pesticides are implemented when necessary. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses ensuring compliance with the EU import requirements for *B. tabaci*. Moreover, if insect vectors like *B. tabaci* are identified in a greenhouse, exports from the greenhouse will be temporarily suspended, 10% of the plants will be sampled for testing of begomoviruses **Shortcomings of current measures/procedures** No major shortcomings were identified in the evaluation. If all the measures described 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 of unnoticed defects in the greenhouse structure. • Presence and distribution of host plants of *B. tabaci* in the surroundings. • The level of resistance of *B. tabaci* populations in Kenya against the listed insecticides. • *B. tabaci* population pressure in the surrounding environment of the nursery. • The intensity and the design of the surveillance scheme.				

5.3.4 | Overview of the evaluation of *Bemisia tabaci*-transmitted viruses

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	9960 out of 10,000 bags	9981 out of 10,000 bags	9993 out of 10,000 bags	9999 out of 10,000 bags	10,000 out of 10,000 bags
Proportion of infected bags	0 out of 10,000 bags	1 out of 10,000 bags	7 out of 10,000 bags	19 out of 10,000 bags	40 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** Cowpea mild mottle virus (CPMMV), tomato mild mottle virus (TMMoV) and tomato yellow leaf curl virus (TYLCV) are clustered as *B. tabaci*-transmitted viruses (Appendix A). These viruses are present in Kenya, and they have a broad host range including solanaceous plants. *Petunia* spp. is an experimental host of TMMoV-IL (Israeli isolate), while is a natural host of TYLCV. The main pathway of entrance of these viruses from the surrounding environment in the nursery is through viruliferous *B. tabaci* adults **Measures taken against the pest and their efficacy** The imported plant material (in vitro tissue cultures and unrooted cuttings) from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). This material is held in post entry quarantine facilities where monthly inspected by NPPO and plants are tested for specific viruses before being approved for further multiplication. The mother plants used for the producing of cuttings to be exported are then grown in dedicated greenhouses, enclosed with thrips-proof nets (vector control). 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 for monitoring insects in and outside the greenhouses. Biological control methods and the application of pesticides are implemented when necessary for insect vector control. Three to four weeks after planting, and before the start of harvesting mother plants are sampled and tested at 100%, following during active growth by additional routine sampling (at 10%–25%) by farmers, weekly or biweekly and testing in EU-accredited laboratories. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses ensuring compliance with the EU import requirements for *B. tabaci*. In the case of *B. tabaci* or *F. occidentalis* occurrence, export is suspended and 10% of the mother plants are sampled and tested for begomoviruses or tospoviruses presence and export is recommended, only when tests are negative **Shortcomings of current measures/procedures** CPMMV, TMMoV and TYLCV are not included in the certification scheme applied. Hence, there is no testing of mother plants against these viruses. Plants are not tested for CPMMV and TMMoV during the production but 10% of the plants are tested only for begomoviruses including TYLCV in case of *B. tabaci* finding. There is no testing for CPMMV and TMMoV **Main uncertainties** • The efficiency of detecting early *B. tabaci* infestations and virus presence, especially in low infection levels. • The intensity and the design of surveillance scheme for whiteflies and the whitefly-transmitted viruses (if any). • Infection (CPMMV, TMMoV and TYLCV) and infestation (*B. tabaci*) pressure in the environment of the nursery (presence and distribution of host plants in the surroundings).				

5.3.5 | Overview of the evaluation of leafminers

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	9950 out of 10,000 bags	9974 out of 10,000 bags	9986 out of 10,000 bags	9993 out of 10,000 bags	9998 out of 10,000 bags
Proportion of infested bags	2 out of 10,000 bags	7 out of 10,000 bags	14 out of 10,000 bags	26 out of 10,000 bags	50 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 Kenya 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 on leaves of harvested unrooted cuttings				

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	Measures taken against the pest and their efficacy The imported plant material from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). The mother plants used for producing the cuttings are grown in dedicated greenhouses, enclosed with thrips-proof nets. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit. Daily scouting is conducted by facilities and sticky traps are used for monitoring the pests in and outside the greenhouses. Some of the plant protection products used for controlling other pests may also have an effect on populations of leafminers. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses **Shortcomings of current measures/procedures** No major shortcomings were identified in the evaluation. If all the measures described 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 of unnoticed defects in the greenhouse structure. • Presence and distribution of host plants of leafminers in the surroundings. • Leafminers population pressure in the surrounding environment of the nursery. • The efficacy of the plant protection products specifically against these leafminers are not known.

5.3.6 | Overview of the evaluation of mealybugs

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	9985 out of 10,000 bags	9992 out of 10,000 bags	9996 out of 10,000 bags	9998 out of 10,000 bags	10,000 out of 10,000 bags
Proportion of infested bags	1 out of 10,000 bags	2 out of 10,000 bags	4 out of 10,000 bags	8 out of 10,000 bags	15 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** The mealybugs *Phenacoccus solenopsis* (Tinsley) and *Nipaecoccus viridis* (Newstead) (Hemiptera: Pseudococcidae) are polyphagous pests present in Kenya. *Petunia* spp. are reported among the hosts of *P. solenopsis*. There is no evidence of *Petunia* spp. or *Calibrachoa* spp. as a host for *N. viridis*, but *N. viridis* has a broad host range including solanaceous plants. Given the wide host range of these mealybugs, it is possible that local populations of *P. solenopsis* and *N. viridis* may be present in the neighbouring environment. The crawlers can enter the nursery through holes in the thrips-proof netting or by hitchhiking on nursery staff. During the crawler stage, infestation is difficult to be identified **Measures taken against the pest and their efficacy** The imported plant material from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). The mother plants used for producing the cuttings are grown in dedicated greenhouses, enclosed with thrips-proof nets. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit. Daily scouting is conducted by facilities. Some of the plant protection products used for controlling other pests may also have an effect on populations of *P. solenopsis* and *N. viridis*. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses **Shortcomings of current measures/procedures** No major shortcomings were identified in the evaluation. If all the measures described 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 of unnoticed defects in the greenhouse structure. • The *P. solenopsis* and *N. viridis* population pressure in the surrounding environment of the nursery (presence and distribution of host plants in the surroundings). • The efficacy of the plant protection products specifically against these mealybugs are not known.				

5.3.7 | Overview of the evaluation of (ortho)tospoviruses

Rating of the likelihood of pest freedom	**Pest free with few exceptional cases** (based on the median)				
Percentile of the distribution	5%	25%	Median	75%	95%
Proportion of pest-free bags	9964 out of 10,000 bags	9983 out of 10,000 bags	9993 out of 10,000 bags	9998 out of 10,000 bags	10,000 out of 10,000 bags
Proportion of infected bags	0 out of 10,000 bags	2 out of 10,000 bags	7 out of 10,000 bags	17 out of 10,000 bags	36 out of 10,000 bags

(Continues)

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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) and tomato yellow ring virus (TYRV) are present in Kenya. TSWV and TYRV infect *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 tospoviruses is present in Kenya. Both TSWV and TYRV can also be very efficiently transmitted by *Thrips tabaci* populations, which are also present in Kenya. Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. can be infected by tospoviruses and/or infested by viruliferous thrips **Measures taken against the pest and their efficacy** The imported plant material (in vitro tissue cultures and unrooted cuttings) from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). This material is held in post entry quarantine facilities where monthly inspected by NPPO and plants are tested for specific viruses before being approved for further multiplication. The mother plants used for the producing of cuttings to be exported are then grown in dedicated greenhouses, enclosed with thrips-proof nets (vector control). 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 for monitoring insects in and outside the greenhouses. Biological control methods and the application of pesticides are implemented when necessary for insect vector control. Three to four weeks after planting, and before the start of harvesting mother plants are sampled and tested at 100%, following during active growth by additional routine sampling (at 10%–25%) by farmers, weekly or biweekly and testing in EU-accredited laboratories. Furthermore, once every 3 weeks, NPPO performs an official inspection in the greenhouses. In the case of *B. tabaci* or *F. occidentalis* occurrence, export is suspended and 10% of the mother plants are sampled and tested for begomoviruses or tospoviruses presence and export is recommended, only when tests are negative **Shortcomings of current measures/procedures** Mother plants are tested for TSWV, but TYRV is not included in the certification scheme applied **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 the tospoviruses (if any). • Infection (TSWV and TYRV) and infestation (thrips) pressure in the environment of the nursery (presence and distribution of host plants in the surroundings).

5.3.8 | 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 infected 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 Kenya. *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 be also facilitated by insects. **Measures taken against the pest and their efficacy** The imported plant material (in vitro tissue cultures and unrooted cuttings) from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). This material is held in post entry quarantine facilities where monthly inspected by NPPO and plants are tested for specific viruses before being approved for further multiplication. The mother plants used for the production of cuttings to be exported are then grown in dedicated greenhouses, enclosed with thrips-proof nets (vector control). 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 for monitoring insects in and outside the greenhouses. Biological control methods and the application of pesticides are implemented when necessary for insect vector control. Three to four weeks after planting, and before the start of harvesting mother plants are sampled and tested at 100%, following during active growth by additional routine sampling (at 10%–25%) by farmers, weekly or biweekly and testing in EU-accredited laboratories. Furthermore, once every 3 weeks, NPPO performs an official inspection in the greenhouses **Shortcomings of current measures/procedures** No major shortcomings were identified in the evaluation. If all the measures described 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** • The efficiency of detecting viroid presence, especially in low infection levels. • The intensity and the design of surveillance scheme for viroids (if any). • Infection (PSTVd) pressure in the environment of the nursery (presence and distribution of host plants in the surroundings).				

5.3.9 | Overview of the evaluation of *Ralstonia* species complex

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	9981 out of 10,000 bags	9990 out of 10,000 bags	9994 out of 10,000 bags	9997 out of 10,000 bags	9999 out of 10,000 bags
Proportion of infected bags	1 out of 10,000 bags	3 out of 10,000 bags	6 out of 10,000 bags	10 out of 10,000 bags	19 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *Petunia hybrida* and *Calibrachoa* spp. are listed as host plants for *R. solanacearum* and *Petunia* spp. is used as experimental host for plant/*R. pseudosolanacearum* molecular interaction studies. *R. solanacearum* and *R. pseudosolanacearum* are soil-borne bacteria present and widespread in Kenya. 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. Unrooted cuttings of *Petunia* and *Calibrachoa* can be systemically infected **Measures taken against the pest and their efficacy** The imported plant material (in vitro tissue cultures and unrooted cuttings) from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). Imported materials are held in post entry quarantine facilities for 4 weeks before being approved for further multiplication. The greenhouses with polythene roof and sidewalls fitted with insect proof nets as well as double door prevent passive introduction of *Ralstonia* spp. by air movements. There are hygienic measures in place for nursery workers entering the production unit. Daily scouting is conducted by nursery staff. Disinfection of pruning tools prevents the spread of bacteria within the greenhouse in case of the introduction of *Ralstonia* spp. New sterilised growing media are used every season. Sterilisation by steam is reported to be efficient to reduce bacterial populations in volcanic pumice. The disinfection of irrigation water is effective in eliminating the presence of *Ralstonia* spp. in the irrigation water. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses **Shortcomings of current measures/procedures** No tests specific to *R. solanacearum* and *R. pseudosolanacearum* are reported to be performed during the production process and at the exporting step. 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. • Presence of unnoticed defects in the water treatment system. • Presence and distribution of infected host plants or soil as such in the surroundings.				

5.3.10 | Overview of the evaluation of *Scirtothrips dorsalis*

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	9955 out of 10,000 bags	9975 out of 10,000 bags	9985 out of 10,000 bags	9993 out of 10,000 bags	9998 out of 10,000 bags
Proportion of infested bags	2 out of 10,000 bags	7 out of 10,000 bags	15 out of 10,000 bags	25 out of 10,000 bags	45 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *Scirtothrips dorsalis* (Hood) (Thysanoptera: Thripidae) is a polyphagous pest present in Kenya and reported to occur on *Petunia* × *hybrida*. *S. dorsalis* is reported as a vector of plant viruses including peanut necrosis virus, groundnut bud necrosis virus, watermelon silver mottle virus, capsicum chlorosis virus and melon yellow spot virus. Adults fly actively for short distances, but they are transported passively by wind currents, which enables long-distance spread. The pest can be present on host plant species in the surrounding 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 early stages are difficult to detect and may be present on the harvested cuttings. All life stages of *S. dorsalis* (eggs, larvae and adults) besides pupae, could be present on the leaves of *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings **Measures taken against the pest and their efficacy** The imported plant material from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). The mother plants used for producing the cuttings are grown in dedicated greenhouses, enclosed with thrips-proof nets. The thrips-proof netting prevents the introduction of *S. dorsalis* from the surrounding environment. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit. Daily scouting is conducted by nursery staff. Some of the plant protection products used for controlling other pests may also have an effect on populations of *S. dorsalis*. Furthermore, once every 3 weeks, NPPO performs an official inspection in the greenhouses **Shortcomings of current measures/procedures** No major shortcomings were identified in the evaluation. If all the measures described are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings				

(Continues)

(Continued)

	Main uncertainties • Presence of unnoticed defects in the greenhouse structure. • The *S. dorsalis* population pressure in the surrounding environment of the nursery (presence and distribution of host plants in the surroundings). • Inclusion of *S. dorsalis* in the surveillance programme.

5.3.11 | Overview of the evaluation of *Tetranychus neocaledonicus*

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	9942 out of 10,000 bags	9972 out of 10,000 bags	9989 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	11 out of 10,000 bags	28 out of 10,000 bags	58 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *Tetranychus neocaledonicus* (André) (Trombidiformes: Tetranychidae) is a polyphagous herbivorous mite present in Kenya. *Petunia* spp. is reported as a host plant for *T. neocaledonicus*. Given the wide host range of this pest it is possible that local populations of *T. neocaledonicus* may be present in the neighbouring environment. 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 thrips-proof netting in production greenhouses could enable mites to enter, as well as hitchhiking on persons or material entering the greenhouse. Furthermore, as all life stages of the mite are very small their detection upon visual inspection may not be easy when infestation level is low **Measures taken against the pest and their efficacy** The imported plant material from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). The mother plants used for producing the cuttings are grown in dedicated greenhouses, enclosed with thrips-proof nets. All greenhouses have double doors. There are hygienic measures in place for nursery workers entering the production unit. Daily scouting is conducted by facilities. The predatory mites and the insecticides used may have an effect on *T. neocaledonicus*. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses **Shortcomings of current measures/procedures** No major shortcomings were identified in the evaluation. If all the measures described 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 of unnoticed defects in the greenhouse structure. • The *T. neocaledonicus* population pressure in the surrounding environment of the nursery (presence and distribution of host plants in the surroundings).				

5.3.12 | Overview of the evaluation of *Xanthomonas vesicatoria*

Rating of the likelihood of pest freedom	**Almost always pest free** (based on the median)				
Percentile of the distribution	5%	25%	Median	75%	95%
Proportion of pest-free bags	9986 out of 10,000 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
Proportion of infected 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	14 out of 10,000 bags
Summary of the information used for the evaluation	**Possibility that the pest could become associated with the commodity** *Petunia* spp. and *Calibrachoa* spp. are not listed as host plants for *Xanthomonas vesicatoria*. However, they have a high potential to be host plants because of the wide host range of *X. vesicatoria* within the solanaceous family. *X. vesicatoria* is a seed-borne bacterium. Less frequently, primary infections may be caused by the presence of infected plant debris or volunteers from a previous crop. Secondary inocula released from lesions on leaves and stems are spread via splashing water and wind driven rain **Measures taken against the pest and their efficacy** The imported plant material (in vitro tissue cultures and unrooted cuttings) from Germany, Portugal, Spain and Israel is reported to be certified (Naktuinbouw Elite). Imported materials are held in post entry quarantine facilities for 4 weeks before being approved for further multiplication. The greenhouses with polythene roof and sidewalls fitted with insect proof nets as well as double door prevent passive introduction of *X. vesicatoria* by air movements. Hygienic procedures described prevent the introduction of bacteria from the surrounding environment by hitchhiking on via contaminated clothes and tools. Disinfection of pruning tools prevents the spread of bacteria within the greenhouse in case of the introduction. Daily scouting is conducted by facilities. Although *X. vesicatoria* is not a soil-borne bacterium, pumice might passively transport bacterial cells. Sterilisation by steam is reported to be efficient to disinfect volcanic pumice. *X. vesicatoria* might enter from the surrounding environment. The disinfection of irrigation water is effective in eliminating the presence of *X. vesicatoria* in the irrigation water. Furthermore, once every 3 weeks, NPPO does an official inspection in the greenhouses				

(Continued)

Shortcomings of current measures/procedures

No shortcomings were identified in the evaluation. If all the measures described are implemented correctly it is unlikely that the pest is present on the harvested and exported *Petunia* spp. and *Calibrachoa* spp. cuttings

Main uncertainties

- There is no information if irrigation water is tested for *X. vesicatoria*.
- Presence of unnoticed defects in the water treatment and storage system.
- Presence and distribution of host plants in the surroundings.
- The efficiency of monitoring and inspection for *X. vesicatoria* due to epiphytic colonisation.

5.3.13 | Outcome of EKE

Table 8 and Figure 6 shows the outcome of the EKE regarding pest freedom after the evaluation of the currently proposed risk mitigation measures for the selected pests.

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

TABLE 8 Assessment of the likelihood of pest freedom following evaluation of current risk mitigation measures against evaluated pests *Aleurodicus dispersus*, aphid-transmitted viruses (pepper veinal mottle virus, potato leafroll virus), *Bemisia tabaci*, *B. tabaci*-transmitted viruses (cowpea mild mottle virus, tomato mild mottle virus, tomato yellow leaf curl virus), leafminers (*Liriomyza huidobrensis, L. sativae, L. trifolii*), mealybugs (*Phenacoccus solenopsis, Nipaecoccus viridis), Tetranychus neocaledonicus*, (ortho)tospoviruses (tomato spotted wilt virus, tomato yellow ring virus), potato spindle tuber viroid, *Ralstonia* species complex (*Ralstonia solancearum, R. pseudosolanacearum*), *Scirtothrips dorsalis* and *Xanthomonas vesicatoria* on *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings designated for export to the EU. In panel A, the median value for the assessed level of pest freedom for each pest is indicated by 'M', the 5% percentile is indicated by L and the 95% percentile is indicated by U. The percentiles together span the 90% uncertainty range regarding pest freedom. The pest freedom categories are defined in panel B of the table.

Number	Cluster	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	–	*Aleurodicus dispersus*						L		MU
2	Aphid-transmitted viruses	Pepper veinal mottle virus, potato leafroll virus							L	MU
3	–	*Bemisia tabaci*						L		MU
4	*Bemisia tabaci*-transmitted viruses	Cowpea mild mottle virus, tomato mild mottle virus, tomato yellow leaf curl virus						L	M	U
5	Leafminers	*Liriomyza huidobrensis, L. sativae, L. trifolii*					L	M		U
6	Mealybugs	*Phenacoccus solenopsis, Nipaecoccus viridis*						L		MU
7	(Ortho)tospoviruses	Tomato spotted wilt virus, tomato yellow ring virus						L	M	U
8	–	Potato spindle tuber viroid					L		M	U
9	*Ralstonia* species complex	*Ralstonia solancearum, R. pseudosolanacearum*						L	M	U
10	–	*Scirtothrips dorsalis*						LM		U
11	–	*Tetranychus neocaledonicus*					L	M		U
12	–	*Xanthomonas vesicatoria*						L		MU

PANEL A

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

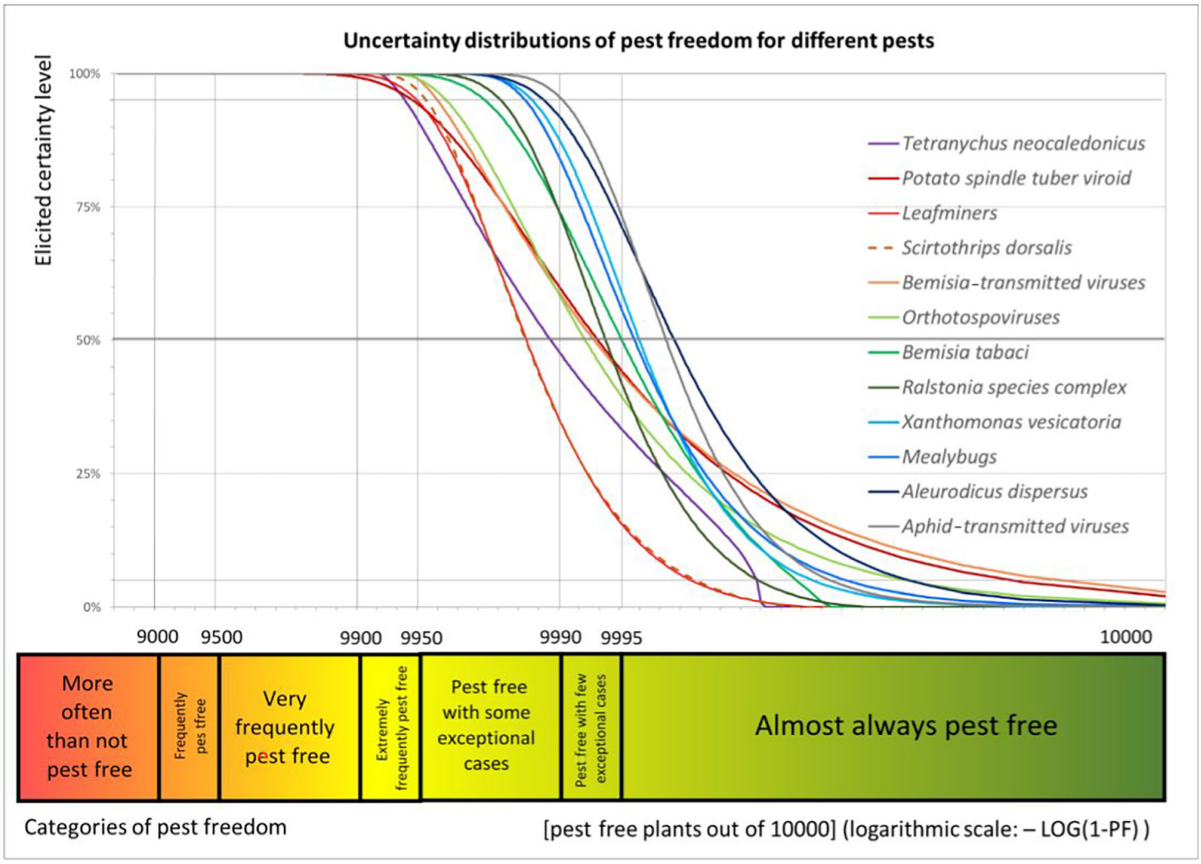

FIGURE 6 Elicited certainty (*y*-axis) of the number of pest-free *Petunia* spp. and *Calibrachoa* spp. bags (*x*-axis; log-scaled) out of 10,000 bags designated for export to the EU introduced from Kenya for all evaluated pests visualised as descending distribution function. Horizontal lines indicate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

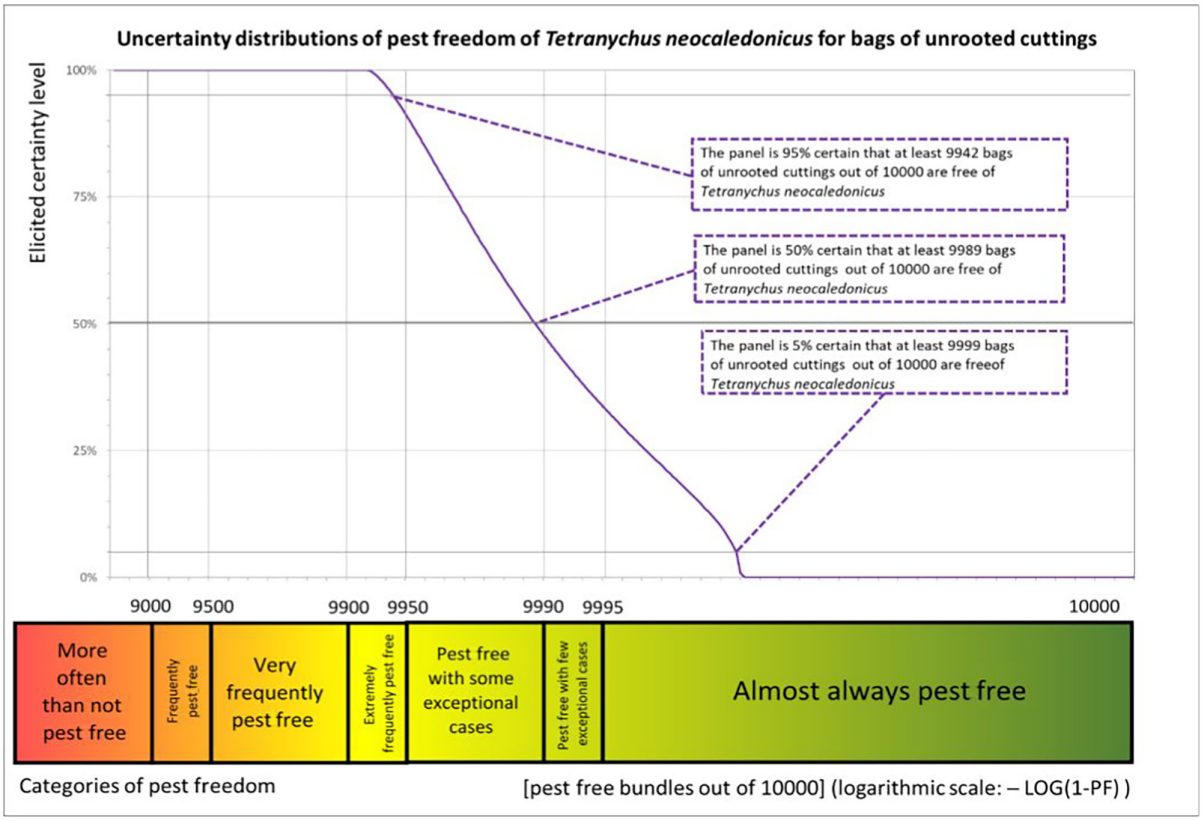

FIGURE 7 Explanation of the descending distribution function describing the likelihood of pest freedom after the evaluation of the currently proposed risk mitigation measures for plants designated for export to the EU based on based on the example of *Tetranychus neocaledonicus*.

6 | CONCLUSIONS

There are 20 pests identified to be present in Kenya and considered to be potentially associated with unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. imported from Kenya 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 *A. 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 EKE indicated, with 95% certainty, that between 9988 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *A. dispersus*.

For the selected aphid-transmitted viruses (pepper veinal mottle virus, potato leafroll 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 EKE indicated, with 95% certainty, that between 9990 and 10,000 bags containing unrooted cuttings per 10,000 will be free from the selected aphid-transmitted viruses.

For *B. tabaci*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'almost always pest free' with the 90% uncertainty range reaching from 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9977 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *B. tabaci*.

For the selected *Bemisia*-transmitted viruses (CPMMV, TMMoV and TYLCV), 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 9960 and 10,000 bags containing unrooted cuttings per 10,000 will be free from the selected *Bemisia*-transmitted viruses.

For the selected leafminers (*Liriomyza huidobrensis*, *L. sativae* and *L. trifolii*), the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'pest free with 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 9950 and 10,000 bags per 10,000 will be free from the selected leafminer species.

For the selected mealybugs (*P. solenopsis*, *N. viridis*), the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'almost always pest free' with the 90% uncertainty range reaching from 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9985 and 10,000 bags per 10,000 will be free from the selected mealybug species.

For *T. neocaledonicus*, 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 9942 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *T. neocaledonicus*.

For the selected (ortho)tospoviruses (TSWV, tomato yellow ring 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 9964 and 10,000 bags containing unrooted cuttings per 10,000 will be free from the selected (ortho) tospoviruses.

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

For *Ralstonia* species complex (*R. solancearum*, *R. pseudosolanacearum*), 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 9981 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *Ralstonia* species complex.

For *S. dorsalis*, 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 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9955 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *S. dorsalis*.

For *X. vesicatoria*, the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'almost always pest free' with the 90% uncertainty range reaching from 'pest free with some exceptional cases' to 'almost always pest free'. The EKE indicated, with 95% certainty, that between 9986 and 10,000 bags containing unrooted cuttings per 10,000 will be free from *X. vesicatoria*.

ABBREVIATIONS

AMV	alfalfa mosaic virus
ARMV	Arabis mosaic virus

BCTV	beet curly top virus
CbMV	Calibrachoa mottle virus
CMV	cucumber mosaic virus
CPMMoV	chilli pepper mild mottle virus
CPMMV	Cowpea mild mottle virus
EKE	Expert Knowledge Elicitation
ELISA	enzyme-linked immunosorbent assay
EPPO GD	European and Mediterranean Plant Protection Organization Global Database
ICTV	International Committee on Taxonomy of Viruses
INSV	Impatiens necrotic spot virus
LMV	lettuce mosaic virus
NPPO's	National Plant Protection Organisations
PCR	polymerase chain reaction
PLRV	potato leafroll virus
PSTVd	potato spindle tuber viroid
PVA	potato virus A
PVMV	pepper veinal mottle virus
PVY	potato virus Y
PZ	protected zone
RNQPs	regulated non-quarantine pests
TMMoV	tomato mild mottle virus
TMMOV-IL	tomato mild mottle virus-Israeli isolate
TMV	tobacco mosaic virus
ToBRFV	tomato brown rugose fruit virus
ToMV	tomato mosaic virus
TRSV	tobacco ringspot virus
TSWV	tomato spotted wilt virus
TVCV	turnip vein-clearing virus
TYLCV	tomato yellow leaf curl 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)

CONFLICT OF INTEREST

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PANEL MEMBERS

Claude Bragard, Paula Baptista, Elisavet Chatzivassiliou, Francesco Di Serio, Paolo Gonthier, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A. Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L. Reignault, Emilio Stefani, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen and Lucia Zappalà.

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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	Group: Insects Current valid scientific name: *Aleurodicus dispersus* (Russell, 1965) EPPO Code: ALEDDI Common name: Spiralling whitefly Name used in the EU legislation: – Order: Hemiptera Family: Aleyrodidae Name used in the Dossier: *Aleurodicus dispersus*	
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 Kenya	Present, no details (CABI, online; EPPO, online)	
Pest status in the EU	Present in Madeira (Portugal) and Canary Islands (Spain) (CABI, online; EPPO, online)	
Risk assessment information	No pest risk analysis has 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) and *Solanum melongena* (aubergine) (EPPO, 2006)	

(Continues)

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What life stages could be expected on the commodity	Eggs, nymphs 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	There is no official surveillance for the regional presence of these insects in Kenya

A.1.2 | Possibility of pest presence in the nursery

A.1.2.1 | 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 Kenya. 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 hitchhikers on clothes of nursery staff from host plants that might be present in the surrounding environment.

Uncertainties:

- The *A. dispersus* population pressure 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.1.2.2 | Possibility of entry with new plants/seeds

The probability that *A. dispersus* is present on the starting material is very low/negligible as the imported material is certified (elite) and is kept in the post-quarantine facility before released to the nursery.

Uncertainties: None.

A.1.2.3 | 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. Hitchhiking of whiteflies (adults) on human clothes is unlikely. *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.

Uncertainties: The specific host plants of *A. dispersus* other than *Petunia* spp. and *Calibrachoa* spp. that are grown in the nursery and their official control measures.

A.1.3 | Information from interceptions

There are no interceptions of *A. dispersus* from Kenya on any imported commodity, or on *Petunia* spp./*Calibrachoa* spp. imports from all origins.

A.1.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The insect proof netting prevents the introduction of insects 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

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. Evaluation: The measures prevent the entrance and spread in the nursery of hitchhiking crawlers of *A. dispersus* 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	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: The probability that *A. dispersus* is present on the certified starting material is very low/negligible Uncertainties: None
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp./*Calibrachoa* spp. Evaluation: No crop rotation with non-host plants takes place. In case of introduction into the greenhouse, populations of *A. dispersus* may build up since the same unit is used for production of *Petunia* spp./*Calibrachoa* spp. Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogen
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis*, *Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: Some 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	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: Populations of whiteflies are monitored using 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

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have been tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Sampling for virus testing may detect the presence of *A. dispersus* Uncertainties: The awareness of the staff for the specific pest is unknown
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Inspections for *B. tabaci* may help in the detection of populations of *A. dispersus* Uncertainties: The awareness of the staff for the specific pest is unknown
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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 whiteflies. 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.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 is thus unlikely.
- The scouting and monitoring regime is effective; therefore, 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 in Kenya and it has a wide host range, mainly solanaceous 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 production areas).
- 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)

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

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

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

A.1.6 | Elicitation outcomes of the assessment of the pest freedom for *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					1		3		5					25
EKE	0.0352	0.0908	0.187	0.392	0.688	1.09	1.55	2.68	4.29	5.43	7.03	9.07	11.8	14.6	18.3

Note: The EKE results is the *BetaGeneral* (0.97301, 2485.4, 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	9975					9995		9997		9999					10,000
EKE results	9982	9985	9988	9991	9993	9995	9996	9997	9998.4	9998.9	9999.3	9999.6	9999.8	9999.9	10,000.0

Note: The EKE results are the fitted values.

(A)

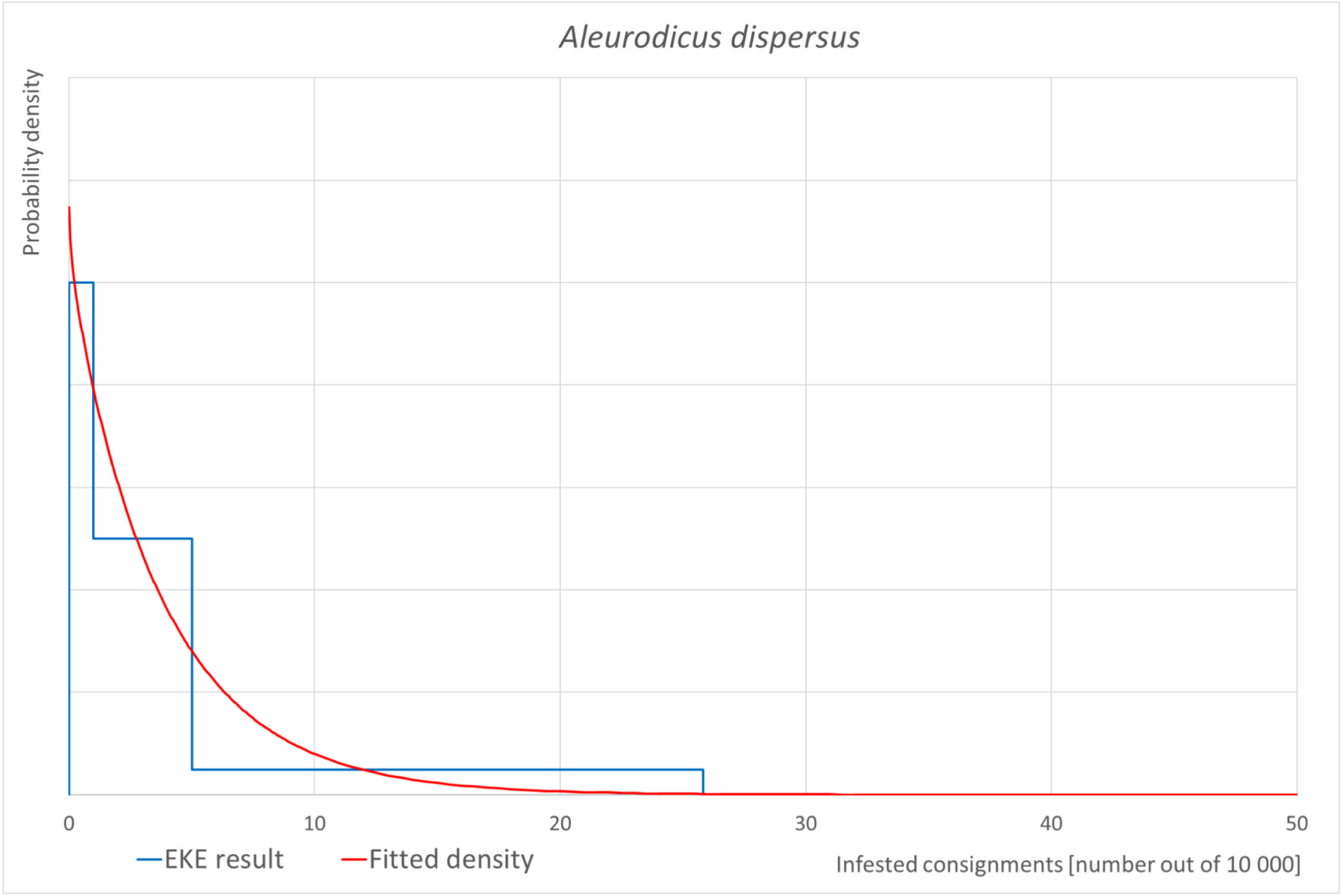

FIGURE A.1 (Continued)

(B)

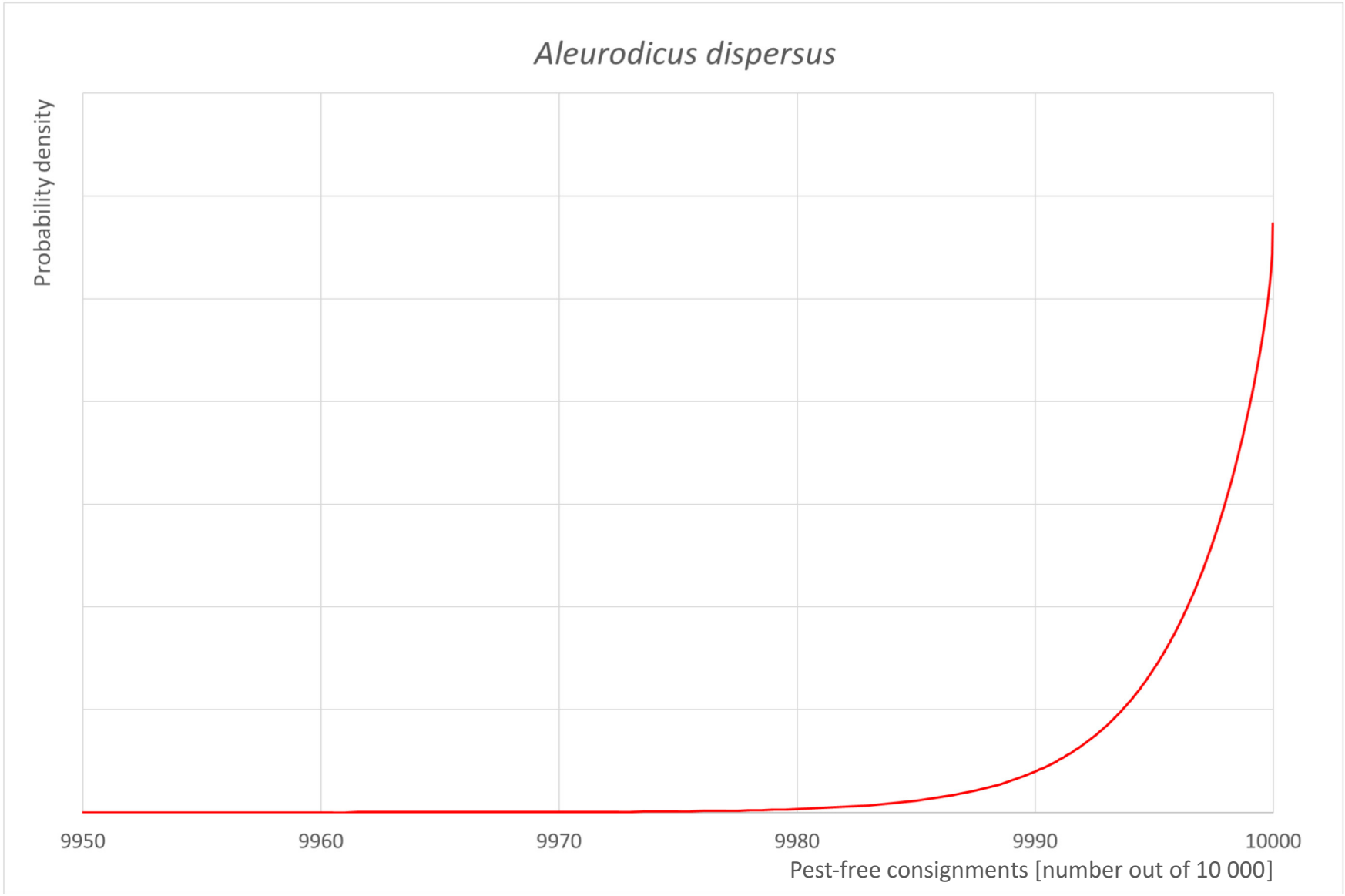

FIGURE A.1 (Continued)

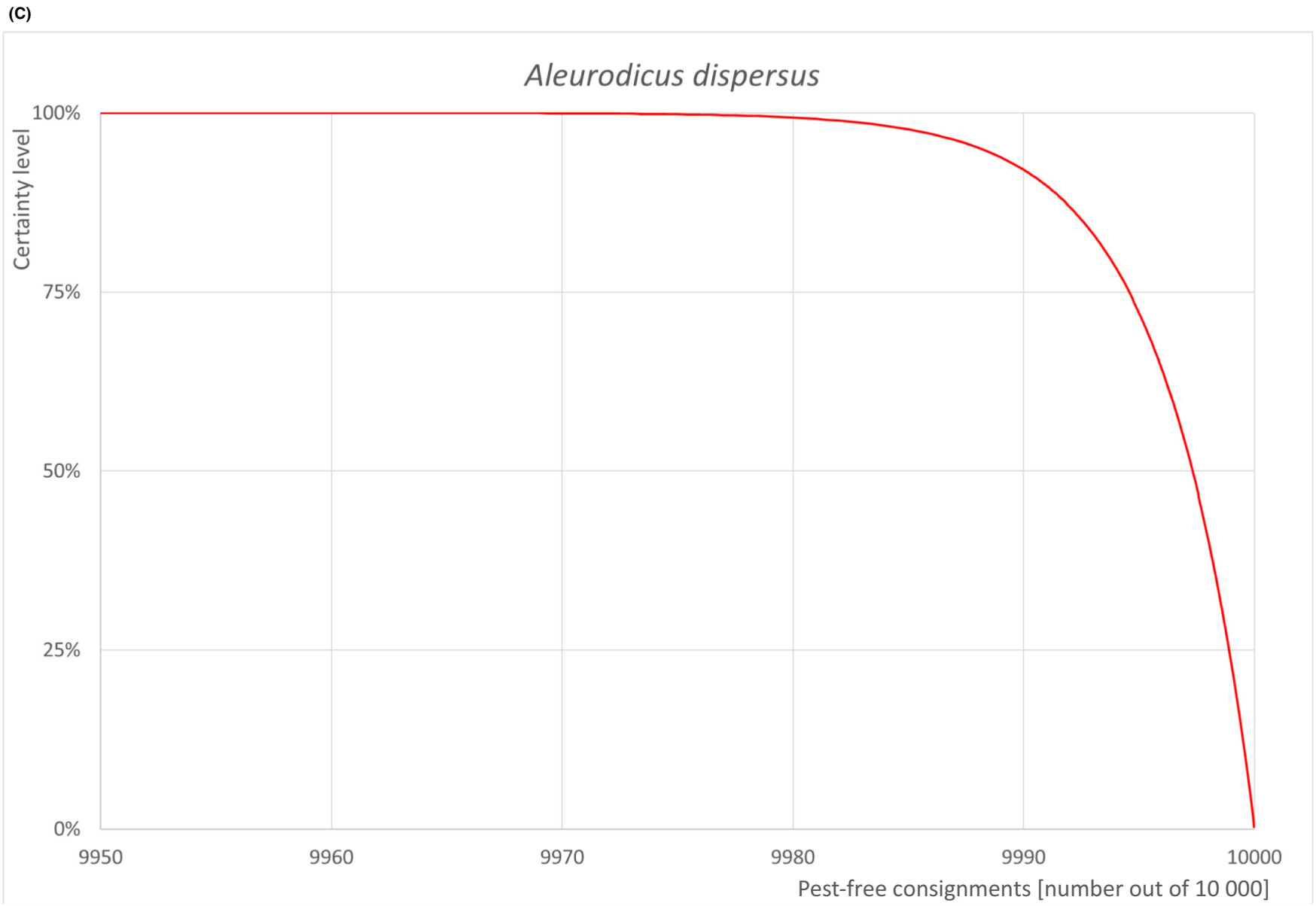

FIGURE A.1 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 105 unrooted cuttings per bag) for *Aleurodicus dispersus* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) 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.

A.1.7. | Reference list

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A.2 | Aphid-transmitted viruses

A.2.1 | Organism information

Taxonomic information of the organisms in the cluster	**Group: Vius and viroids** **1. Pepper veinal mottle virus (PVMV)** Species: *Pepper veinal mosaic virus* EPPO code: PVMV00 Synonyms: Pepper veinal mottle potyvirus, PVMV (CABI, EPPO, online) Common name: Pepper veinal mottle virus (CABI, EPPO, online) Name used in the EU legislation: – Family: *Potyviridae* Genus: *Potyvirus* Name used in the Dossier: Pepper veinal mottle virus **2. Potato leafroll virus (PLRV)** Species: *Potato leafroll virus* EPPO code: PLRV00 Synonyms: potato leafroll luteovirus, potato leafroll polerovirus, potato phloem necrosis virus, PLRV Name used in the EU legislation: Potato leafroll virus Family: *Solemoviridae* Genus: *Polerovirus* Common name: Potato leafroll virus Name used in the Dossier: Potato leafroll virus **Reasons for clustering:** The above-listed viruses are transmitted by aphids. While this cluster includes virus species belonging to different genus, their epidemiology shares sufficient commonalities to justify their clustering		
Regulated status	**PVMV:** Pepper veinal mottle virus is not regulated in the EU and it is not included in the Commission Implementing Regulation (EU) 2019/2072 **PLRV:** The Non-EU isolates of PLRV are regulated as quarantine pests not known to occur in the union territory in Commission Implementing Regulation (EU) 2019/2072, Annex II, Part A and Annex IV, Part G		
Pest status in Kenya	**PVMV:** Present (CABI, EPPO, online) **PLRV:** Present (EPPO, CABI, online; Onditi et al, 2021; Were et al, 2013)		
Pest status in the EU	**PVMV:** Absent (CABI, EPPO, online) **PLRV:** Present (CABI, EPPO, online). Non-EU isolates are considered as Quarantine pests		
Host status on *Petunia* spp./*Calibrachoa* spp.	**Virus name**	***Petunia*/Calibrachoa host status**	**Solanaceae host plants**
	Pepper veinal mottle virus (PVMV)	*Petunia* spp. are hosts of PVMV (CABI, EPPO, online)	The virus infects tomato, pepper, tobacco, eggplant
	Potato leafroll virus (PLRV)	Uncertain, *Petunia* spp are likely to be hosts	Most known hosts (about 20 species) are in the Solanaceae family (Harrison, 1984)
	Uncertainties: There are no records that *Petunia* spp. are hosts of PLRV and *Calibrachoa* spp. are hosts of PVMV and PLRV (CABI, EPPO, online). Given their host range especially among solanaceous species, the panel considered likely that these viruses infect *Petunia* spp. and *Calibrachoa* spp.		
PRA information	There are no available Pest Risk Assessments for PVMV and PLRV		

(Continued)

Other relevant information for the assessment	
Biology	**Biology and Transmission** **PVMV:** PVMV can be found in Africa (essentially in central Africa: Kenya, Ethiopia, Rwanda, mostly in the Sub-Saharan countries, Asia and the United States) (CABI, online). In nature, PVMV is transmitted by aphids in a non-persistent manner. Transmission was recorded for *Aphis craccivora*, *A. gossypii*, *A. spiraecola*, *Hysteroneura setariae, Myzus persicae*, *Rhopalosiphum* sp. and *R. maidis*; however, there is a report of *R. maidis* and *Toxoptera citricidus* failing to transmit some PVMV isolates (Alegbejo and Abo, 2002; Sastry et al., 2019). PVMV is not seed-borne (Brunt and Kenten, 1971; CABI) **PLRV:** Potato leafroll virus occurs almost worldwide in all potato growing areas. PLRV is transmitted by several aphid species, such as *Myzus persicae*, *Macrosiphum euphorbiae*, *Aulacorthum solani*, *Aphis gossypii* and *Aphis fabae*, in a persistent, circulative manner, whereas *M. persicae* is considered the main and most effective vector of the virus in nature (CABI, 2021; Singh et al., 1988; Taliansky et al., 2003) **Uncertainty on biology** The efficiency of transmission and spread of the virus species/isolates of the aphid-transmitted viruses with specific aphid species **Host range and distribution of host plants in the environment** The host range of **PVMV** includes: *Abelmoschus esculentus, Capsicum annuum* (major host), *Capsicum frutescens* (major host), *Chenopodium giganteum, Datura metel, Datura stramonium, Euphorbia hirta, Eustoma grandiflorum, Moringa oleifera, Nicotiana tabacum* (major host), ***Petunia hybrida* (major host)**, *Physalis angulata, Physalis lagascae, Solanum lycopersicum* (major host), *Solanum melongena* (major host), *Solanum nigrum, Telfairia occidentalis* (CABI, online; Sastry et al., 2019) The host range of **PLRV** includes: *Capsella bursa-pastoris, Capsicum annuum, Cicer arietinum, Corchorus olitorius, Cyphomandra betacea, Fritillaria thunbergii, Gossypium hirsutum, Lens culinaris, Sisymbrium altissimum, Solanum acaule, Solanum lycopersicum, Solanum phureja, Solanum quitoense, Solanum sarrachoides, Solanum tuberosum* (major host), *Solanum viarum, Ullucus tuberosus* (major host), *Vicia faba* (CABI, online; Sastry et al., 2019) **Uncertainty on host range** The host range of most potyviruses is continuously growing; therefore, it remains unknown The host status of *Petunia* spp. for PLRV and *Calibrachoa* spp. for PVMV and PLRV **Ecology and biology of the vectors** *M. persicae* the most efficient vector of all aphid-transmitted viruses, occurs worldwide (CABI, online). Although the aphid-transmitted viruses may be transmitted by all aphid developmental stages, the alatae are the major ones spreading these viruses **Uncertainty on ecology and biology of the vectors** The prevalence and distribution of aphid vector species **Symptoms on *Petunia/Calibrachoa*** For all viruses, symptoms vary according to the host species and cultivar, the virus isolate/strain, the environmental conditions and the developmental stage of the plant upon infection **PVMV**-infected *Petunia hybrida* cv. Rosy Morn plants exhibit chlorotic lesions on inoculated leaves, followed by systemic leaf mottling (CABI, online; Sastry et al., 2019) There is no record of *Petunia* spp. or *Calibrachoa* spp. infection by **PLRV**. Symptoms on potato may including chlorosis, necrosis and leaf curling (Sastry et al., 2019) **Uncertainties on symptoms on *Petunia/Calibrachoa*** The host status of *Petunia* spp. for PLRV and *Calibrachoa* spp. for PVMV and PLRV
Evidence that the commodity can be a pathway	Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. can be infected by PYMV and PLRV. Also, the exported commodity may be infested by viruliferous aphids; therefore, they can act as an additional pathway for PLRV due to the persistency of the virus in its aphid vectors
Surveillance information	There is no surveillance for the aphid-transmitted viruses. However, yellow traps are used in the surroundings to monitor the aphids

A.2.2 | Possibility of pest presence in the nursery

A.2.2.1 | Possibility of entry from the surrounding environment

The natural host range of PVMV and PLRV includes weeds and annual or perennial plants that can be found in the surrounding environment of the nursery and can act as reservoirs of the virus (CABI; online). These viruses and at least *M. persicae,* which is their most efficient vector, are present in Kenya (CABI, EPPO, online). Defect in the insect-proof structure of the production greenhouses could enable aphids to enter, as well as hitchhiking aphids on persons or materials entering the greenhouse. Therefore, the infestation of plants in the nursery with viruliferous aphids that acquire the virus is the main entry pathway of PVMV and PLRV in the nursery from the surrounding environment. However, PVMV is non-persistently transmitted; that is, aphids can only transmit for only very short period of time and therefore present a limited risk compared to the persistently transmitted PLRV.

Uncertainties:

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

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

Plant material (cuttings) for *Petunia* spp. and *Calibrachoa* spp. mother plants used for the production of unrooted cuttings originate from the Germany, Portugal, Spain and Israel. PVMV and non-EU isolates of PLRV are not present in the EU (EPPO GD) but the latter are present in Israel. From all countries 'Elite planting material' according to the Naktuinbouw certification programme is imported. The certification scheme in place for *Petunia* spp. and *Calibrachoa* spp. does not include PVMV or PLRV. However, PVMV can still be detected as plants are tested with a generic test for potyviruses.

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 PVMV and PLRV and the phytosanitary status of other plant species (solanaceous, non-solanaceous) than *Petunia* spp. and *Calibrachoa* spp. entering the same nursery.

A.2.2.3 | 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 point 1.8). However, other plants (solanaceous and non-solanaceous) possible hosts of tospoviruses are cultivated and aphids could be present in other greenhouses/compartments of the nursery. *M. persicae* is the most efficient vector of all aphid-transmitted viruses occurring in greenhouses and a major pest of ornamentals (CABI, online). Viruliferous aphids could spread PYMV and PLRV between the different or within the same greenhouse/compartment. These viruses may also spread by vegetative propagation of infected mother plants. There are strict hygiene conditions inside the nursery that may prevent the spread of the aphids within the nursery compartments, while the probability of alate aphid infestation is low.

Uncertainties:

- The presence and density of the PYMV, PLRV and aphids-vectors in the nursery.
- The presence and the host status for PYMV and PLRV of other plant species (solanaceous, non-solanaceous) growing in the same nursery.
- The level of physical separation (with thrips-proof netting) of the *Petunia* spp. and *Calibrachoa* spp. production units with other production units

A.2.3 | Information from interceptions

PVMV: There were no interceptions of pepper veinal mottle virus on different commodities imported into the EU from Kenya or from any other third country (EUROPHYT and TRACES, online [Accessed: 14 October 2023]).

PLRV: There were no interceptions of potato leafroll virus on different commodities imported into the EU from Kenya

A.2.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The insect proof netting prevents the introduction of insects from the surrounding environment. However, aphids 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	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants.

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
		Evaluation: The double door system with the expeller fan at the door can be effective in preventing the entry of aphids via active flying and entry and spread of the aphid-transmitted viruses. The fact that potyviruses are not detected during monitoring of the crop indicates that the above-mentioned measures are efficiently applied Uncertainties: The strictness of the measures applied
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
Quality of source plant material	Yes	The propagation material used for establishing mother plants originatesfrom EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: Although PYMV is not included in the certification scheme, it is expected to be detected with the use of potyvirus generic tests. PLRV is not included in the certification scheme applied; therefore, plants are not expected to be tested for PLRV Uncertainties: none
Crop rotation	No	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp. Evaluation: No crop rotation with non-host plants takes place. In case of introduction into the greenhouse, populations of aphid vectors may build up since the same unit is used for production of *Petunia* spp. and *Calibrachoa* spp. Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/ audits. Water is tested weekly to check for any pathogen
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: The products used are known to control a range of insect species (including whiteflies and aphids). Aphids are easier to control than other insect vectors Uncertainties: The efficiency of the applied insecticides against aphid species that might have developed insecticide resistance
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: Yellow sticky traps are effective to detect the presence of alate aphids. Monitoring could detect virus-infected petunia plants. However, early infections cannot be detected due to the lack of symptoms Uncertainties: • The efficiency of yellow sticky traps to detect early aphid infestations. • The efficiency of monitoring and inspection. • The symptoms on *Petunia* spp. and *Calibrachoa* spp. and the length of the latent period till the expression of symptoms.
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0). In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Plants are tested for some potyviruses but not for PVMV and PLRV. However, no specific data are available (sampling scheme) for the evaluation of the efficacy of the sampling and testing. No samples of *Petunia* spp. and *Calibrochoa* spp. have been tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned in the dossier Uncertainties: The efficiency of the sampling method and testing intensity to detect infections

(Continues)

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: No official measures present for aphid control in the production system Uncertainties: The efficiency of detecting the early aphid infestations and virus presence, especially in low infection levels
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. No details are given for the surveillance of any other possible pests/pathogens Evaluation: Surveillance in the area surrounding the nurseries could provide data on the presence and abundance of aphids. However, no specific data is available for the evaluation of the efficacy of the surveillance of potential hosts. In addition, it is not known if the area is being surveilled for the presence of viruses Uncertainties: The intensity and the design of surveillance scheme for aphids and the aphid-transmitted viruses (if any)

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

- The listed viruses have not been reported to infect *Petunia* spp. and *Calibrachoa* spp.
- The listed viruses have never been intercepted on produce from Kenya (ornamentals).
- Low infection pressure (prevalence of host plants) of the listed viruses in the surrounding environment.
- No infection pressure (prevalence of host plants) of the listed viruses 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 insect proof structure, the efficient inspection of the greenhouse and the strict hygienic measure in place preventing the natural and human-assisted movement of aphids.
- Some of the aphid vectors are not colonising *Petunia* spp. and *Calibrachoa* spp. and have poor efficiency of transmission of the listed viruses.
- The scouting monitoring regime is effective and infected plants by the listed virus species and aphids present in the nurseries are expected to be easily detected.
- Application of the insecticides (substances and schedule) have a good efficacy against aphids.
- 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.2.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- Even if there is no evidence that *Petunia* spp. and *Calibrachoa* spp. is a host plant for some of the listed viruses, given the sensitivity of solanaceous hosts it is likely that *Petunia* spp. and *Calibrachoa* spp. could be suitable host plants.
- Solanaceous plants are very sensitive to listed virus species infections and infections are reported in Kenya.
- Presence of insect vector in the environment is not monitored.
- Aphid vectors are widespread in Kenya and considering their wide host range it is likely that host plants are present in the surrounding environment.
- High aphid population pressure in highly preferred host (e.g. abandoned infected field of highly preferable host close to the greenhouse).
- Presence of listed virus species in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure or aphids hitchhike on greenhouse staff or materials.
- Transmission of listed viruses via vegetative propagated material increases the probability of their entry and establishment in the nursery on *Petunia* spp. and *Calibrachoa* spp. or other host plant species.
- *M. persicae* the most efficient vector of the listed viruses infests a lot of ornamentals.
- Aphid vectors have developed insecticide resistance to the applied insecticides.
- Early (asymptomatic) infections and low aphid infestations cannot be visually detected.

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

The value of the median is estimated based on:

- The listed viruses infect many solanaceous species, especially ornamentals; therefore, both *Petunia* spp. and *Calibrachoa* spp. are expected to be hosts.
- *Petunia* spp. and *Calibrachoa* spp. are preferable hosts for aphids.
- The insecticide treatments are expected to have moderately effective against aphids (insecticide resistance).
- The high density of plants in the nurseries before cutting prevents the detection of aphids and infested/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 a low uncertainty about the protective effect of the greenhouse structure.

A.2.6 | Elicitation outcomes of the assessment of the pest freedom for aphid-transmitted viruses

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

TABLE A.3 Elicited and fitted values of the uncertainty distribution of pest infection by aphid-transmitted viruses 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					20
EKE	0.152	0.282	0.454	0.746	1.10	1.53	1.96	2.94	4.21	5.07	6.23	7.67	9.56	11.4	13.8

Note: The EKE results is the *BetaGeneral* (1.5414, 4157.9, 0, 10,000) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infected 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 aphid-transmitted viruses 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	9980					9995		9997		9999					10,000
EKE results	9986	9989	9990	9992	9994	9995	9996	9997	9998.0	9998.5	9998.9	9999.3	9999.5	9999.7	9999.8

Note: The EKE results are the fitted values.

(A)

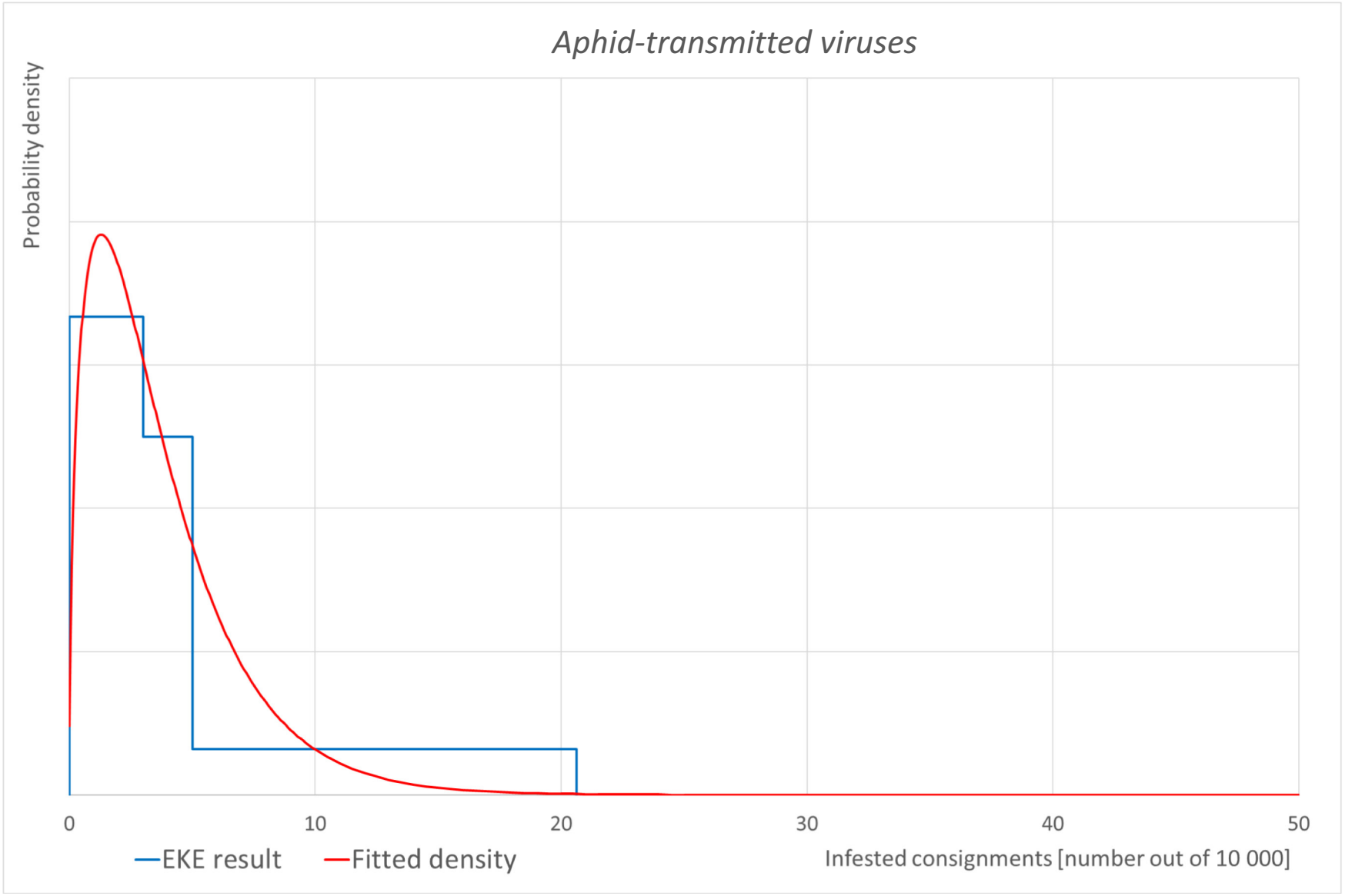

FIGURE A.2 (Continued)

(B)

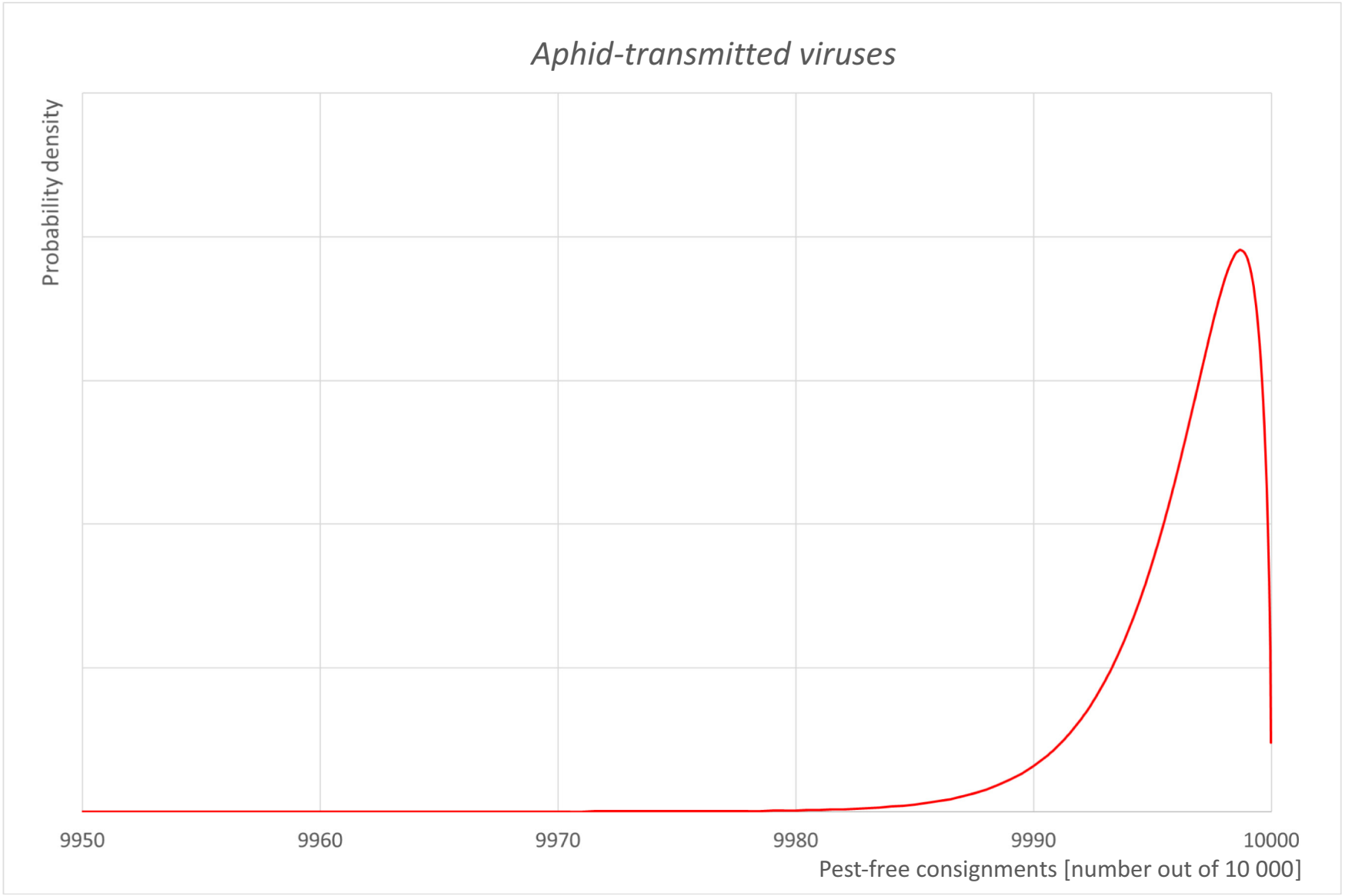

FIGURE A.2 (Continued)

(C)

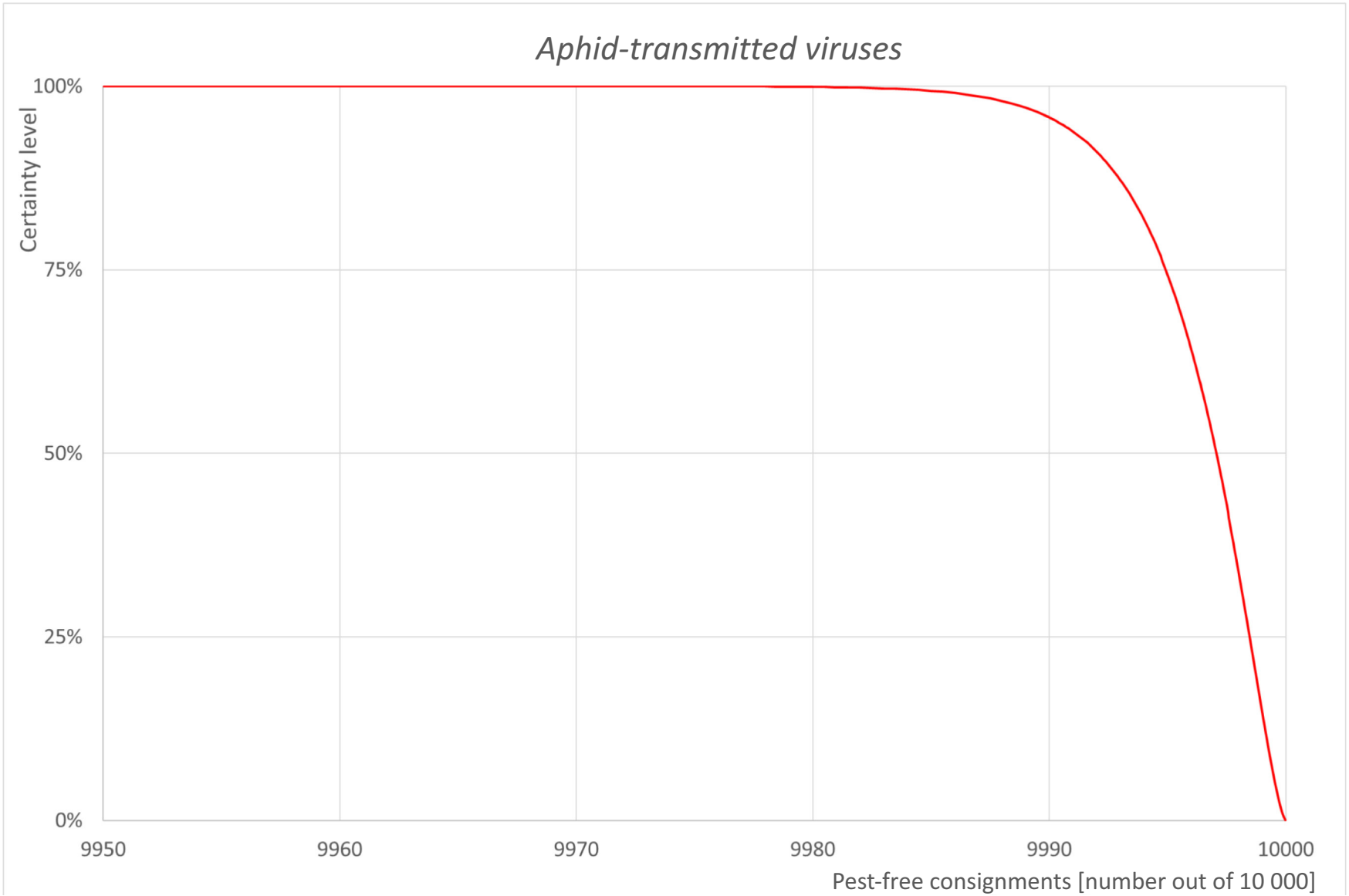

FIGURE A.2 (A) Elicited uncertainty of pest infection per 10,000 bags (containing 105 unrooted cuttings per bag) for aphid-transmitted viruses (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection per 10,000 bags.

A.2.7 | Reference list

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A.3 | *Bemisia tabaci*

A.3.1 | Organism information

Taxonomic information	Group: Insects EPPO Code: BEMITA Current valid scientific name: *Bemisia tabaci* (Gennadius, 1889) 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* Common name: tobacco whitefly, cassava whitefly, cotton whitefly, silverleaf whitefly, sweetpotato whitefly Name used in the EU legislation: *Bemisia tabaci* Genn. (non-European populations) known to be vector of viruses [BEMITA] Order: Hemiptera Family: Aleyrodidae Name used in the Dossier: *Bemisia tabaci*
Regulated status	The pest is listed in Annex II/A of Commission implementing Regulation (EU) 2019/2072 as *Bemisia tabaci* Genn. (non-European populations) known to be vector of viruses [BEMITA], and in Annex III as Protected Zone Quarantine Pest (European populations)
Pest status in Kenya	*B. tabaci* is present in Kenya (CABI, online; EPPO, online). In the Dossier 1.0, it is stated that *B. tabaci* is restricted to the cassava and sweet potato production areas in Kenya
Host status on *Petunia* sp. and *Calibrachoa* sp.	Certain *Petunia* species (*Petunia* sp., *P. axillaris*, *P. grandiflora*, *P. integrifolia*, *P. hybrida*) and *Calibrachoa* sp. are reported as host plants for *B. tabaci* (EPPO, online). *Petunia hybrida* is reported as field-verified host plant for *B. tabaci* in China, Iran and Turkey (Bayhan et al. 2006; Li et al. 2011; Samin et al. 2015). In Brasil, *B. tabaci is reported to infest* petunia plants in commercial green greenhouses (de Moraes et al. 2017)
PRA information	– Scientific Opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory (EFSA PLH Panel, 2013) – 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). These 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 cucurbit crops and ornamental plants (EFSA PLH Panel, 2013)

(Continued)

		B. tabaci adult is about 1 mm long. It develops through three life stages: egg, nymph (four instars) and adult (Walker et al., 2009). Nymphs of *B. tabaci* mainly feed on phloem in minor veins of the underside leaf surface (Cohen et al., 1996). Adults feed on both phloem and xylem of leaves (Walker et al., 2009) *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 nymph (crawler) and adults are mobile. Movement of crawlers by walking is very limited, usually within the leaf where they hatched (Price and Taborsky, 1992) or to more suitable neighbouring leaves. The average distance was estimated to be within 10–70 mm (Summers et al., 1996). For these reasons, they are not considered to be good colonisers. On the contrary, adults can fly reaching quite long distances in a search of a permanent host. According to Cohen et al. (1988), some of the marked individuals were trapped 7 km away from the initial place after 6 days. Long-distance passive dispersal by wind is also possible (Byrne, 1999)
Symptoms	**Main type of symptoms**	Wide range of symptoms can occur on plants due to direct feeding of the pest, contamination of honeydew and sooty moulds, transmitted viruses and phytotoxic responses. Plants exhibit one or more of these symptoms: chlorotic spotting, vein yellowing, intervein yellowing, leaf yellowing, yellow blotching of leaves, yellow mosaic of leaves, leaf curling, leaf crumpling, leaf vein thickening, leaf enations, leaf cupping, stem twisting, plant stunting, wilting, leaf loss and silvering of leaves (CABI, online; EPPO, 2004)
	Presence of asymptomatic plants	No asymptomatic period is known to occur in the infested plants. However, eggs and first instar larvae are difficult to detect. Symptoms of the infestation by the insect are visible. *B. tabaci* is a vector of several viruses and their infection could be asymptomatic
	Confusion with other pathogens/ pests	*B. 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 1,000 different plant species (Abd-Rabou and Simmons, 2010)
What life stages could be expected on the commodity		All life stages of *B. tabaci* (eggs, larvae and adults) are present on the leaves of the plants and could be present on unrooted cuttings of Petunia
Surveillance information		There is no official surveillance for the regional presence of these insects in Kenya

A.3.2 | Possibility of pest presence in the nursery

A.3.2.1 | Possibility of entry from the surrounding environment

B. tabaci is a polyphagous whitefly that is present in Kenya (EPPO GD, CABI). In Kenya it is regarded as serious pest on cassava and sweet potato. If these crops are near the production facilities, the pest pressure could be high in the surrounding environment. *B. tabaci* is intercepted numerous times on ornamental plants produced in greenhouses in Kenya (see section 2.4). 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. and *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.

Uncertainties:

- The *B. tabaci* population pressure 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.3.2.2 | Possibility of entry with new plants/seeds

The probability that *B. tabaci* is present on the starting material is very low/negligible as the imported material is certified (elite) and is kept in the post-quarantine facility before released to the nursery.

A.3.2.3 | Possibility of spread within the nursery

B. tabaci can be present in other host plants (perennials, bedding plants and succulents that are mainly intended to be exported to the EU, but not for the local markets) 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) with no mixing with the other ornamentals. If *B. tabaci* is detected, the nursery will be under official control.

Uncertainties:

- Specific host plants of *B. tabaci* other than *Petunia* spp. and *Calibrachoa* spp. that are grown in the nursery and their official control measures.
- The level of physical separation (with thrips-proof netting) of the *Petunia* spp. and *Calibrachoa* spp. production units with other production units.

A.3.3 | Information from interceptions

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

There were 119 interceptions of *B. tabaci* on different commodities imported into the EU from Kenya (EUROPHYT and TRACES, online).

In the EUROPHYT/TRACES-NT database there are 2 records of interceptions of *B. tabaci* on *Petunia* sp. and 1 records of interception on *Calibrachoa* spp. from Israel.

A.3.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The thrips-proof netting prevents the introduction of whiteflies from the surrounding environment. However, *B. tabaci* adults may be introduced through defects in the greenhouse Uncertainties: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. Evaluation: The measures prevent the entrance and spread in the nursery of hitchhiking crawlers of *B. tabaci* Uncertainties: Is not known if there is an additional change and disinfection area before entering the *Petunia/Calibrachoa* production units
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: The probability that *B. tabaci* is present on the certified starting material is very low/negligible Uncertainties: None
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp./*Calibrachoa* spp. Evaluation: No crop rotation with non-host plants takes place. In case of introduction into the greenhouse, populations of *B. tabaci* may build up since the same unit is used for production of *Petunia* spp. and *Calibrachoa* spp. Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogen
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *F.occidentalis* Evaluation: The products used may have an effect on populations of *B. tabaci* Uncertainties: The level of resistance against the listed insecticides of *B. tabaci* populations in Kenya
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: Populations of *B. tabaci* are monitored through sticky traps and the presence of the pest in the nursery may be detected at an early stage. Early infestation of *B. tabaci* in the crop may be difficult to detect Uncertainties: The efficiency of detecting the early infestations of *B. tabaci*
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Sampling for virus testing may detect the presence of *B. tabaci* Uncertainties: The efficiency of detecting the early infestations of *B. tabaci*

(Continues)

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Official measures are targeted to *B. tabaci* and may efficiently prevent the presence of *B. tabaci* on unrooted cuttings designated for export to the EU Uncertainties: The efficiency of detecting the early infestations of *B. tabaci*
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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.3.5 | Overall likelihood of pest freedom

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

- *Petunia* spp. and *Calibrachoa* spp. are not a preferred host.
- 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 thrips-proof and entrance is thus unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected because of the typical symptoms on leaves.
- Application of the insecticides have a good efficacy against *B. tabaci*.
- At harvest and packing, cuttings with symptoms will be detected.

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

- *B. tabaci* has been intercepted on *Petunia* spp. and *Calibrachoa* spp. plants.
- *B. tabaci* is present throughout Kenya, and they have a wide host range, mainly solanaceous plant; therefore, it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *B. tabaci* is present and abundant (e.g. melon).
- Presence of *B. tabaci* in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *B. tabaci*.

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

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

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

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

A.3.6 | 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.5) and pest freedom (Table A.6).

TABLE A.5 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	0.5					2		5		10					50
EKE	0.501	0.555	0.668	0.941	1.38	2.04	2.82	4.88	7.94	10.2	13.4	17.5	23.2	29.0	36.6

Note: The EKE results is the *BetaGeneral* (0.80047, 1140, 0.475, 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.6.

TABLE A.6 The uncertainty distribution of plants free of *B. tabaci* 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	9975					9995		9997		9999					10,000
EKE results	9982	9985	9988	9991	9993	9995	9996	9997	9998.4	9998.9	9999.3	9999.6	9999.8	9999.9	10,000.0

Note: The EKE results are the fitted values.

(A)

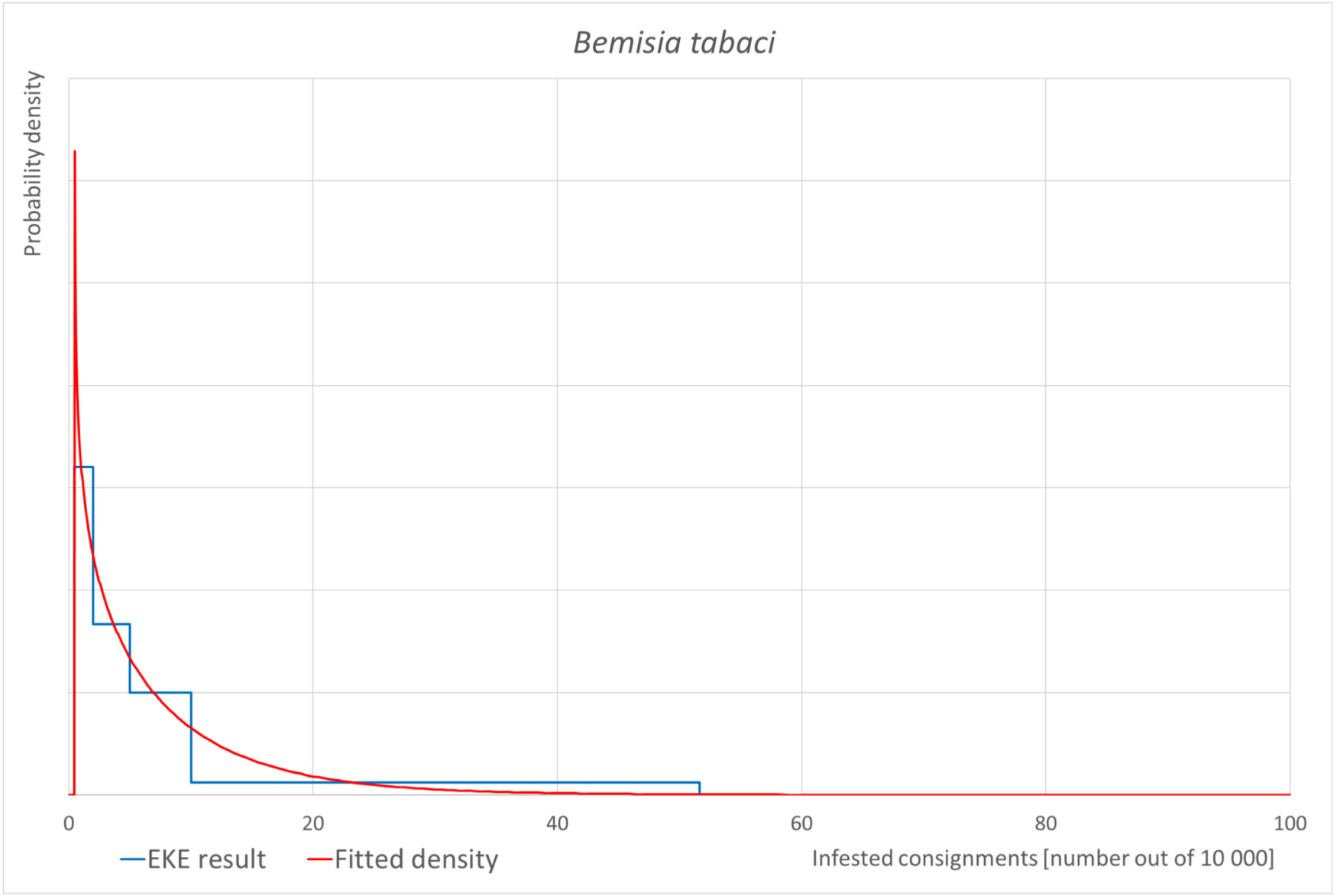

FIGURE A.3 (Continued)

(B)

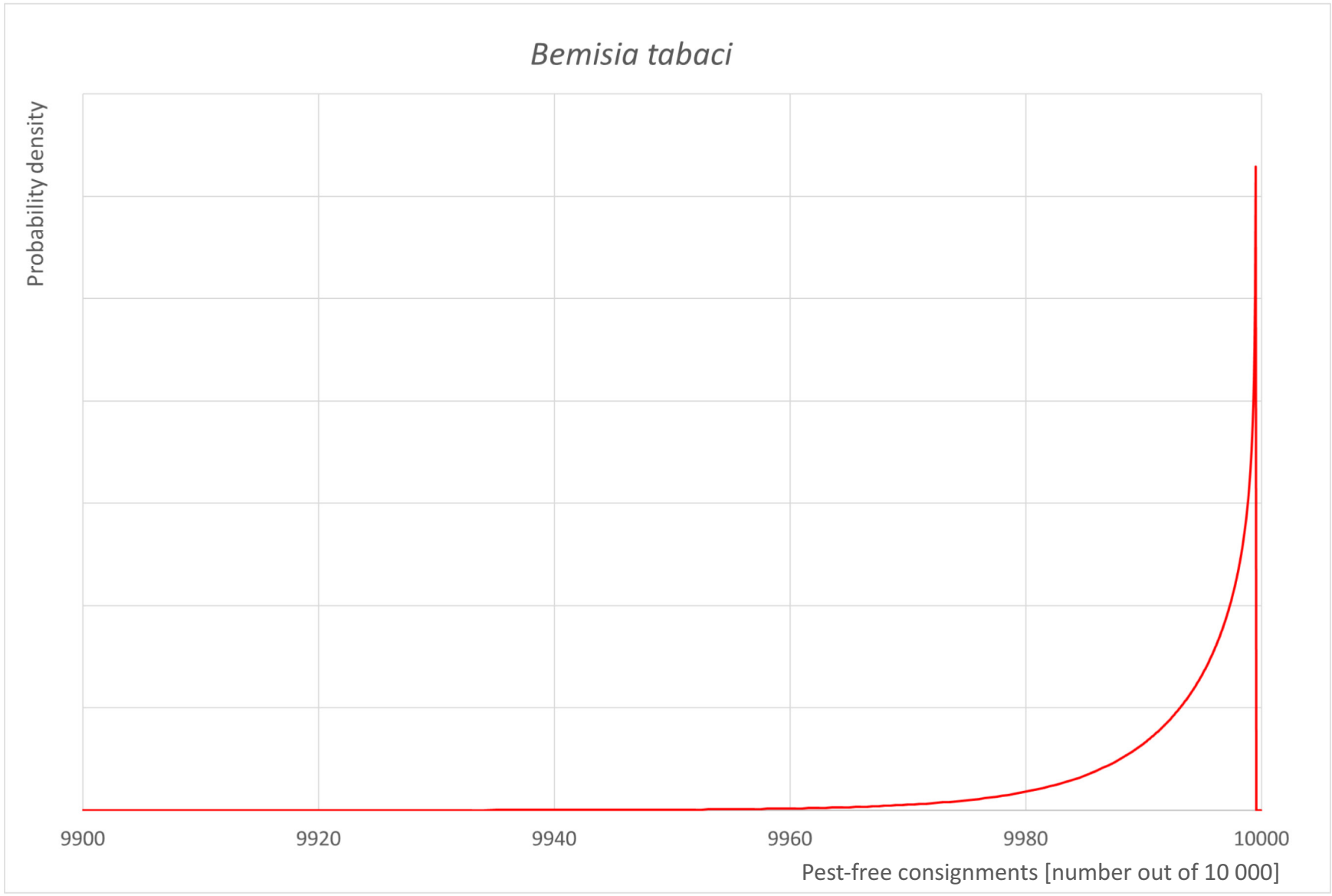

FIGURE A.3 (Continued)

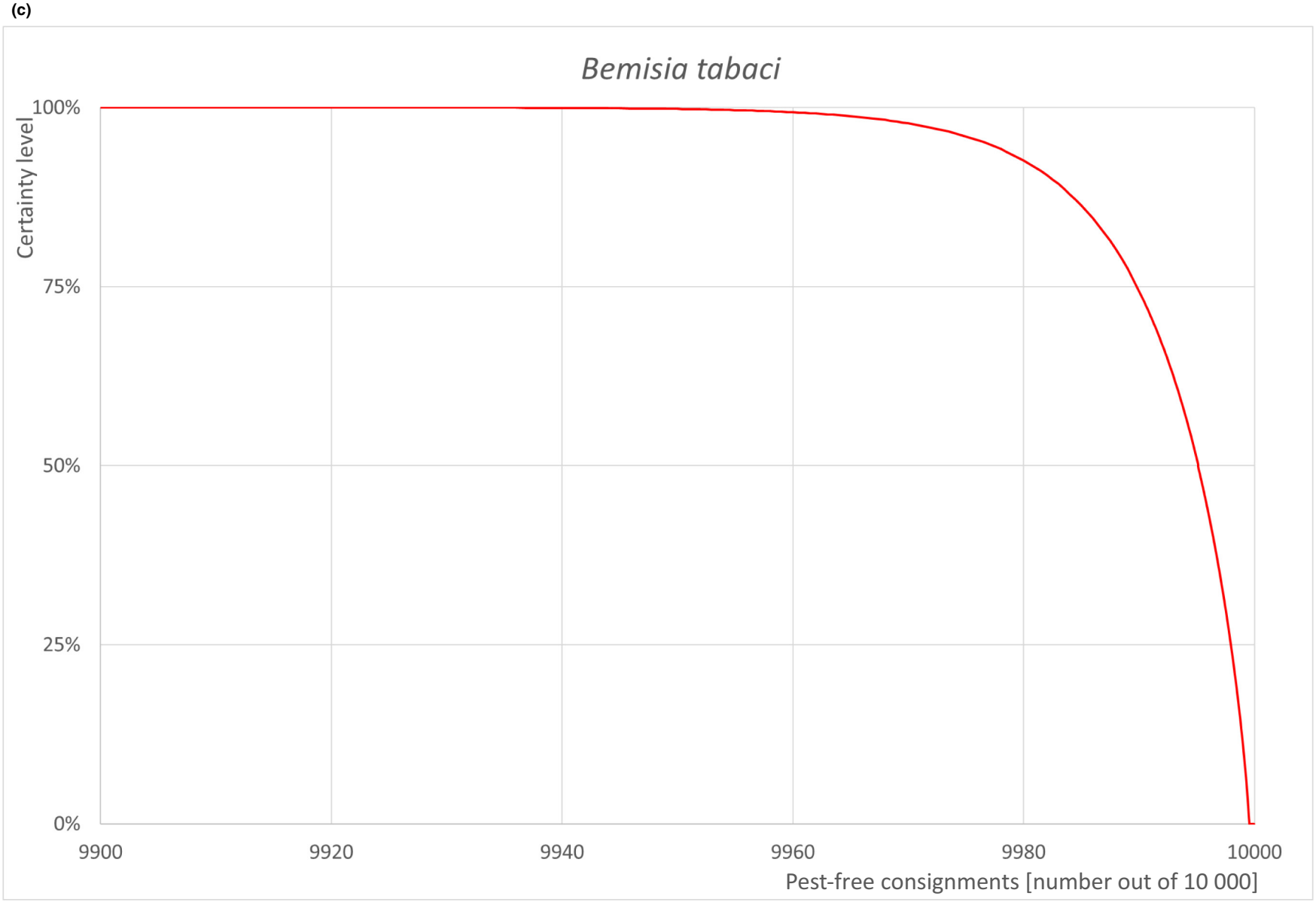

FIGURE A.3 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 105 unrooted cuttings per bag) for *B. tabaci* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty 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.4 | *Bemisia tabaci*-transmitted viruses

A.4.1 | Organism information

Taxonomic information of the organisms in the cluster	**Group: Virus and viroids** • **Cowpea mild mottle virus (CPMMV)** Species: *Cowpea mild mottle virus* EPPO code: CPMMV0 Synonyms: cowpea mild mottle carlavirus, bean angular mosaic virus, eggplant mild mottle virus, groundnut crinkle virus, groundnut Ngomeni mottle virus, psophocarpus necrotic mosaic virus, tomato pale chlorosis virus, voandzeia mosaic virus (CABI, EPPO, online) Name used in the EU legislation: Cowpea mild mottle virus [CPMMV0] Family: *Betaflexiviridae* Genus: *Carlavirus* Common names: angular mosaic of beans, mild mottle of cowpea, pale chlorosis of tomato (CABI, EPPO; online) • **Tomato mild mottle virus (TMMoV)** Species: *Tomato mild mottle virus* EPPO code: TOMMOV Synonyms: eggplant mild leaf mottle virus, TomMMoV, ToMMoV, ToMMV. Name used in the EU legislation: Tomato mild mottle virus [TOMMOV] Family: *Potyviridae* Genus: *Ipomovirus* Common name: tomato mild mottle virus • **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) Name used in the EU legislation: Tomato yellow leaf curl virus [TYLCV0] Family: *Geminiviridae* Genus: *Begomovirus* Name used in the Dossier: tomato yellow leaf curl virus, Tomato leaf curl virus **Reasons for clustering:** The above-listed viruses, although belonging to different genera, are all transmitted by the whitefly *B. tabaci*. They share similar biology and epidemiology characteristics that affect the risk they pose for the EU
Regulated status	**CPMMV** and **TMMoV** are quarantine pests not known to occur in the EU territory (Commission Implementing Regulation (EU) 2019/2072, Annex II, Part A) **TYLCV** is regulated as an RNQP in Commission Implementing Regulation (EU) 2019/2072, ANNEX IV, Part I
Pest status in Kenya	CPMMV, TMMoV and TYLCV are present in Kenya (CABI, EPPO, online)
Pest status in the EU	CPMMV and TMMoV are absent from the EU (CABI, EPPO, online) TYLCV is present in the EU (CABI, EPPO, online)
Host status on *Petunia* sp./*Calibrachoa* sp.	**Virus name** / ***Petunia*/Calibrachoa host status** / **Solanaceae host plants** **Cowpea mild mottle virus (CPMMV)** / Uncertain, *Petunia* is likely to be a host / Tomato, eggplant, *Nicotiana* spp. (the later experimentally) **Tomato mild mottle virus (TMMoV)** / *Petunia* sp. is an experimental host of TMMoV-IL (Israeli isolate from eggplant) / The virus infects only solanaceous hosts including tomato, tobacco, eggplant **Tomato yellow leaf curl virus (TYLCV)** / *Petunia* is a natural host / Tomato, potato, pepper, tobacco <u>Uncertainties:</u> There are no records that *Calibrachoa* spp. is a host of CPMMV, TMMoV and TYLCV. The same applies for *Petunia* spp. and CPMMV. However, TMMoV infects only solanaceous species including tomato, tobacco, eggplant (Dombrovsky et al., 2013; EPPO). Also, begomoviruses (TYLCV) infecting solanaceous species are expected to have an extended host range especially within the Solanaceae family (Devendran et al., 2022; Hancinský et al., 2020), while CPMMV infects tomato, eggplant and (experimentally) some *Nicotiana* spp. hosts (CABI, EPPO; online). Therefore, *Petunia* spp. is likely to be a host plant of CpMMoV, and *Calibrachoa* spp. to be a host of CPMMV, TMMoV and TYLCV
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 (Health (PLH), 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, 2014)

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Other relevant information for the assessment

Biology

Transmission:

CPMMV is transmitted by the whitefly *B. tabaci* in a non-persistent manner with an acquisition access period of 10 min, an inoculation access period of 5 min and without a latent period (Marubayashi et al., 2010; Zanardo and Carvalho, 2017). The ability of CPMMV to be seed transmissible is still unclear, due to contradictory results which might indicate that seed transmissibility depends on the CPMMV strain, the host cultivar, the time of infection and the environmental conditions (CABI, EPPO, online; Zanardo and Carvalho, 2017)

TMMoV is transmitted by *B. tabaci* in a non-circulative, semi-persistent manner. The virus persists in the whitefly vector for at least 5 days (Dombrovsky et al., 2013, 2014). There are two known strains/isolates/closely related viruses: TMMoV (or TMMoV-E) from Ethiopia where it was found infecting tomatoes and TMMoV-IL, found to infect eggplants in Israel also known as Eggplant mild leaf mottle virus (EMLMV) (Dombrovsky et al. 2014). Limited laboratory studies showed a relatively erratic transmission for TMMoV-IL by *B. tabaci* B biotype, while TMMoV-E almost failed to be successfully transmitted. However, a rapid spread has been observed under field conditions, possibly due to large field populations of *B. tabaci* (Dombrovsky et al., 2013, 2014)

Interestingly, TMMoV is reported to be, opportunistically, transmitted by aphids when in mixed infections with a potyvirus that acts as a helper virus (Abraham et al., 2012; Dombrovsky et al., 2014)

TYLCV is transmitted by *B. 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 (Rosen et al., 2015). For TYLCV, a single insect is capable of acquiring and transmitting the virus to infect tomato plants. Even nymphs can ingest and transmit begomoviruses. All evidence reported so far supports that infectious begomoviruses are not transovarially passed onto the insect progeny (EFSA, 2013). Most of the *B. tabaci* species complex members may transmit most, if not all, begomoviruses; however, the transmission efficiencies vary significantly among different *B. tabaci* species and sometime among different populations of the same species (EFSA, 2013; Rosen et al., 2015). Among some other begomoviruses – host combinations, seed transmission has been proved for TYLCV in soybean and sweet pepper; no seed transmission has been reported for any begomovirus in *Petunia* spp. or *Calibrachoa* spp. (Gomathi Devi et al., 2023). There are no other means of begomovirus transmission

Like all plant viruses that systemically infect their host, CPMMV, ToMMoV and TYLCV can be also transmitted via the vegetative propagation material

Uncertainty on transmission

- Seed transmission of CPMMV, ToMMoV and TYLCV in *Petunia* spp. or *Calibrachoa* spp.
- The efficiency of CPMMV, ToMMoV and TYLCV transmission by different biotypes/subspecies of *B. tabaci*.
- The efficiency of the synergistic transmission of TMMoV by aphids in mixed infections with a potyvirus.

Host range and distribution of host plants in the environment:

The host range of **CPMMV** include: *Agave sisalana, Arachis hypogaea* (major host)*, Beta vulgaris, Blainvillea dichotoma, Browallia speciosa, Cajanus cajan, Calopogonium mucunoides, Canavalia ensiformis, Carica papaya, Centrosema* spp.*, Chenopodiastrum murale, Chenopodium giganteum, Chenopodium quinoa, Chenopodium vulvaria, Cleome affinis, Crotalaria trichotoma, Cucumis sativus, Desmodium tortuosum, Glycine max* (major host)*, Gomphrena globose, Hibiscus syriacus, Indigofera hirsute, Macroptilium* sp.*, Macrotyloma uniflorum, Mirabilis jalapa, Mucuna pruriens, Nauclea latifolia, Nicotiana benthamiana, Nicotiana clevelandii, Nicotiana debneyi, Nicotiana glutinosa, Nicotiana megalosiphon, Penstemon hirsutus, Phaseolus lunatus, Phaseolus radiata, Phaseolus vulgaris* (major host)*, Pisum sativum, Psophocarpus tetragonolobus, Rhynchosia minima, Salvia hispanica, Senna* sp.*, Sesamum indicum, Solanum carolinense, Solanum lycopersicum, Solanum melongena, Stylosanthes gracile, Tephrosia villosa, Theobroma cacao, Trifolium incarnatum, Vicia faba, Vigna mungo, Vigna radiate, Vigna unguiculata* (major host)*, Voandzeia subterranean* (EPPO, CABI, online; Sastry et al., 2019)

TMMoV infects mainly solanaceous hosts including: *Datura stramonium, Nicandra physalodes, Nicotiana glutinosa, N. tabacum, N. rustica, N. clevelandii, N. benthamiana, N. sylvestris, N. occidentalis, Physalis floridana,* ***Petunia*** **sp.,** *Solanum betaceum, Solanum lycopersicum, Solanum melongena, Solanum nigrum* (CABI, 2019; Dombrovsky et al., 2013)

TYLCV has a large host range including species in many families (Amaranthaceae, Chenopodiaceae, Compositae, Convolvulaceae, Cruciferae, Euphorbiaceae, Geraniaceae, Leguminosae, Malvaceae, Orobanchaceae, Plantaginaceae, Primulaceae, Solanaceae, Umbelliferae and Urticaceae) (CABI, 2012; Papayiannis et al., 2011). Among cultivated plants it infects tomato, bean (*Phaseolus vulgaris*), **petunia (*Petunia hybrida*)** and lisianthus (*Eustoma grandiflorum*). Common weeds infected by TYLCV are *Conyza sumatrensis*, *Convolvulus* sp., *Cynanchum acutum*, *Cuscuta* sp., *Chenopodium murale*, *Datura stramonium*, *Dittrichia viscosa, Malva parviflora* and *Solanum nigrum* which either exhibit severe symptoms or remain asymptomatic (Jorda et al., 2001; CABI, 2012). TYLCV is 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., 2013)

Uncertainty on host range

- The actual host range of TYLCV.
- The host status of *Petunia* spp. for CPMMV and of *Calibrachoa* spp. for CPMMV, TMMoV and TYLCV.

Ecology and biology of the vectors:

B. tabaci is present in Kenya (EPPO GD). *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. *and Calibrachoa* spp.:

Most common symptoms caused by **CPMMV** include mosaic and leaf mottling. Infected tomato plants show transient narrow chlorotic banding of secondary leaf veins, whereas aubergine plants exhibit mild leaf mosaic symptoms. The major legume host species of CPMMV exhibit symptoms of vein clearing and downward rolling of the leaves, light green and yellow mosaic, stunting of plants, mottling and necrosis on the leaves, stems and pods of beans (*Arachis hypogaea, Glycine max, Phaseolus vulgaris, Vigna unguiculata*) (Brunt and Kenten, 1973; Mink and Keswani, 1987; Naidu et al., 1998; Thouvenel et al., 1982).

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	Symptoms induced by **TMMoV** in tomato plants include faint leaf mottling and stunting of the plants. ToMMV-infected eggplants show leaf mottling and fruit distortion that is occasionally accompanied by the formation of blisters in the fruit surface (Dombrovsky et al., 2013; Walkey et al., 1994). However, no symptoms develop on tomato plants of some varieties or TMMoV-infected *Petunia* spp. plants infected with TMMoV-IL (Dombrovsky et al., 2013). Mixed infections of tomato or tree tomato plants with TMMoV and PVY, may result in a synergistic effect and aggravation of symptoms (Hiskias et al. 1999) *Petunia* spp. plants infected with **TYLCV** are expected to exhibit typical begomovirus symptoms that are 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 (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 for another begomovirus, Chilli leaf curl virus (Al-Shihi et al., 2014). However, there is an asymptomatic phase of all systemic virus infections. Temperature and light intensity are expected to affect the speed of systemic infection (usually within 2–3 weeks) and disease severity
Evidence that the commodity can be a pathway	Unrooted cuttings of *Petunia* spp. or *Calibrachoa* spp. can be systemically infected by the *B. tabaci*-transmitted viruses and/or infested by viruliferous whiteflies
Surveillance information	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. There are no targeted surveys for begomoviruses in general or TYLCV in particular, CPMMV (genus *Carlavirus*) or ToMMoV (genus *Ipomovirus*) in Kenya

A.4.2 | Possibility of pest presence in the nursery

A.4.2.1 | Possibility of entry from the surrounding environment

The natural host range of CPMMV, ToMMoV and TYLCV includes members of the Solanaceae, but also from other families. These viruses are transmitted by *B. tabaci*, and both the viruses and their vector are present in Kenya (CABI, EPPO, online). Infections of all three viruses are associated with tomato plants. However, they can also infect other cultivated plants, while weeds can also act as their reservoirs. The main pathway of entrance of these viruses from the surrounding environment in the nursery is through viruliferous *B. tabaci* adults. Defects in the insect proof structure of the production greenhouses could enable whiteflies to enter, as well as hitchhiking whiteflies on persons or materials entering the greenhouse.

Uncertainties:

- Infection (CPMMV, ToMMoV and TYLCV) and infestation (*B. tabaci*) pressure in the environment of the nursery (presence and distribution of host plants in the surroundings).
- Presence of defects in the greenhouse structure.
- The efficiency of TMMoV transmission by *B. tabaci* populations/biotypes.

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

The probability that CPMMV, ToMMoV and TYLCV are present on the starting material is very low/negligible as the imported material is certified (elite) and is kept in the post-quarantine facility before released to the nursery. However, the material is not tested for CPMMV and ToMMoV and *Petunia* spp. plants are asymptomatic hosts of TMMoV (Dombrovsky et al., 2013); therefore, it is possible that the virus can enter the nursery by infected plants.

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

Uncertainties:

- The origin and the host status for CPMMV, ToMMoV and TYLCV and the phytosanitary status of other plant species (solanaceous, non-solanaceous) entering the same nursery.

A.4.2.3 | Possibility of spread within the nursery

Petunia spp. and *Calibrachoa* spp. are cultivated in dedicated compartments for their cultivation with no other plant species. However, other plants (solanaceous and non-solanaceous) possible hosts of CPMMV, ToMMoV and TYLCV are cultivated and *B. tabaci* could be present in other greenhouses/compartments of the nursery. Viruliferous *B. tabaci* could spread these viruses between the different or within the same greenhouse/compartment. *Petunia* spp. and *Calibrachoa* spp. for export are produced in a separate unit with hygienic standards (double doors, clean uniforms) with no mixing with the other ornamentals. If *B. tabaci* is detected, the nursery will be under official control. CPMMV, ToMMoV and TYLCV may also spread by vegetative propagation of infected mother plants.

Uncertainties:

- Specific host plants of *B. tabaci* other than *Petunia* spp. and *Calibrachoa* spp. that are grown in the nursery and their phytosanitary status and possible application of official control measures.
- The presence and the host status for CPMMV, ToMMoV and TYLCV of other plant species (solanaceous, non-solanaceous) growing in the same nursery.
- The efficiency of TMMoV transmission by *B. tabaci* populations/biotypes.
- The level of physical separation (with thrips-proof netting) of the *Petunia* spp. and *Calibrachoa* spp. production units with other production units

A.4.3 | Information from interceptions

There were no interceptions of CPMMV on different commodities imported into the EU from Kenya or from any other third country (EUROPHYT and TRACES, online)

There were no interceptions of ToMMoV on different commodities imported into the EU from Kenya or from any other third country (EUROPHYT and TRACES, online)

There were no interceptions of TYLCV on different commodities imported into the EU from Kenya. (EUROPHYT and TRACES, online, [Accessed: 18 October 2023]).

A.4.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse 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	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. Evaluation: The double door system with the expeller fan at the door can be effective in preventing the entry of *B. tabaci* via active flying and entry and spread of CPMMV, ToMMoV and TYLCV. Changing clothes prevents also the entrance of vectors via hitchhiking. The fact that begomoviruses are not detected during monitoring of the crop indicates that the above-mentioned measures are efficiently applied Uncertainties: The strictness of the measures applied
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: CPMMV, ToMMoV and TYLCV testing is not included in the certification scheme applied, or in the testing performed before multiplication; therefore, plants are not tested for CPMMV, ToMMoV and TYLCV Uncertainties: None

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp. 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. Uncertainties: None
Disinfect irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogen
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: The products used may have an effect against the vector *B. tabaci*. However, *B. tabaci* and especially some species of the complex (e.g. MED) are known for having developed resistance to some insecticides Uncertainties: The efficiency and timing of the applied insecticides against *B. tabaci*
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: • Yellow sticky traps are effective to detect the presence of flying *B. tabaci* adults, but cannot detect the larvae of *B. tabaci,* therefore early infestations. • Monitoring could detect petunia plants infected by CPMMV and TYLCV. However, *Petunia* spp. plants have been reported to be asymptomatically infected by some isolates of TMMoV; therefore, infections cannot be visually detected. Uncertainties: • The efficiency of yellow sticky traps to detect early whitefly infestations. • The efficiency of monitoring and inspection. • The symptoms on *Petunia* spp. and *Calibrachoa* spp. and the length of the latent period till the expression of symptoms.
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Plants are tested for begomoviruses in general and TYLCV in particular only when *B. tabaci* is found in the production sites. However, no specific data are available (sampling scheme,) for the evaluation of the efficacy of the sampling and testing. The fact that no sample was tested positive shows that the measures in place may be efficient against TYLCV. However, although there are methods to detect CPMMV and TMMoV, no testing against CPMMV and TMMoV is performed Uncertainties: In the case of *B. tabaci* or *F. occidentalis* findings, the efficiency of the sampling method and testing intensity to detect TYLCV infections
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Official measures are targeting *B. tabaci* and begomoviruses and may efficiently prevent their presence on unrooted cuttings designated for export to the EU. However, CPMMV and TMMoV are not included in the testing performed when *B. tabaci* is found in the nursery. In addition, inspections may identify TMMoV infections on *Petunia* spp. that may be asymptomatic Uncertainties: The efficiency of detecting early *B. tabaci* infestations and virus presence, especially in low infection levels

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. No details are given for the surveillance of any other possible pests/pathogens Evaluation: Surveillance in the area surrounding the nurseries could provide data on the presence and abundance of whiteflies. However, no specific data is available for the evaluation of the efficacy of the surveillance of potential hosts. In addition, it is not known if the area is being surveilled for the presence of viruses Uncertainties: The intensity and the design of surveillance scheme for whiteflies and the whitefly-transmitted viruses (if any)

A.4.5 | Overall likelihood of pest freedom

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

- CPMMV, ToMMoV and TYLCV have not been reported to infect *Calibrachoa* spp.
- CPMMV, ToMMoV and TYLCV have not been reported on *Petunia* spp. and *Calibrachoa* spp. in Kenya.
- CPMMV, ToMMoV and TYLCV have never been intercepted on produce from Kenya.
- Certification system for mother plants ensure the absence of CPMMV, ToMMoV and TYLCV in the source material.
- Low infection pressure (prevalence of host plants) of CPMMV, ToMMoV and TYLCV in the surrounding environment.
- No infection pressure (prevalence of host plants) of CPMMV, ToMMoV and TYLCV 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.
    - Pest-free area of production.
- *Petunia* spp. and *Calibrachoa* spp. are not a preferred host for *B. tabaci*.
- The scouting monitoring regime is effective and infected plants by CPMMV, ToMMoV and TYLCV or *B. tabaci* individuals present in the nursaries are expected to be easily detected.
- Application of the insecticides have a good efficacy against whiteflies.
- *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.
- At harvest and packing, cuttings with symptoms are easy to be detected.

A.4.5.2 | 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 CPMMV, ToMMoV and TYLCV, given the sensitivity of solanaceous hosts it is likely that *Calibrachoa* spp. is a suitable host plant.
- Solanaceous species are very sensitive to CPMMV, ToMMoV and TYLCV and infections are reported in Kenya.
- *B. tabaci* is widespread in Kenya and considering its wide host range it is likely that host plants are present in the surrounding environment.
- High thrips population pressure (e.g. abandoned infected field) in highly preferable hosts close to the greenhouse.
- Presence of whiteflies species in the environment is not monitored.
- Certification system for mother plants does not include testing for CPMMV, and ToMMoV in the source material.
- Presence of CPMMV, ToMMoV and TYLCV 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 CPMMV, ToMMoV and TYLCV via vegetative propagated material increases the probability of their entry and establishment in the nursery on petunia/calibrachoa or other host plant species.
- *B. tabaci* has developed insecticide resistance to the applied insecticides; therefore, the treatments are moderately effective.
- Early (asymptomatic) infections cannot be visually detected.

A.4.5.3 | 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 CPMMV, ToMMoV and TYLCV; therefore, *Petunia* spp. and *Calibrachoa* spp. Are expected to be host also for CPMMV, ToMMoV and TYLCV.
- There are no records of interceptions from Kenya.
- 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.4.5.4 | 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.4.6 | Elicitation outcomes of the assessment of the pest freedom for *Bemisia tabaci*-transmitted viruses

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

TABLE A.7 Elicited and fitted values of the uncertainty distribution of pest infection by *B. tabaci*-transmitted viruses 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					50
EKE	0.00100	0.00777	0.0366	0.173	0.546	1.35	2.60	6.69	13.6	18.6	25.1	32.3	39.8	45.3	50.0

Note: The EKE results is the *BetaGeneral* (0.44721, 1.7172, 0.57) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infected 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*-transmitted viruses 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	9950					9980		9995		9998					10,000
EKE results	9950	9955	9960	9968	9975	9981	9986	9993	9997	9998.6	9999.5	9999.8	9999.96	9999.99	10,000.00

Note: The EKE results are the fitted values.

(A)

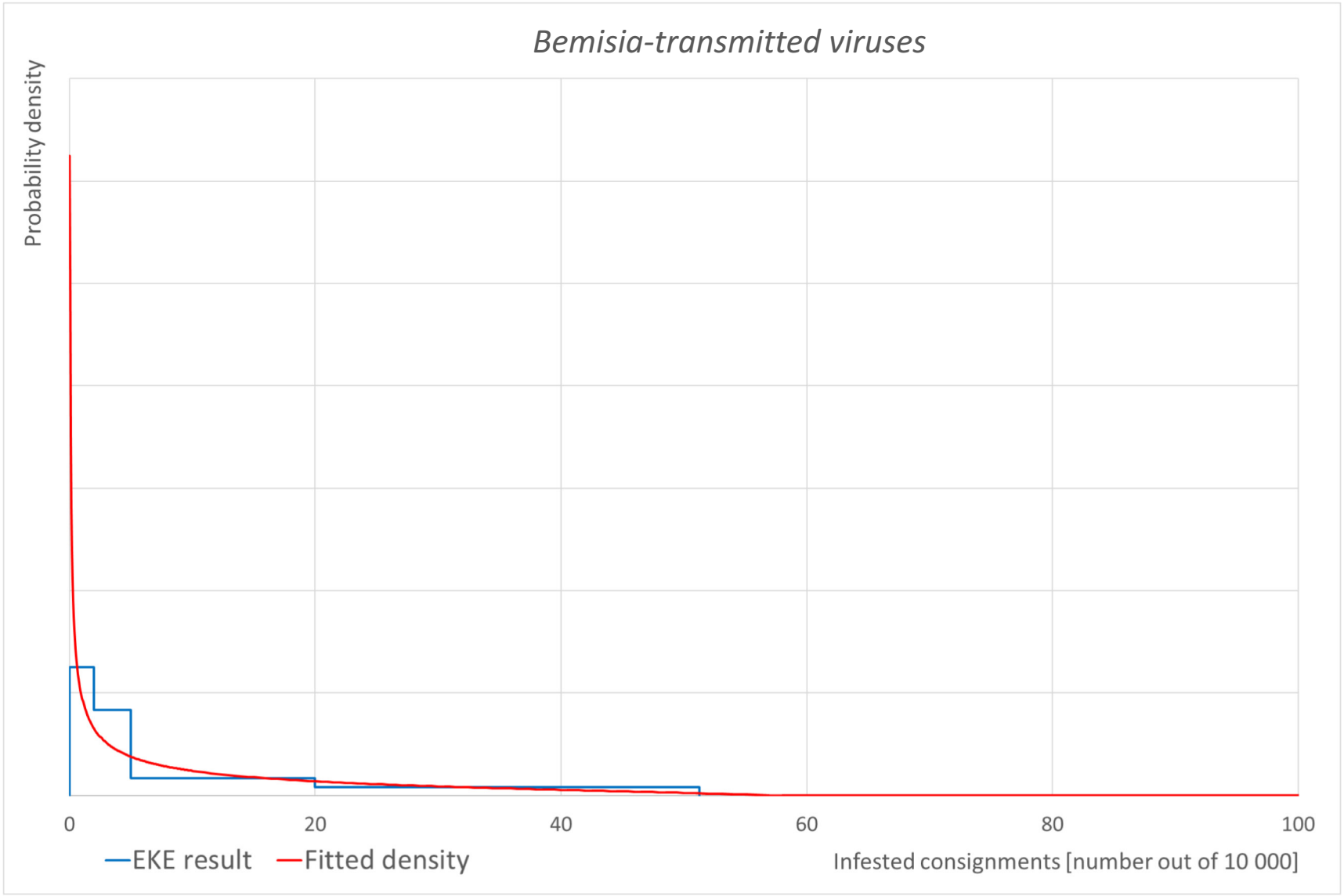

FIGURE A.4 (Continued)

(B)

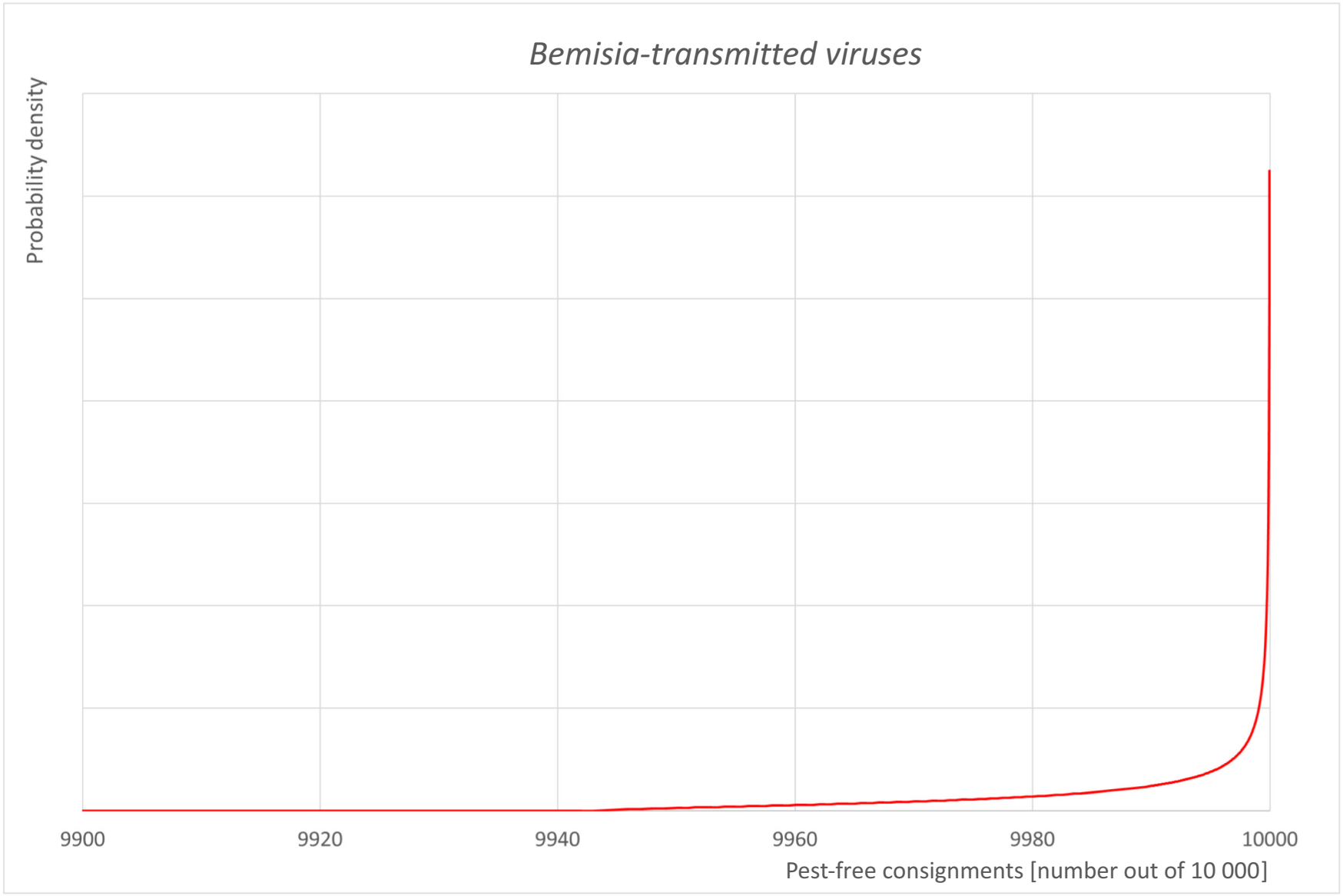

FIGURE A.4 (Continued)

(C)

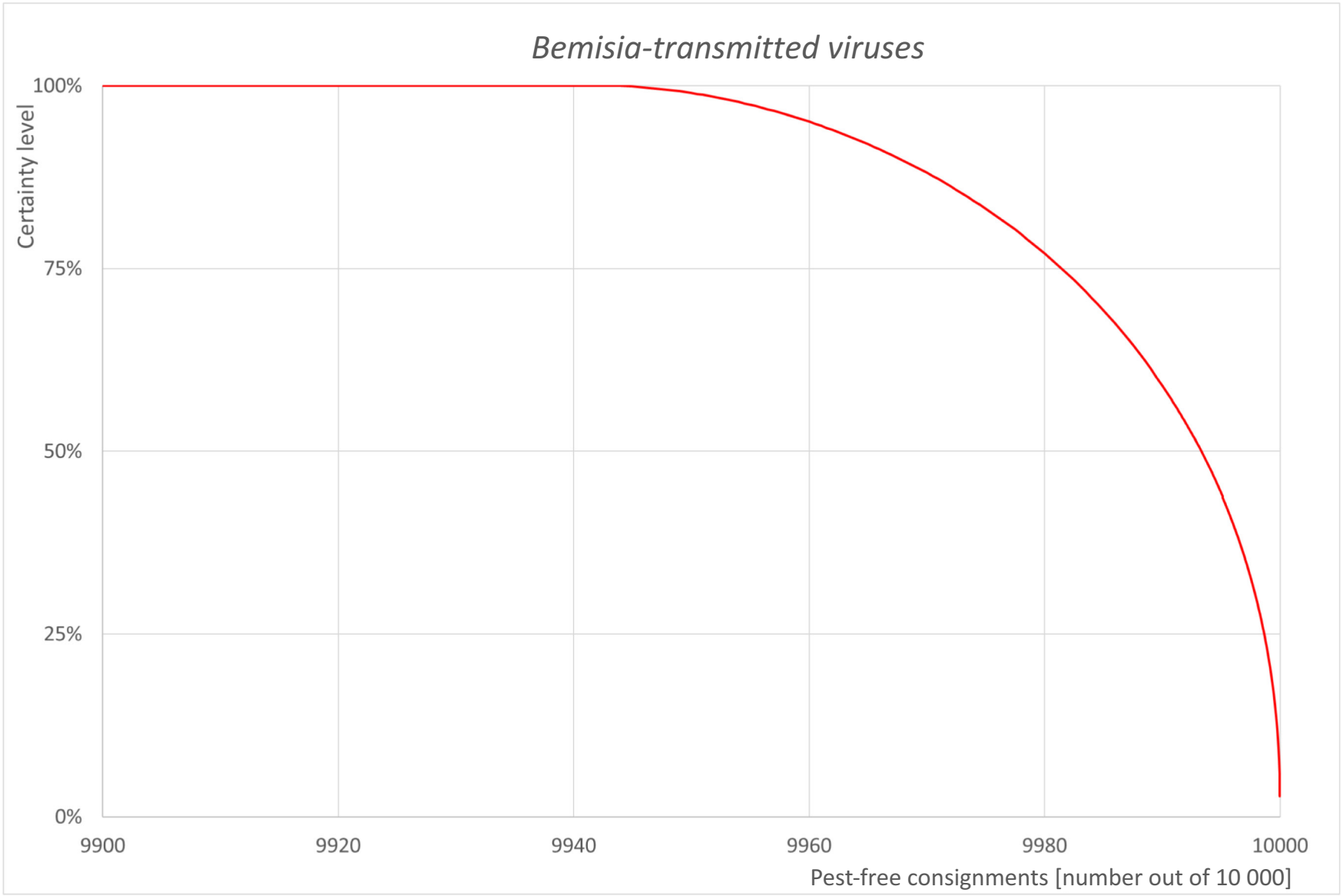

FIGURE A.4 (A) Elicited uncertainty of pest infection per 10,000 bags (containing 105 unrooted cuttings per bag) for *Bemisia tabaci*-transmitted viruses (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection per 10,000 bags.

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A.5 | Leafminers

A.5.1 | Organism information

Taxonomic information of the organisms in the cluster	Group: Insects 1. *Liriomyza huidobrensis* (Blanchard) EPPO code: LIRIHU Synonyms: *Agromyza huidobrensis, Liriomyza cucumifoliae , Liriomyza decora, Liriomyza dianthi, Liriomyza lange* Common name: pea leaf miner Name used in legislation: *Liriomyza huidobrensis* Order: Diptera Family: Agromyzidae Name used in the dossier: – 2. *Liriomyza sativae* Blanchard EPPO code: LIRISA Synonyms: *Lemurimyza lycopersicae, Liriomyza canomarginis, Liriomyza guytona, Liriomyza minutiseta, Liriomyza munda, Liriomyza propepusilla, Liriomyza pullata, Liriomyza subpusilla, Liriomyza verbenicola* Common name: cabbage leaf miner

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	Name used in legislation: *Liriomyza sativae* Order: Diptera Family: Agromyzidae Name used in the dossier: – 3. *Liriomyza trifolii* (Burgess) EPPO code: LIRITR Synonyms: *Liriomyza alliovora*, *Liriomyza phaseolunata* Common name: American serpentine leaf miner Name used in legislation: *Liriomyza trifolii* Order: Diptera Family: Agromyzidae Name used in the dossier: – Reasons for clustering: The three leafminer species have a very similar biology and are therefore evaluated as a group		
Regulated status	*L. sativae* is listed as a Union quarantine pest (Annex IIA), whereas *L. huidobrensis* and *L. trifolii* are regulated in the EU as protected zone pests (Annex III) (Commission Implementing Regulation (EU) 2019/2072		
Host status on *Petunia* sp./*Calibrachoa* sp.	**Pest name**	**Petunia/Calibrachoa host status**	**Solanaceae host plants**
	L. huidobrensis	*Petunia* spp.	Pepper, tomato
	L. sativae	*Petunia* spp.	Potato, tomato
	L. trifolii	*Petunia* spp.	Pepper, tomato
Pest status in Kenya	*L. huidobrensis*, *L. sativae* and *L. trifolii* according to EPPO/CABI/ NPPO are present in Kenya		
Risk Assessment information	Scientific Opinion on the risks to plant health posed by *Liriomyza huidobrensis* (Blanchard) and *Liriomyza trifolii* (Burgess) to the EU territory with the identification and evaluation of risk reduction options (EFSA, 2012)		
Other relevant information for the assessment			
Biology	**Host range and distribution of host plants in the environment:** *Liriomyza huidobrensis* is a highly polyphagous species and develops in many different vegetable and flower crops in the greenhouse as well as in the open field (Mujica et al., 2017; Weintraub and Horowitz, 1995). Major host plants of *L. huidobrensis* are *Apium graveolens, Capsicum annuum, Chrysanthemum x morifolium, Cucumis melo, Cucumis sativus, Lactuca sativa, Phaseolus vulgaris, Solanum lycopersicum* and *Verbena* hybrids (EPPO, online) *Liriomyza sativae* is a highly polyphagous species, with more than 60 host plants in 18 different botanical families (EFSA, 2020; Xu et al., 2022). Hosts include cultivated monocots (e.g. maize, sorghum), dicots (e.g. potatoes, cabbages, sugar beet, melons) and ornamentals (e.g. dahlia, phlox), as well as weed species (EFSA, 2020). Major host plants of *L. sativae* are *Cucurbita pepo*, *Solanum lycopersicum* and *Solanum tuberosum* (EPPO, online) *Liriomyza trifolii* is a highly polyphagous species *(Stegmaier, 1966)*. The host range of *L. trifolii* includes over 400 species of plants in 28 families including both ornamental crops and vegetables (CABI, online). The main host families and species include: Apiaceae (*A. graveolens*); Asteraceae (*Aster* spp., *Chrysanthemum* spp., *Gerbera* spp., *Dahlia* spp., *Ixeris stolonifera*, *Lactuca sativa*, *Lactuca* spp., *Zinnia* spp.); Brassicaceae (*Brassica* spp.); Caryophyllaceae (*Gypsophila* spp.); Chenopodiaceae (*Spinacia oleracea*, *Beta vulgaris*); Cucurbitaceae (*Cucumis* spp., *Cucurbita* spp.); Fabaceae (*Glycine max*, *Medicago sativa*, *Phaseolus vulgaris*, *Pisum sativum*, *Pisum* spp., *Trifolium* spp., *Vicia faba*); Liliaceae (*A. cepa, Allium sativum*) and Solanaceae (*Capsicum annuum*, *Capsicum frutescens*, ***Petunia* spp.,** *Solanum lycopersicum*, *Solanum* spp.) (CABI, online; EFSA, 2012) **Characteristics of the pests** Size of adults; The wing length of the *Liriomyza* species is between 1.3 and 2.25 mm (EPPO PM7/53(2) *Liriomyza*). Adults leafminer 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/Calibrachoa*** The presence of *Liriomyza* at the first state 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 *Liriomyza* spp. in Kenya		

A.5.2 | Possibility of pest presence in the nursery

A.5.2.1 | Possibility of entry from the surrounding environment

Leafminers are highly polyphagous pests and are reported to be present in Kenya. There are numerous interceptions of *Liriomyza* spp. on exported commodities from Kenya, including cuttings. Given the wide distribution range of host plants,

it is possible that local populations of leafminers are present in the neighbouring environment. If suitable host crops are present in the surrounding environment and the pest is not controlled, then the pest population densities could be high.

Adult leafminers can naturally spread over short distances through flight or wind assisted dispersal (EFSA, 2012; Plant Health Australia, 2020) and could enter the greenhouse through defects in the thrips-proof netting.

Uncertainties: There is no information on the pest pressure in the environment.

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

The probability that leafminers are present on the starting material is very low/negligible as the imported material is certified (elite) and is kept in the post-quarantine facility before released to the nursery.

Uncertainties: None.

A.5.2.3 | 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. Hitchhiking of leafminers flies (adults) on human clothes is unlikely. *Petunia* spp. 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* if all hygienic standards are correctly applied.

Uncertainties: The specific host plants of leafminers other than *Petunia* spp. and *Calibrachoa* spp. that are grown in the nursery and their official control measures.

A.5.3 | Information from interceptions

There were no interceptions of *Liriomyza* spp. on *Petunia* spp. and *Calibrachoa* spp. from all origins. There were nine interceptions of *L. sativae* and two of *L. trifolii* on other commodities imported from Kenya (Europhyt and TRACES, online).

A.5.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse 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 Uncertainties: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. Evaluation: The measures prevent the entrance and spread in the nursery of hitchhiking adults of *Liriomyza* spp. Uncertainties: Is not known if there is an additional change and disinfection area before entering the *Petunia* spp. and *Calibrachoa* spp. production units

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: The probability that *Liriomyza* spp. are present on the certified starting material is very low/negligible Uncertainties: None
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp./*Calibrachoa* spp. Evaluation: If undetected starting populations are present, then populations of *Liriomyza* spp. may build up since the same unit is used for production of *Petunia* spp. and *Calibrachoa* spp. Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogen
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: The products used may also have an effect on populations of *Liriomyza* Uncertainties: The efficacy of the plant protection products against the specific insect pest is not known
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment 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	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Sampling for virus testing may detect the presence of *Liriomyza* spp. Uncertainties: The awareness of the staff for the specific pest is unknown

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Inspections for other insect pests may help in the detection of populations of *Liriomyza* spp. Uncertainties: The awareness of the staff for the specific pest is unknown
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. No details are given for the surveillance of any other possible pests/pathogens Evaluation: There is no targeted surveillance for the presence of *Liriomyza* spp. in the environment Uncertainties: none

A.5.5 | Overall likelihood of pest freedom

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

- *Calibrachoa* spp. is not a preferred host.
- 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, insects are expected to be easily detected because of the presence of leafminers.
- At harvest and packing, cuttings with symptoms will be detected.

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

- *L. huidobrensis, L. sativae* and *L. trifolii* are present throughout Kenya and they have a wide host range, mainly solanaceous plant, including *Petunia* and it is likely that host plants are present in the surrounding environment.
- There are numerous interceptions of *Liriomyza* spp. from Kenya.
- Greenhouses are located in areas where *L. huidobrensis, L. sativae* and *L. trifolii* are present and abundant (e.g. pepper, tomato) and natural enemy activity is low.
- Presence of leafminer species in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure or leafminers hitchhike on greenhouse staff.
- Insecticide treatments are not targeting to leafminers.

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

- The protective effect of the greenhouse structure.
- The insecticides treatments are not targeting leafminers but are moderately effective.

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

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

A.5.6 | Elicitation outcomes of the assessment of the pest freedom for leafminers

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

TABLE A.9 Elicited and fitted values of the uncertainty distribution of pest infestation by leafminers 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					7		15		25					100
EKE	1.00	1.50	2.22	3.51	5.17	7.23	9.41	14.4	21.1	25.7	32.0	39.8	50.3	60.5	74.0

Note: The EKE results is the *BetaGeneral* (1.3135, 717.45, 0.52, 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.10.

TABLE A.10 The uncertainty distribution of plants free of leafminers 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	9900					9975		9985		9993					9999
EKE results	9926	9939	9950	9960	9968	9974	9979	9986	9991	9993	9995	9996	9997.8	9998.5	9999.0

Note: The EKE results are the fitted values.

(A)

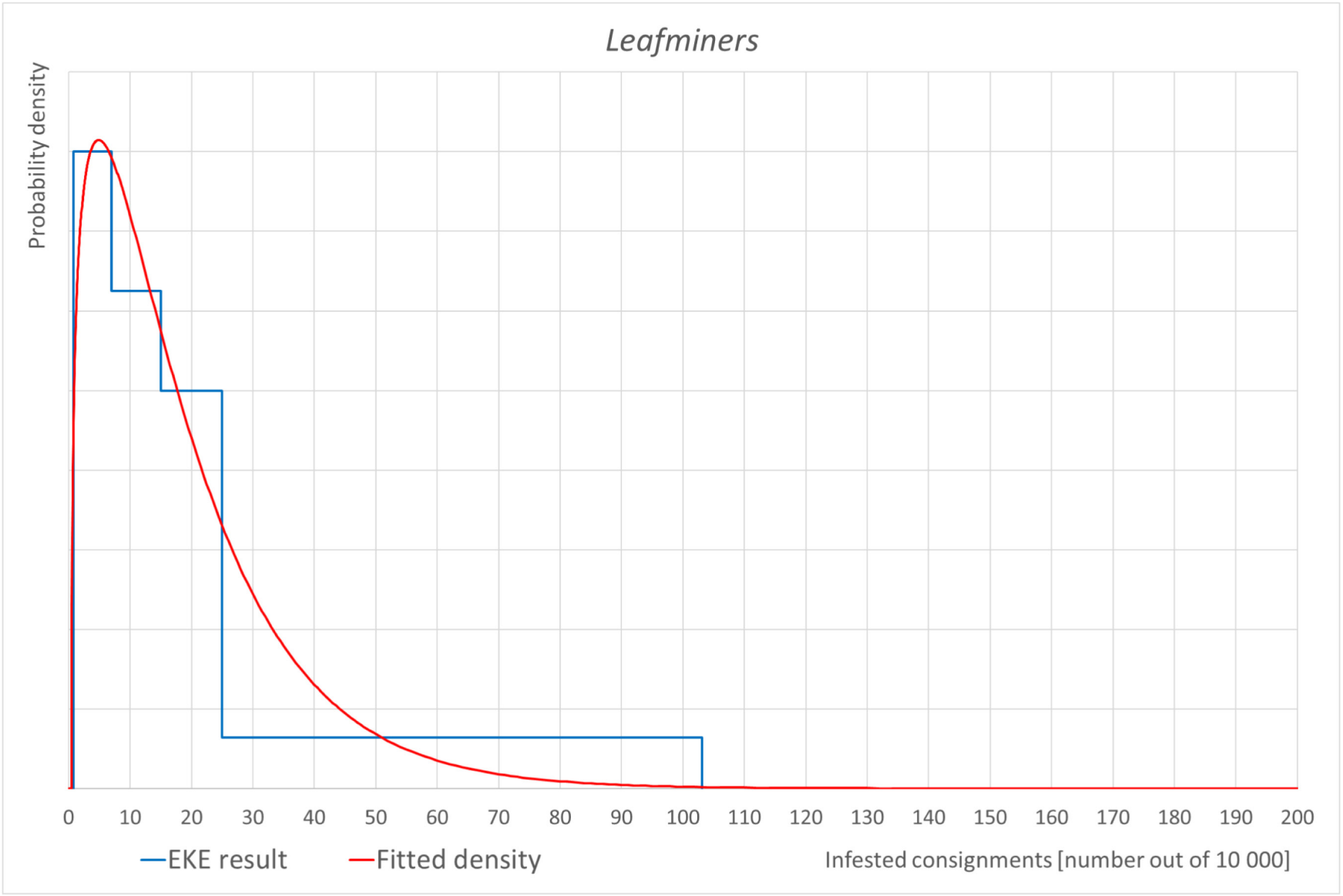

FIGURE A.5 (Continued)

(B)

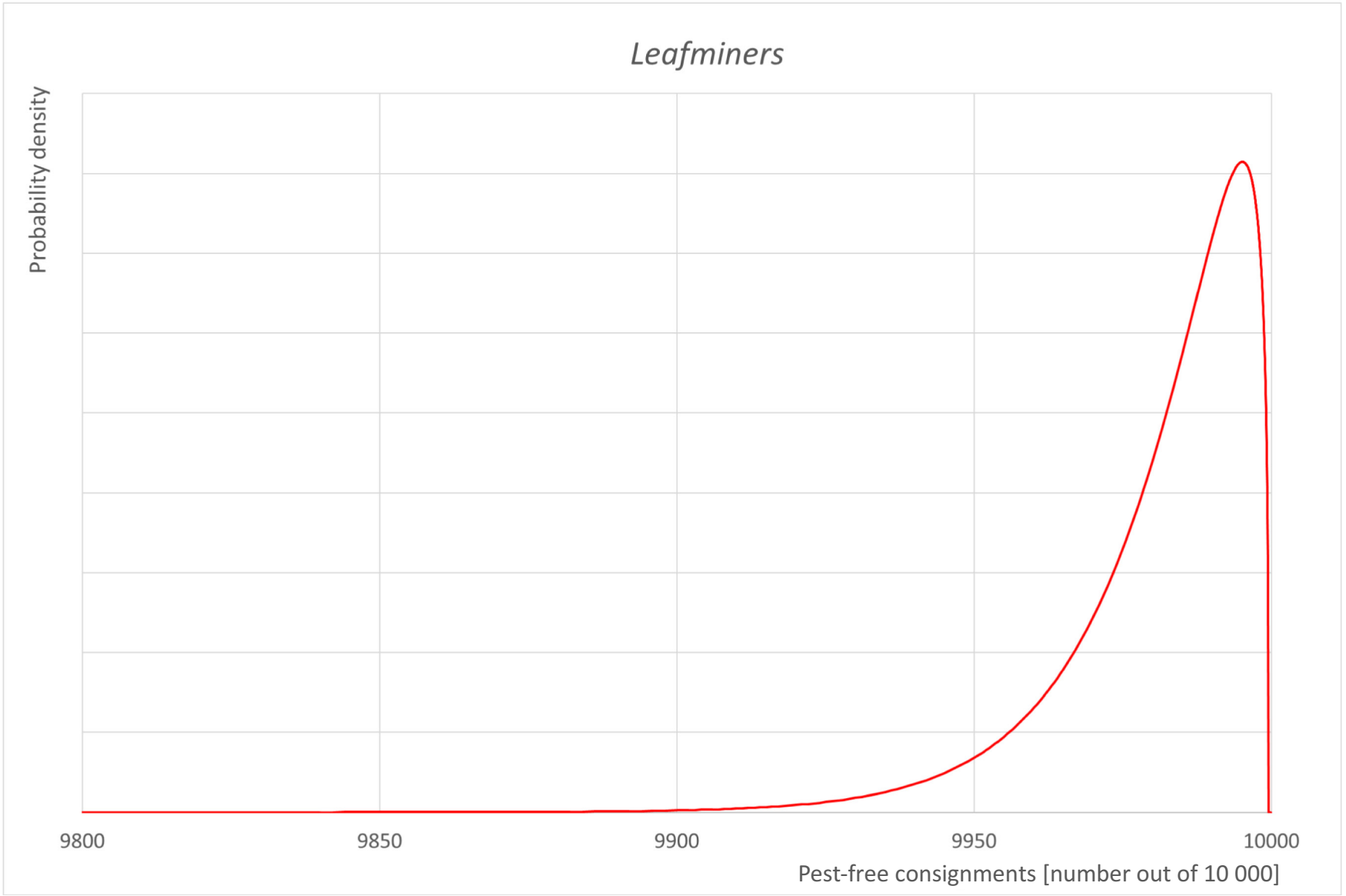

FIGURE A.5 (Continued)

(C)

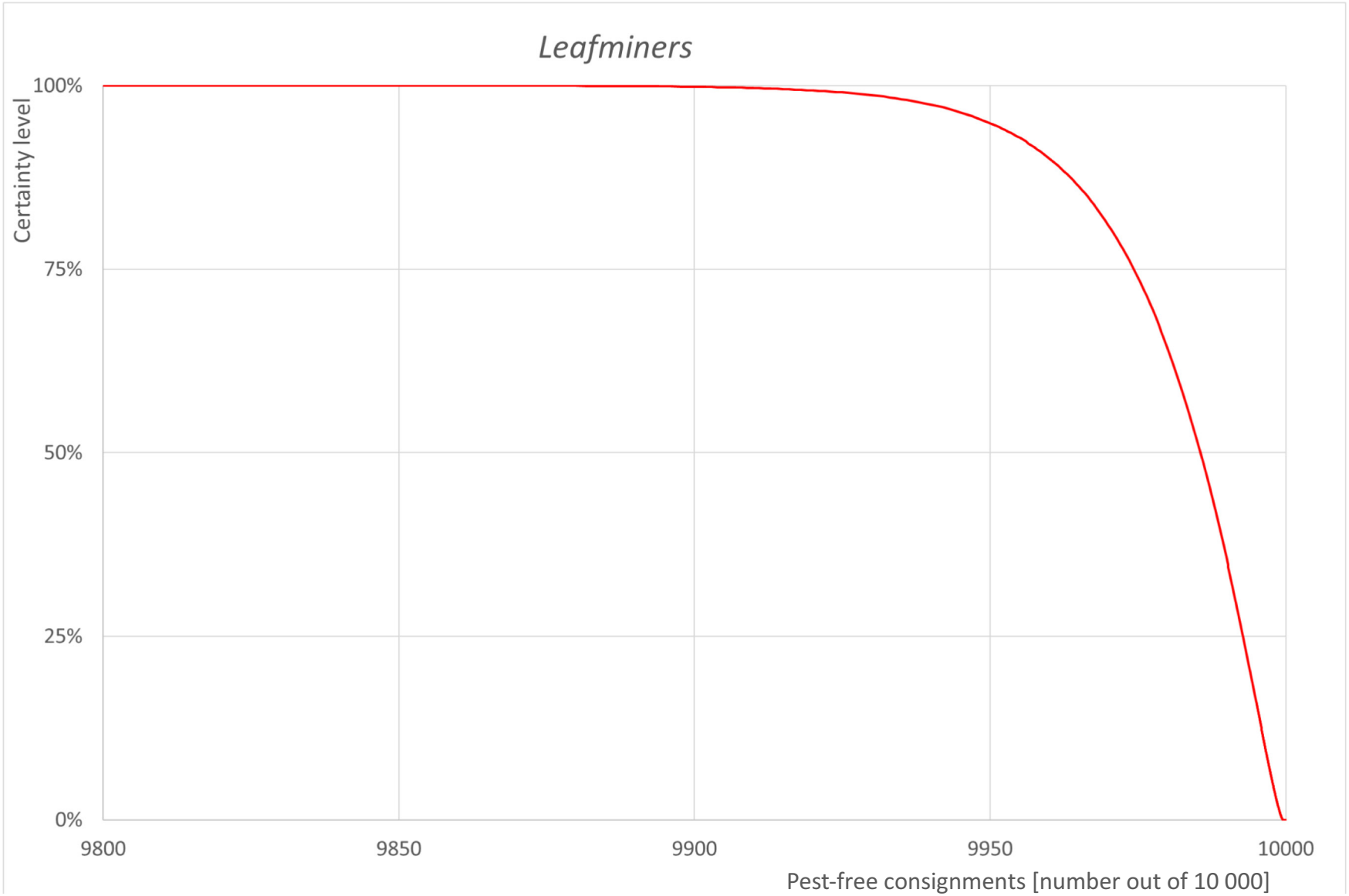

FIGURE A.5 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 105 unrooted cuttings per bag) for leafminers (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags.

A.5.7 | Reference list

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A.6 | Mealybugs

A.6.1 | Organism information

Taxonomic information of the organisms in the cluster	Group: Insects 1. *Phenacoccus solenopsis* (Tinsley) EPPO code: PHENSO Synonyms: – Common name: cotton mealybug Name used in legislation: – Order: Hemiptera Family: Pseudococcidae Name used in the dossier: – 2. *Nipaecoccus viridis* (Newstead) EPPO code: NIPAVI Synonyms: *Dactylopius perniciosus, Dactylopius viridis, Nipaecoccus vastator, Pseudococcus perniciosus, Pseudococcus vastator* *Common name:* cotton mealybug Name used in legislation: – Order: Hemiptera Family: Pseudococcidae Name used in the dossier: – Reasons for clustering: The two scale mealybugs species have a similar biology and are therefore evaluated as a group
Regulated status	*P. solenopsis* is not regulated in the EU *N. viridis* is categorised in Turkey (A1 list since 2016) and in countries of Asia and America (EPPO, online, a)
Host status on *Petunia* spp. *and Calibrachoa* spp.	***P. solenopsis:*** *Petunia* sp. and *P. integrifolia* are reported as host plants (Fallahzadeh et al., 2014; Malumphy et al. 2013). There is no information on whether *P. solenopsis* can also attack *Calibrachoa* species ***N. viridis:*** There are no evidence of *Petunia* spp. or *Calibrachoa* spp. as host, while other Solanaceae species can be a host (García et al. 2016) but given its wide host range *Petunia* spp. or *Calibrachoa* spp. are likely to be suitable hosts
Pest status in Kenya	*P. solenopsis* is reported to be present in Kenya with no further details (EPPO, online, Macharia et al., 2021). It is reported as present, localised (Birithia et al., 2012) *N. viridis* is reported to be present in Kenya, no details (EPPO, online)
Pest status in the EU	*P. solenopsis* is present, with restricted distribution (CABI, EPPO) The pest is present in Cyprus (EPPO GD, online), in Greece only in island of Crete (EFSA PHL Panel, 2021a), in Italy in Lazio region and Sicily (Ricupero et al., 2021; Sannino et al., 2019) and in France in the province of Brittany (Kreiter et al. 2020) *N. viridis* is absent in the EU (CABI, online; EPPO, online; Garcıa Morales et al., online)
Risk Assessment information	• Rapid pest risk analysis for *Phenacoccus solenopsis* (Cotton mealybug) and the closely related *P. defectus* and *P. solani* (Malumphy et al., 2013). • Pest risk analysis of Mealybug spp. in Bangladesh (Islam et al., 2017). • Scientific Opinion on the pest categorisation of *Phenacoccus solenopsis* (EFSA PLH Panel, 2021b). • *P. solenopsis* was identified as an actionable pest in the commodity risk assessments of *Prunus persica* and *P. dulcis* plants from Türkiye, *Nerium oleander* plants from Türkiye and *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings from Guatemala (EFSA PLH Panel, 2024). • Scientific Opinion on pest categorisation of *Nipaecoccus viridis* (EFSA PLH Panel, 2023). • *N. viridis* was identified as an actionable pest in the commodity risk assessment of *Prunus persica* and *P. dulcis* plants from Türkiye.
Other relevant information for the assessment	
Biology	***P. solenopsis:*** female develops through an egg, three nymphal instars to an adult. The male has additional nymphal stage, the last two are called prepupa and pupa. Reproduction is sexual and ovoviviparous. Facultative parthenogenesis was observed under laboratory conditions of mealybugs collected from Nagpur, India (Vennila et al., 2010). Females lay ~ 150–600 eggs in a white, waxy ovisac (Fand and Suroshe, 2015). The life cycle of *P. solenopsis* ranges between 28 and 35 days and can complete about 8–12 generations in a year (Fand and Suroshe, 2015)

(Continued)

	The first nymphs are crawlers, which disperse to other parts of the same plant or get carried by the wind or other means (machinery, workers, animals) to other areas (Hodgson et al., 2008). The adult males live from few hours up to 3 days, depending on the temperature (Hodgson et al., 2008). Adult females can live for up to 3 months (Gerson and Aplebaum, online) It overwinters as an adult female, on the bark, the stem and branches of woody plants. It seems that it may develop in the ground on roots of non-woody plants (Spodek et al., 2018). This mealybug has been reported to be capable of surviving temperatures ranging from 0 to 45°C, throughout the year (CABI, online). The crawlers of *P. solenopsis* have been reported be commonly dispersed by wind for distances ranging from a few meters to several kilometres (Islam et al., 2017). Males have wings and can fly, females are wingless ***N. viridis:*** reproduce both sexually and parthenogenically. Eggs are laid in a large hemispherical ovisac, which usually hide the female (Sharaf and Meyerdirk, 1987). Females lay about 300–500 eggs in their lifetime (Mani and Shivaraju, 2016) and sometimes more than 1,100 eggs (Bartlett, 1978). The mealybug prefers to feed and reproduce on fast growing tissues like new branches and fruits (Diepenbrock and Burrow, 2020). *N. viridis* is probably indigenous to the warm tropical areas of the Indian subcontinent (Franco et al., 2004) and is spread in many parts of the world, mainly in tropics and subtropics (Thomas and Leppla, 2008) The development stages of *N. viridis* are egg, three nymphal instars (for females) and four nymphal instars (for males), and adult (Mani and Shivaraju, 2016). According to Sharaf and Meyerdirk (1987), the number of instars is four for females and five for males. The first instar nymph (crawler) can be carried away by wind. The development time lasts between 19 and 20 days at 25°C and 15–19 days at 32°C (Gerson and Aplebaum, online). Males have forewings and live up to 3 days. Females are wingless and live up to 50 days (Gerson and Aplebaum, online) The mealybug can have several overlapping generations per year (Sharaf and Meyerdirk, 1987). Six to seven generations occur annually in the Jordan Valley (Gerson and Aplebaum, online) In the Middle East mealybug overwinters as adult in cracks and crevices of the stems and branches (Gerson and Aplebaum, online). In Iraq, *N. viridis* overwinters as egg, nymph and adult (Jarjes et al., 1989)	
Symptoms	Main type of symptoms	***P. solenopsis*** prefers the upper parts of the plants, young shoots or branches carrying fruitlets (Spodek et al., 2018). Large populations of mealybugs cause general weakening, distortion, defoliation, dieback and death of susceptible plants (Malumphy et al., 2013). Plants become covered in sooty moulds that grow on the honeydew produced by mealybugs. The honeydew also attracts ants that protect the mealybugs from natural enemies (Hodgson et al., 2008). The infested plants of cotton become stunted, growth appears to stop and most plants look dehydrated. In severe outbreaks, the cotton bolls fail to open, and defoliation occurs (including the loss of flower buds, flowers and immature bolls) (Hodgson et al., 2008). On tomatoes the pest causes foliar yellowing, leaf wrinkling, puckering and severe damage, resulting in death (Ibrahim et al., 2015) ***N. viridis*** adults and larvae can damage all plant parts, such as leaves, fruits, twigs, flowers and even roots (Abdul-Rassoul, 1970; CABI, online; Gerson and Aplebaum, online; Sharaf and Meyerdirk, 1987). On citrus, feeding on twigs causes deformation. The pest may stunt trees, produces honeydew and on fruit may cause deformation, discoloration and drop
	Presence of asymptomatic plants	No asymptomatic period is known to occur in the infested plants. Plant damage might not be obvious in early infestation or during dormancy (due to absence of leaves), but the presence of mealybugs on the plants could be observed. During the crawler stage, infestation is difficult to be noted (Ben-Dov, 1994)
	Confusion with other pathogens/pests	*Although they may be confused with other* species of mealybugs*, a slide-mounted female can be distinguished* using taxonomic keys (Hodgson et al., 2008)
Host plant range	***P. solenopsis*** is highly polyphagous, feeding on approximately 300 plant species in 65 botanical families. The plant families containing most hosts are Amaranthaceae, Asteraceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Malvaceae and Solanaceae, including Petunia (Arif et al., 2009; Vennila et al., 2013; Fallahzadeh et al., 2014; Fand and Suroshe, 2015; Garcsıa Morales et al., online) ***N. viridis*** attacks 53 plant families and 140 genera (Garcia Morales et al., online). Main hosts are avocado (*Persea americana*), citrus (Citrus spp.), coffee (*Coffea* spp.), cotton (*Gossypium* spp.), grapevine (*Vitis vinifera*), mango (*Mangifera indica*), pomegranate (*Punica granatum*) and tamarind (*Tamarindus* spp.) (CABI, online; Gerson and Aplebaum, online). Other host plants are fig (*Ficus carica*), Indian siris (*Albizia lebbeck*), jack fruit (*Artocarpus heterophyllus*), crape myrtle (*Lagerstroemia indica*), white mulberry (*Morus alba*), oleander (*Nerium oleander*), potato (*Solanum tuberosum*), tomato (*Solanum Lycopersicum)* rosemallows (*Hibiscus* spp.) and soybean (*Glycine max*) (CABI, online; Garcia Morales et al., online)	
What life stages could be expected on the commodity	All developmental stages of these mealybugs could be present on harvested unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp.	
Surveillance information	There is no official surveillance for the regional presence of mealybugs in Kenya	

A.6.2 | Possibility of pest presence in the nursery

A.6.2.1 | Possibility of entry from the surrounding environment

P. solenopsis and *N. viridis* are polyphagous species that are reported to be present in Kenya. However, *P. solenopsis* has been recently recorded in Kenya (Macharia et al. 2021), whereas *N. viridis* is known to be present in Kenya from long time.

Given the wide host range of these pests it is possible that local populations of *P. solenopsis* and *N. viridis* are present in the neighbouring environment of the nursaries.

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

Uncertainties:

- The *P. solenopsis* and *N. viridis* population pressure in the surrounding environment of the nursery (presence and distribution of host plants in the surroundings).
- The presence of defects in the greenhouse structure.
- The efficacy of the hygiene measures in the greenhouse.

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

The probability that mealybugs are present on the starting material is very low/negligible as the imported material is certified (elite) and is kept in the post-quarantine facility before released to the nursery.

A.6.2.3 | Possibility of spread within the nursery

Mealybugs can be present on other host plants (perennials, bedding plants and succulents that are mainly intended to be exported to the EU, but not for the local markets) in other production units of the nursery. When present, hitchhiking life stages of the mealybugs can spread from infested host plants within the nursery. *Petunia* spp. Cuttings for export are produced in a separate unit with hygienic standards (double doors, clean uniforms) with no mixing with the other ornamentals. Young first instar crawlers can walk and enter the production facility through the internal defects between greenhouse compartments.

Uncertainties:

- Specific host plants of mealybugs other than *Petunia* spp. and *Calibrachoa* spp. that are grown in the nursery.
- Presence of defects within the greenhouse compartments.

A.6.3 | Information from interceptions

There are no records of interceptions of *P. solenopsis* and *N. viridis* on *Petunia* spp. and *Calibrachoa* spp. plants for planting in the EU from any country, neither on any other commodity imported from Kenya in the EU (EUROPHYT and TRACES, online).

A.6.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The thrips-proof netting prevents the introduction of mealybugs from the surrounding environment. However, *P. solenopsis* and *N. viridis* adults may be introduced through defects in the greenhouse Uncertainties: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants.

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
		Evaluation: The measures prevent the entrance and spread in the nursery of hitchhiking crawlers of *P. solenopsis* and *N. viridis* Uncertainties: Is not known if there is an additional change and disinfection area before entering the *Petunia* spp. and *Calibrachoa* spp. production units
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: The probability that mealybugs is present on the certified starting material is very low/ negligible Uncertainties: None
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp./ *Calibrachoa* spp. Evaluation: No crop rotation with non-host plants takes place. In case of introduction into the greenhouse, populations of *P. solenopsis* and *N. viridis* may build up since the same unit is used for production of *Petunia* spp. and *Calibrachoa* spp. Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogen
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: Some of the products used may also have an effect on populations of *P. solenopsis* and *N. viridis* Uncertainties: The efficacy of the plant protection products against the specific insect pest is not known
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: Infestation could be detected during the daily scouting Uncertainties: The efficiency of detecting the early infestations of the mealybugs
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Sampling for virus testing may detect the presence of *P. solenopsis* and *N. viridis* Uncertainties: The awareness of the staff for the specific pest is unknown

(Continues)

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Inspections for other insect pests may help in the detection of populations of *P. solenopsis* and *N. viridis* Uncertainties: The awareness of the staff for the specific pest is unknown
Surveillance of production area	No	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. No details are given for the surveillance of any other possible pests/pathogens

A.6.5 | Overall likelihood of pest freedom

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

- *Petunia* spp. and *Calibrachoa* spp. are not a preferred host.
- The pests have never been intercepted on produce from Kenya.
- Dispersal capacity of the adults of these scale insects is limited.
- Low population pressure of these insects in the surrounding environment, due to the limited presence of preferred host plants.
- *P. solenopsis* has recently been recorded in Kenya.
- Greenhouse structure is insect proof and entrance is thus unlikely.
- The scouting monitoring regime is effective, insects are expected to be easily detected.
- Application of the insecticides have a good efficacy against *P. solenopsis* and *N. viridis*.
- 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

- *P. solenopsis* and *N.viridis* are present throughout Kenya and they have a wide host range, mainly solanaceous plant, including Petunia (for *P. solenopsis*) and it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *P. solenopsis* and *N. viridis* are present and abundant.
- Presence of these insects in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *P. solenopsis* and *N. viridis*.
- Hitchhiking is possible.

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

- Low possibility of introduction from the neighbouring environment
- Early stages are difficult to detect.

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

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

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

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 mealybugs 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		4		8					20
EKE	0.0836	0.197	0.381	0.744	1.24	1.89	2.59	4.22	6.36	7.79	9.68	11.9	14.7	17.1	20.0

Note: The EKE results is the *BetaGeneral* (1.0764, 6.8505, 0, 40) 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 mealybugs 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	9980					9992		9996		9998					10,000
EKE results	9980	9983	9985	9988	9990	9992	9994	9996	9997	9998.1	9998.8	9999.3	9999.6	9999.8	9999.9

Note: The EKE results are the fitted values.

(A)

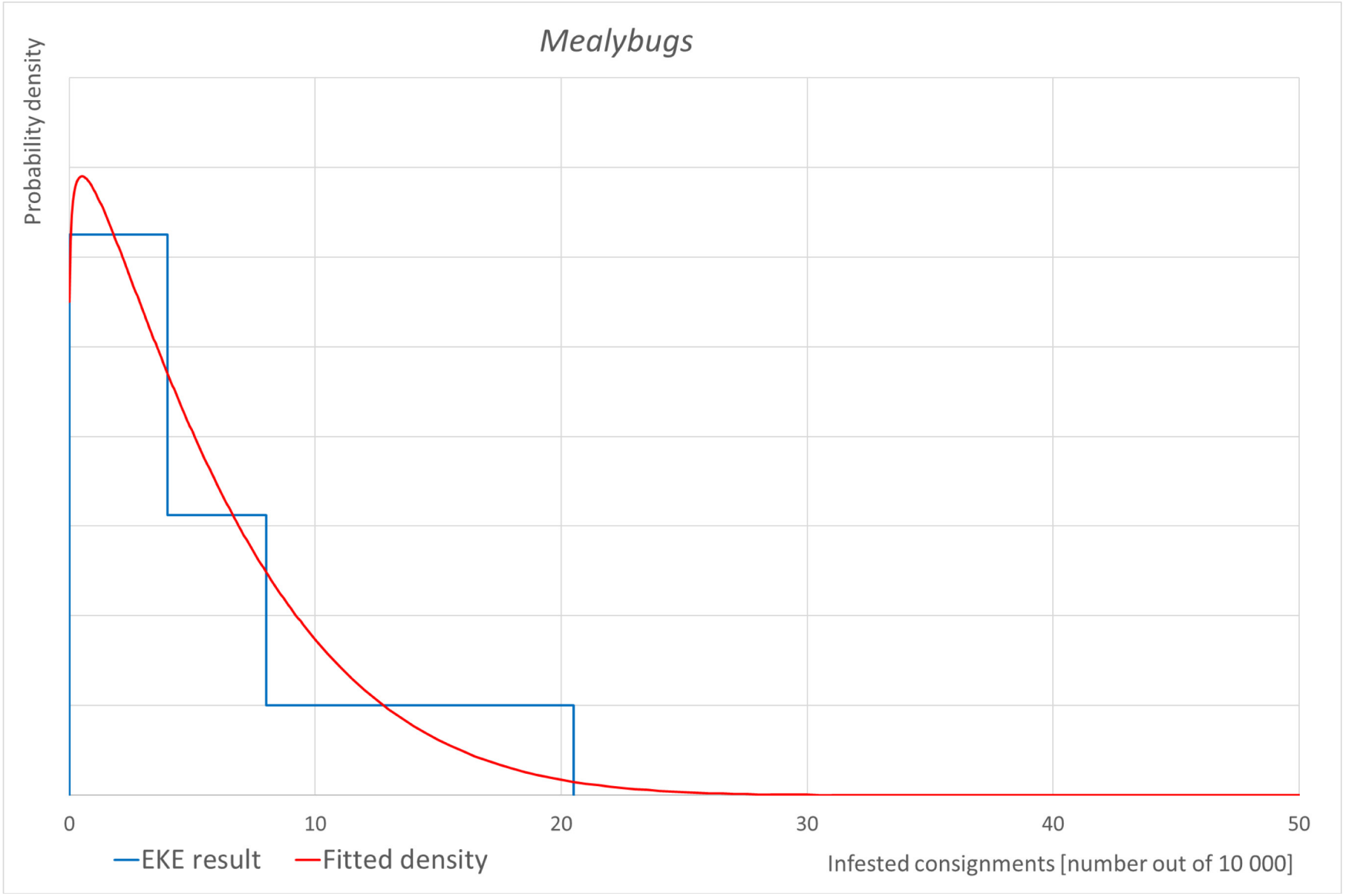

FIGURE A.6 (Continued)

(B)

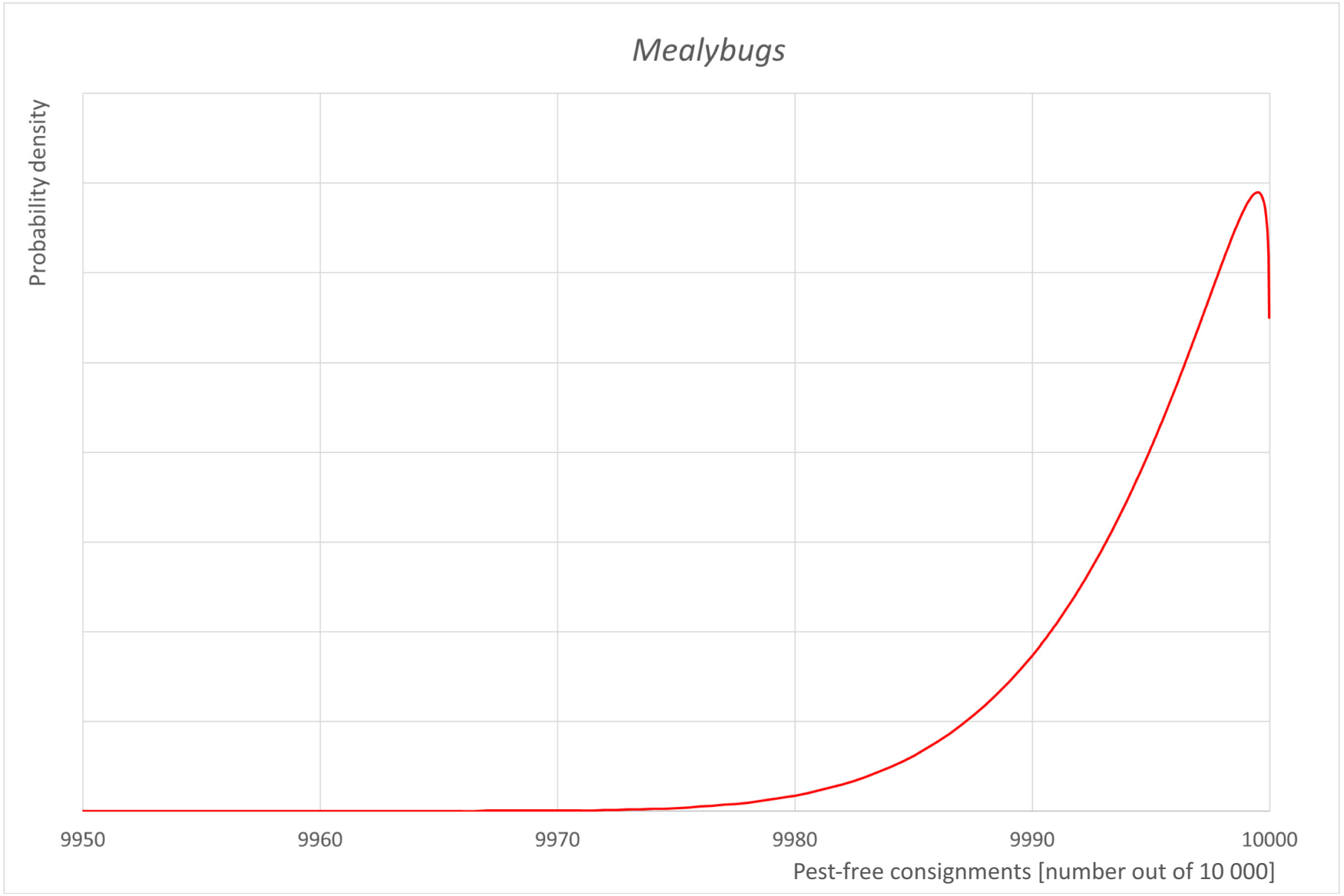

FIGURE A.6 (Continued)

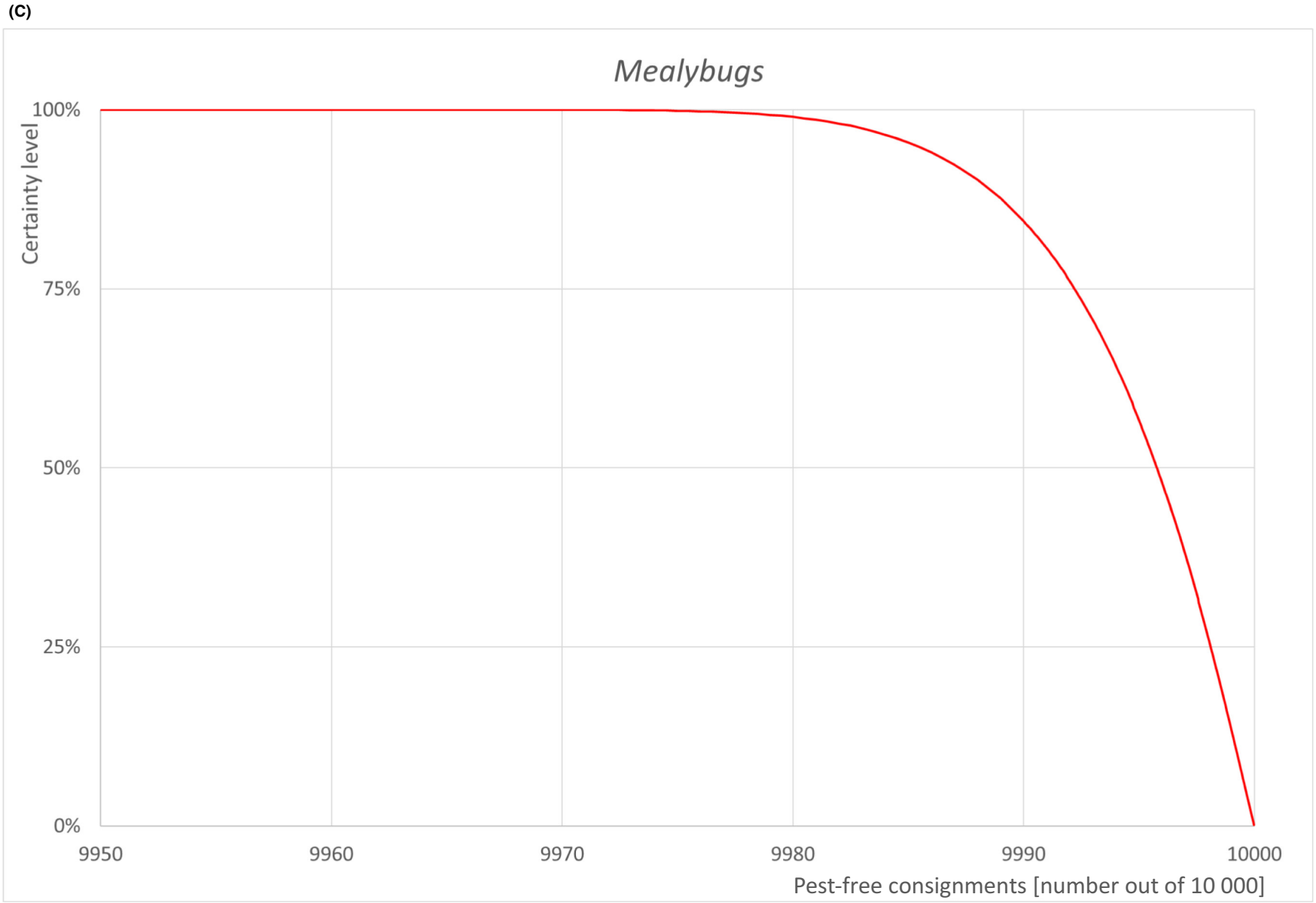

FIGURE A.6 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 105 unrooted cuttings per bag) for mealybugs (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty 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 | *Tetranychus neocaledonicus*

A.7.1 | Organism information

Taxonomic information	Group: Mites Current valid scientific name: *Tetranychus neocaledonicus* André EPPO code: TETRNC Synonyms: *Tetranychus cucurbitae, Eotetranychus neocaledonicus, Tetranychus equatorius* Common name: vegetable spider mite Name used in legislation: Order: Acarida Family: Tetranychidae Name used in the Dossier: *Tetranychus neocaledonicus*	
Regulated status	*Tetranychus neocaledonicus* is not regulated in the EU	
Pest status in Kenya	Present (Toroitchi et al., 2009)	
Pest status in the EU	Present in Canary Islands (Spain) (CABI, online)	
Host status on *Petunia* spp. *and Calibrachoa spp*	*Petunia* sp. is reported as a host plant for *T. neocaledonicus* (Bolland et al. 1998), but there are no records that *Calibrachoa* spp. are hosts of *T. neocaledonicus* Uncertainties: the host status of *Calibrachoa* spp. to *T. neocaledonicus*	
PRA information	Express Pest risk analysis for *Tetranychus neocaledonicus* (JKI, 2022) has been conducted from Julius Kühn-Institut (in German)	
Other relevant information for the assessment		
Biology	There are five stages in the life cycle of *T. neocaledonicus*: egg, larva, protonymph, deutonymph and adult (da Silva and Gondim, 2016). The fertilised female overwinters on secondary hosts and when temperature rise, they breed rapidly and move to other hosts (Australian government, 2003). The females usually lay their eggs on the underside of leaves. The eggs are deposited singly, directly on the host leaf surfaces or on the mite's web (Zhang, 2018). The eggs hatch after 5 days at 25 ± 2°C (Briozo et al., 2023). *T. neocaledonicus* immature stages at 25 ± 2°C last 11–13.5 days. Adult longevity ranges from 30 to 47 days and the fecundity from 30 to 95 eggs/female, depending on the host plant (Briozo et al., 2023). *T. neocaledonicus* can reproduce either parthenogenetically or sexually. In parthenogenetic reproduction only males are produced while in sexual reproduction the offsprings may be males and females (JKI, 2022). In the tropics there may be several overlapping generations in a single season (Zhang, 2018). High temperature and low humidity are favourable conditions for *T. neocaledonicus* (Jyothis and Ramani, 2019). According to Gutierrez & Schicha (1983) *T. neocaledonicus* is restricted to areas where the temperature rarely falls below 10°C	
Symptoms	**Main type of symptoms**	The feeding activity of the mite on plants leads to the disappearance of chloroplasts (Jyothis and Ramani, 2019). Consequently, the infested plants have small whitish spots on the leaves, which evolve quickly to chlorotic spots, followed by silvering, drying and falling. The new leaves may roll up and the oldest may become silvery and are covered by the mite web. Mites are found on both sides of the leaves (da Silva and Gondim, 2016)
	Presence of asymptomatic plants	No asymptomatic plants are known to occur. However, because all life stages of the mite are very small their detection upon visual inspection may not be easy when infestation level is low
	Confusion with other pathogens/ pests	*T. neocaledonicus* is similar with other species of the genus and it is often identified in the field as *T. urticae* (Spider mites of Australia, online). Identification requires slide mounting of the specimen and examination of the diagnostic features (Seeman and Beard, 2005; Spider mites of Australia, online)
Host plant range	*T. neocaledonicus* is a highly polyphagous species and its host list includes 528 plant species belonging to 90 families. Among them there are many vegetables, fruit crops, medicinal plants, ornamentals and plantation crops. Some important hosts are *Abelmoschus esculentus* (okra), *Arachis hypogaea* (groundnut), *Cocos nucifera* (coconut), *Cucumis sativus* (cucumber), *Cucurbita* spp., *Manihot esculenta* (cassava), *Morus* sp. (mulberry tree), *Musa* sp. (banana), *Phaseolus vulgaris* (common bean), *Solanum melongena, Prunus persica* (peach), *Carica papaya* (papaya) and *Citrus* spp. (Australian government, 2003; Jyothis & Ramani, 2019; Migeon & Dorkeld, 2022)	
Evidence that the commodity can be a pathway	Eggs, larvae, nymphs and adults can be present on the unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp.	
Evidence of impact	The larvae, nymphs and adults of the vegetable mite feed on plant sap causing serious damage to a variety of vegetable and fruit crops (Oliveira et al., 2023). Severe infestation may lead to a decrease in the rate of photosynthesis and substantial reduction in yield (Jyothis and Ramani, 2019) This mite has a quarantine status in Chile (EPPO GD (online)	
Surveillance information	No information on surveillance for this pest in Kenya	

A.7.2 | Possibility of pest presence in the nursery

A.7.2.1 | Possibility of entry from the surrounding environment

T. neocaledonicus is a highly polyphagous pest (more than 400 plant species) and it is reported to be present in Kenya. Given the wide host range of this pest it is possible that local populations of *T. neocaledonicus* may be present in the neighbouring

environment of the nursery. Tetranychid mites have various methods of dispersal to other plant hosts. They may crawl, disperse through air currents or accidently via farm machinery (Australian government, 2003). Thus, *T. neocaledonicus* can enter the nursery from host plants that might be present in the surrounding environment.

Uncertainties:

- The *T. neocaledonicus* population pressure 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.7.2.2 | Possibility of entry with new plants/seeds

The probability that *T. neocaledonicus* is present on the starting material is very low/negligible as the imported material is certified (elite) and is kept in the post-quarantine facility before released to the nursery.

A.7.2.3 | Possibility of spread within the nursery

If the pest is introduced and established on other plant species present in the nursery spread within the nursery is possible. When present, larvae, nymphs or adults of the mite searching for food sources can spread (e.g. on clothing of nursery staff) from infested host plants within the nursery to the *Petunia* spp. and *Calibrachoa* spp. production units.

Uncertainties:

- The presence and the numbers of other host plants in the export nursery.

A.7.3 | Information from interceptions

There are no interceptions of *T. neocaledonicus* in commodities imported into the EU Member States from third countries (EUROPHYT and TRACES, online).

A.7.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The insect proof netting prevents the introduction of insects and mites from the surrounding environment. However, *T. neocaledonicus* adults may be introduced through defects in the greenhouse Uncertainties: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. Evaluation: The measures may prevent the entrance and spread in the nursery of hitchhiking *T. neocaledonicus* Uncertainties: Is not known if there is an additional change and disinfection area before entering the *Petunia* spp. and *Calibrachoa* spp. production units
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum

(Continues)

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Quality of source plant material	No	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: The probability that *T. neocaledonicus* is present on the certified starting material is very low/negligible Uncertainties: None
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp. Evaluation: No crop rotation with other host plants (with lower health standards) takes place, reducing the likelihood of introduction of this pest Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogens
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: The predatory mites and insecticides used may also have a moderate effect on populations of *T. neocaledonicus* Uncertainties: The efficacy of the plant protection products against the specific insect pest is not known
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: There is no specific monitoring for *T. neocaledonicus* Uncertainties: None
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Sampling for virus testing may accidentally detect the presence of *T. neocaledonicus* Uncertainties: The awareness of the staff for the specific pest is unknown
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Inspections for other insect pests may help in the detection of populations of *T. neocaledonicus* Uncertainties: The awareness of the staff for the specific pest is unknown

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. No details are given for the surveillance of any other possible pests/pathogens Evaluation: The sticky traps used are targeting flying insects, not mites Uncertainties: None

A.7.5 | Overall likelihood of pest freedom

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

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

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

- *T. neocaledonicus* is present throughout Kenya and it has a wide host range, including Petunia and it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *T. neocaledonicus* is present and abundant.
- Presence of this mite in the environment is not monitored.
- It cannot be excluded that there are defects in the greenhouse structure.
- Insecticide treatments are not targeting *T. neocaledonicus*
- Hitchhiking is possible

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

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

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 *T. neocaledonicus* in the surrounding environment.
- High uncertainty for values below median.
- Less uncertainty for higher values.

A.7.6 | Elicitation outcomes of the assessment of the pest freedom for *Tetranychus neocaledonicus*

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 *T. neocaledonicus* 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		7		30					70
EKE	1.00	1.01	1.05	1.25	1.80	3.01	4.86	11.0	21.1	28.3	37.7	47.7	57.8	64.7	70.5

Note: The EKE results is the *BetaGeneral* (0.4444, 1.5555, 0.999, 78) 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 *T. neocaledonicus* 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	9930					9970		9993		9995					9999
EKE results	9929	9935	9942	9952	9962	9972	9979	9989	9995	9997	9998.2	9998.7	9998.9	9998.99	9999.00

Note: The EKE results are the fitted values.

(A)

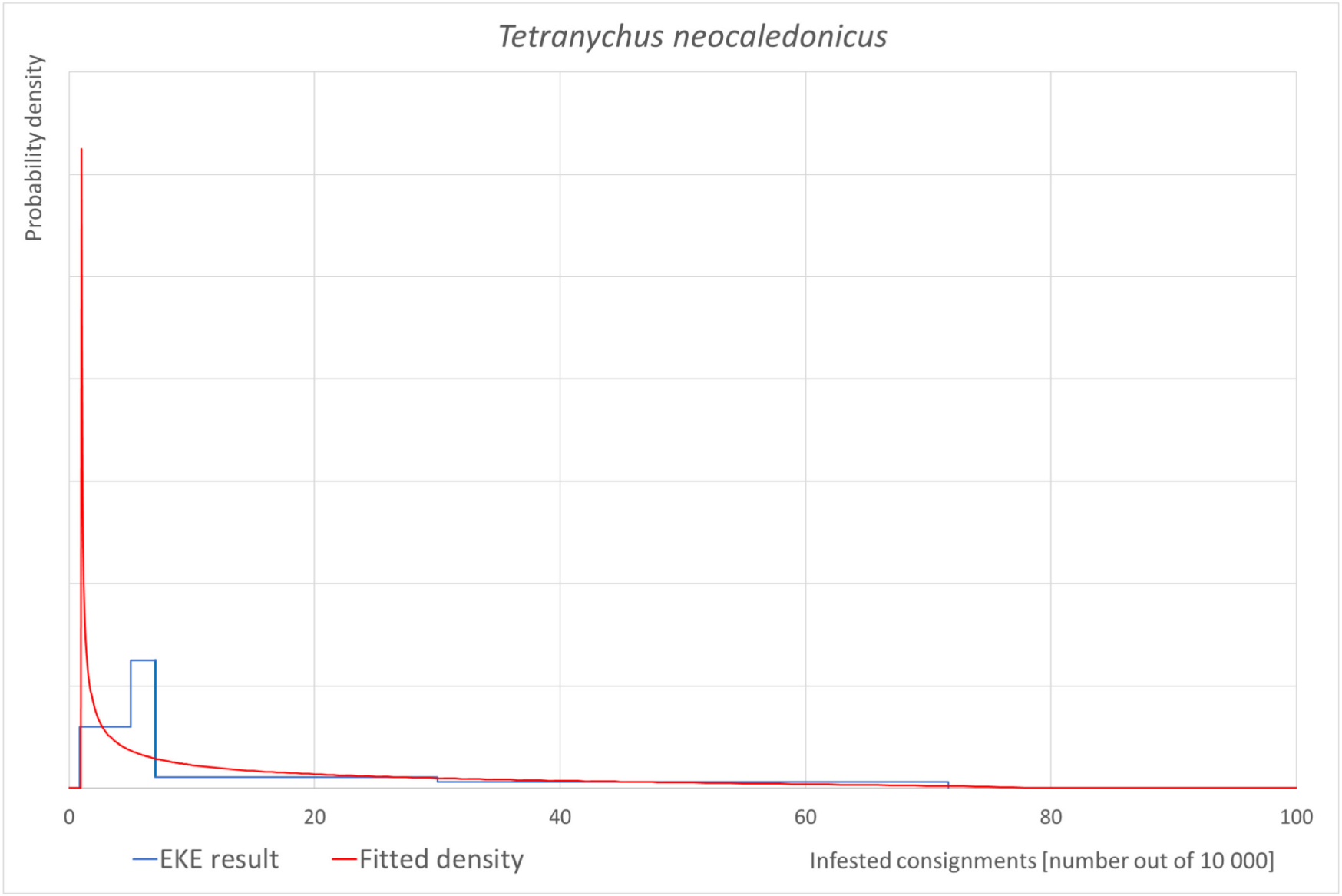

FIGURE A.7 (Continued)

(B)

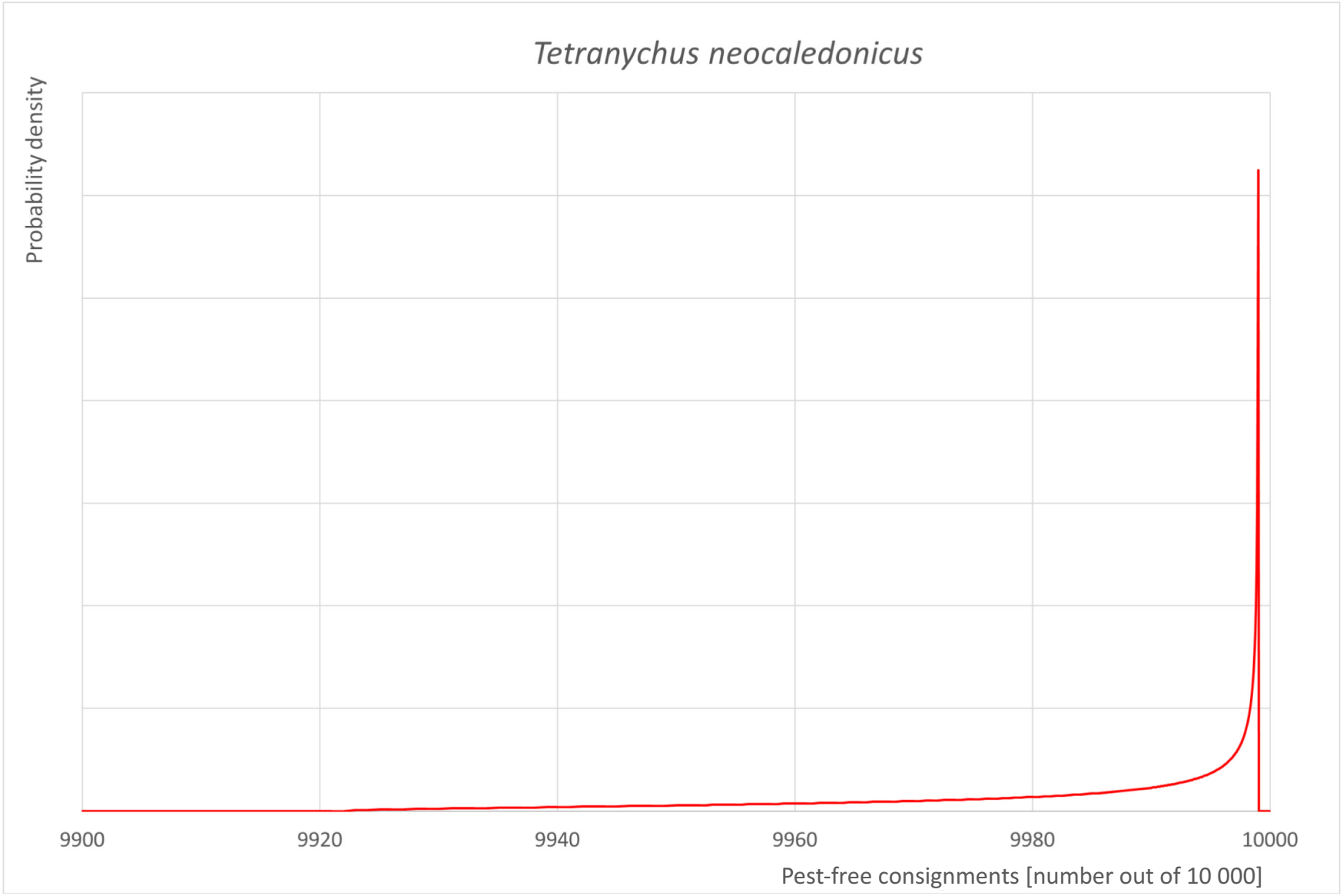

FIGURE A.7 (Continued)

(C)

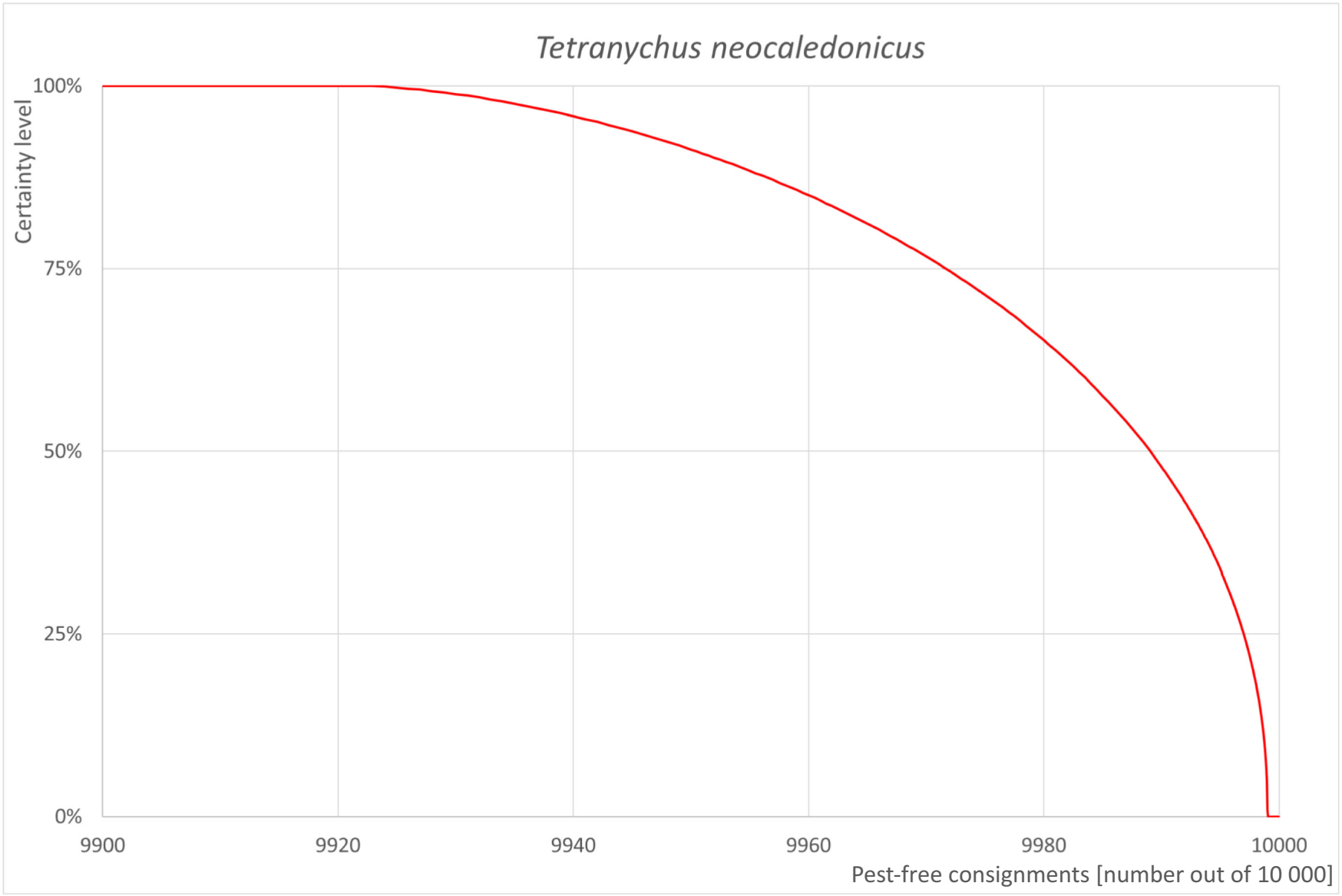

FIGURE A.7 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 105 unrooted cuttings per bag) for *T. neocaledonicus* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 bags.

A.7.7 | Reference list

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A.8 | (Ortho)Tospoviruses

A.8.1 | Organism information

Taxonomic information of the organisms in the cluster	Group: Viruses and viroids 1. **Tomato spotted wilt virus** (TSWV) Species: *Orthotospovirus tomatomaculae* (*proposed binomial nomenclature by ICTV*) EPPO code: TSWV00 Synonyms: *Tomato spotted wilt orthotospovirus*; *Tomato spotted wilt tospovirus* Common name: bronze leaf of tomato; kromnek virus; spotted wilt of tomato; yellow spot of pineapple; tomato bronze leaf virus (CABI, EPPO, online) Name used in the EU legislation: Tomato spotted wilt tospovirus Order: *Bunyavirales* Family: *Tospoviridae* Genus: *Orthotospovirus* Name used in the Dossier: Tomato spotted wilt orthotospovirus 2. **Tomato yellow ring virus** (TYRSV) Species: *Orthotospovirus tomatanuli* (proposed binomial nomenclature by ICTV) EPPO code: TYRSV0 Synonyms: *Tomato yellow ring orthotospovirus;* tomato yellow fruit ring virus; tomato fruit yellow ring virus; tomato Varamin virus Common name: – Name used in the EU legislation: – Order: *Bunyavirales* Family: *Tospoviridae* Genus: *Orthotospovirus* Name used in the Dossier: – **Reasons for clustering:** The above-listed viruses belong in the same genus (*Orthotospovirus*), and they share the same biology and epidemiology characteristics that affect the risk they pose for EU
Regulated status	Tomato spotted wilt virus (TSWV) is regulated as non-quarantine pests (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 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 Tomato yellow ring virus (TYRSV) is not regulated in the EU. However, it is only present in one province of Poland where it is 'localised, only undercover/indoors'
Host status on *Petunia* sp./*Calibrachoa* sp.	TSWV (EPPO Bulletin, 2020) and TYRV (CABI pest datasheet) both infect petunia, tomato, pepper and potato in nature There are no records that *Calibrachoa* sp. is a host of TSWV or TYRV Uncertainties: The host status of *Calibrachoa* sp. to TSWV and TYRV The ability of TSWV to systemically infect *Petunia* sp. and *Calibrachoa* sp.

(Continued)

Pest status in Kenya	TSWV and TYRV are both present in Kenya (Birithia et al., 2012; 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 (Health (PLH), 2012). – Express Pest Risk Analysis for Tomato yellow ring virus [Poland, 2016-06-30]. https://pra.eppo.int/pra/87b74743-231e-4dc7-82c7-275718954975
Other relevant information for the assessment	
Biology	**Transmission** Tospoviruses are transmitted by thrips species (Thysanoptera: Thripidae) in a circulative, propagative manner by which the virus persists through the various developmental stages of the insect. *Frankliniella occidentalis* is the most efficient vector of tospoviruses for their spread in ornamental and vegetable crops. Both TSWV and TYRV can be also very efficiently transmitted by *Thrips tabaci* populations (Chatzivassiliou, et al., 2002; Mortazavi, et al., 2013, 2015) Transmission parameters have been studied in detail for TSWV in the vector *F. occidentalis* and generally apply to all tospoviruses. Only thrips that acquire the virus as larvae (L1 and L2) are able to transmit tospoviruses. The first instar larvae (L1) is the most efficient at acquiring the virus which can be then transmitted by second instar larvae (L2) and adults after a latent period that is negatively correlated with temperature. The minimum acquisition access period and inoculation access period range from 5 min to 1 day with increasing frequency of transmission when the feeding period is extended. Following acquisition, tospoviruses are retained for the entire lifespan of the thrips, but they are not transovarially passed onto the insect progeny. Tospoviruses are better spread by flying adult thrips than crawling larvae (Wijkamp & Peters, 1993; Wijkamp et al., 1993, 1995, 1996; Ullman et al., 1993) There are reports of TYRV occurring often in mixed infections with TSWV in tomato plants (Zarzyńska-Nowak et al., 2022) or with TSWV, and other tospoviruses in ornamentals (Ghotbi et al., 2005) As all plant viruses that systemically infect their host, tospoviruses can be also transmitted via the vegetative propagation material and generally are considered not to be seed-transmitted (EFSA, 2012) **Uncertainty on biology** The vector ability of additional thrips species and biotypes for tospoviruses **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 1,300 species dicotyledonous and monocotyledonous angiosperms belonging to at least 85 families but mainly infecting species in the Asteraceae and Solanaceae families (Parella 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 (Parella et al., 2013). TSWV also infects many weed species which may contribute significantly to its epidemiology as virus reservoirs (Chatzivassiliou et al., 2001) **TYRV** has also a large host range including crops and ornamental plants produced/grown outdoors and in protected environments. It infects tomato, tomato, pepper, potato, eggplant, cucumber, peanut, French beans and ornamental plants such as chrysanthemum, gazania, cineraria and anemone (Beikzadeh et al., 2012; CABI, online; Ghotbi et al., 2005; Pourrahim et al., 2007).TYRV is also reported to infect some weeds species as well (Ghotbi et al., 2005) **Uncertainty on host range** The host range of most tospoviruses is continuously growing; therefore, it remains unknown The host status of *Calibrachoa* sp. to TSWV and TYRV **Ecology and biology of the vectors** *F. occidentalis* is present in Kenya (EPPO GD) where it is widespread in field-grown crops and weeds (CABI, online; Macharia et al., 2015). *F. occidentalis* is a highly polyphagous invasive species and a highly efficient vector of TSWV and TYRV, 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 Kenya (CABI, online) and widespread in tomato crops (Macharia et al., 2015). 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 both TSWV and TYRV (Chatzivassiliou, et al., 2002; Mortazavi, et al., 2015). *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/Calibrachoa*** Torpoviruses-infected petunia plants in general and for TSWV (Daughtrey et al., 1997; DPVnet) and TYRV (Ghotbi et al., 2005) 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 tospovirus infection (Daughtrey et al., 1997) **Uncertainties on symptoms on *Petunia/Calibrachoa*** The host status of *Calibrachoa* sp. to TSWV and TYRV The ability of TSWV and TYRV to systemically infect some *Petunia* sp. and *Calibrachoa* sp. varieties
Evidence that the commodity can be a pathway	Unrooted cuttings of *Petunia* spp. and *Calibrachoa* spp. can be infected by tospoviruses and/or infested by viruliferous thrips
Surveillance information	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. There are no targeted surveys for tospoviruses in Kenya

A.8.2 | Possibility of pest presence in the nursery

A.8.2.1 | Possibility of entry from the surrounding environment

TSWV and TYRV are present in Kenya (EPPO GD, CABI, online). They are transmitted by thrips (*T. tabaci* and *F. occidentalis*), which are also present in Kenya (EPPO GD, online) and widespread in field-grown crops such as tomato and weeds (Macharia et al., 2015). TSWV and TYRV have a large host range, including many vegetables, ornamentals and also weeds (especially TSWV) (EPPO GD, online). Therefore, hosts and vectors are expected to be present and possibly widespread in Kenya. The main pathway of entrance of tospoviruses 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 (virus) and infestation (thrips vectors) pressure in the surroundings.

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

Plant material (cuttings) for *Petunia* sp. and *Calibrachoa* sp. mother plants used for the production of unrooted cuttings originate from the Germany, Portugal, Spain and Israel. Tospoviruses are widespread in the EU (TSWV) or localised (TYRV only in Poland) and in Israel (TSWV; EPPO GD). From all countries 'Elite planting material' according to the Naktuinbouw certification programme is imported. The certification scheme in place for *Petunia* spp. and *Calibrachoa* spp. includes TSWV, but not TYRV. Although the details for the certification systems in the non-EU countries are not known, a percentage (10%) of incoming mother plants in the nursery are tested for TSWV at the start of the production for TSWV, but not for TYRV (Dossier section 2.0).

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 TYRV and TSWV and the phytosanitary status of other plant species (solanaceous, non-solanaceous) than *Petunia* spp. and *Calibrachoa* spp. entering the same nursery.

A.8.2.3 | 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 point 1.8). However, other plants (solanaceous and non-solanaceous) possible hosts of tospoviruses are cultivated and thrips could be present in other greenhouses/compartments of the nursery. *Frankliniella occidentalis* is the most efficient vector of tospoviruses occurring in greenhouses and a major pest of ornamentals, feeding in almost any flower plant (Daughtrey et al., 1997; CABI). Viruliferous thrips could spread TYRV and TSWV between the different or within the same greenhouse/compartment. TYRV and TSWV may also spread by vegetative propagation of infected mother plants. There are strict hygiene conditions inside the nursery. However, thrips due to their minute size are more difficult to observe and easier to escape these conditions than other insects.

Uncertainties:

- The presence and density of the TSWV and TYRV and thrips vectors in the nursery.
- The presence and the host status for TSWV and TYRV of other plant species (solanaceous, non-solanaceous) growing in the same nursery.
- The level of physical separation (with thrips-proof netting) of the *Petunia* spp. and *Calibrachoa* spp. production units with other production units.

A.8.3 | Information from interceptions

There were no interceptions of tomato yellow ring virus (TYRSV0) and tomato spotted wilt virus (TSWV00) on different commodities imported into the EU from Kenya (TRACES, online). Tospovirus vectors, *F. occidentalis* and *T. tabaci,* are not regulated; therefore, it is not expected to have any interception records.

A.8.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The thrips-proof netting prevents the introduction of thrips from the surrounding environment. However, thrips adults may be introduced through defects in the greenhouse netting or as hitchhikers on workers Uncertainties: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. Evaluation: The double door system with the expeller fan at the door can be effective in preventing the entry of thrips vectors via active flying and spread of TSWV and TYRV. Changing clothes prevents also the entrance of thrips vectors via hitchhiking. The fact that TSWV are not detected during monitoring of the crop indicate that the above-mentioned measures are efficiently applied Uncertainties: The strictness of the measures applied
Treatment of growing media	Yes	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum Evaluation: The use of new/sterilised growing media may kill thrips pupating in debris in the soil Uncertainties: None
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: Plants are tested for TSWV, but not for TYRV Uncertainties: The efficiency of the applied sampling and detection methods to detect local lesions caused by tospoviruses on *Petunia* spp./*Calibrachoa* spp.
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp. Evaluation: In case of introduction into the greenhouse, populations of thrips may build up since the same unit is used for production of *Petunia* spp./*Calibrachoa* spp. Uncertainties: None

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogens
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: The products used may have an effect against thrips vectors of tospoviruses. However, some transmission may occur before/during the lethal thrips feedings. *Frankliniella occidentalis* is known for having developed resistance to some insecticides. According to the Section 2.0 incidences of about 1–2 thrips are occasionally observed on the sticky traps suggesting that the measures are efficient Uncertainties: The efficacy and timing of the plant protection products used against thrips
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: Yellow and blue sticky traps are effective to detect the presence of flying *Frankliniella occidentalis* and *Thrips tabaci* adults. Sticky traps cannot detect the larvae of thrips, therefore they cannot detect early infestations. Local lesions caused by orthotospoviruses on petunia are difficult to detect, especially in plants with dense canopy Uncertainties: • The efficiency of yellow sticky traps to detect early thrips infestations. • The efficiency of monitoring and inspection. • The length of the latent period till the expression of tospovirus symptoms.
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories. No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Plants are tested for TSWV but not for TYRV. However, no specific data are available (sampling scheme) for the evaluation of the efficacy of the sampling and testing. Plants are reported to be tested with a generic molecular test for tospoviruses if thrips are found; therefore, TYRV possible infections are expected to be detected. The fact that no sample was tested positive shows that the measures in place are efficient Uncertainties: • The efficiency of the sampling method and testing intensity to detect local lesions caused by tospoviruses on *Petunia* spp. and *Calibrachoa* spp. especially in low infection levels
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Official measures are targeting thrips and tospoviruses and may efficiently prevent their presence on unrooted cuttings designated for export to the EU Uncertainties: The efficiency of detecting early thrips infestations and tospovirus local lesions, especially in low infection levels

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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 thrips; however, no specific data are available for the evaluation of the efficacy of the surveillance of potential hosts. In addition, it is not known if the area is surveyed for the presence of tospoviruses Uncertainties: The intensity and the design of surveillance scheme for thrips and tospoviruses (if any)

A.8.5 | Overall likelihood of pest freedom

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

- TSWV and TYRV have not been reported to infect *Calibrachoa* spp.
- TSWV and TYRV have has not been reported on *Petunia* spp. and *Calibrachoa* spp. in Kenya.
- TSWV and TYRV have have never been intercepted on produce from Kenya
- Low infection pressure (prevalence of host plants) of TSWV and TYRV in the surrounding environment.
- No infection pressure (prevalence of host plants) of TSWV and TYRV 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- and TYRV-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 and TYRV 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.8.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested consignments

- Even if there is no evidence that *Calibrachoa* spp. is a host plant for TSWV and TYRV, given their polyphagous nature especially among ornamentals it is likely that *Calibrachoa* spp. is also a suitable host plant
- Solanaceous species are very sensitive to TSWV and TYRV infections
- *Petunia* spp. and *Calibrachoa* spp. are preferable hosts for thrips vectors of tospoviruses
- Presence of TSWV and TYRV in the environment is not monitored.
- Considering the wide host range of TSWV and TYRV it is likely that host plants are present in the surrounding environment.
- High thrips population pressure (e.g. abandoned infected field) in highly preferable tospovirus 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 and TYRV via vegetative propagated material increases the probability of their 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 tospoviruses.
- Other thrips species vectoring tospoviruses are also present and widely distributed in Kenya.
- 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 and TYRV are not easy to distinguish from thrips feeding symptoms

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

The value of the median is estimated based on:

- TSWV and TYRV infect many solanaceous species, especially ornamentals, therefore, *Calibrachoa* spp. is expected to be also a host for both of the viruses.
- *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 tospoviruses.

- 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 plants when infected by TSWV and TYRV exhibit local lesions on the leaves difficult to visually detect especially in high canopy densities.

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

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

A.8.6 | Elicitation outcomes of the assessment of the pest freedom for (ortho)tospoviruses

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

TABLE A.15 Elicited and fitted values of the uncertainty distribution of pest infection by (ortho)tospoviruses per 10,000 bags of unrooted cuttings.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Elicited values	0					3		6		18					50
EKE	0.0169	0.0675	0.193	0.556	1.23	2.31	3.68	7.39	12.9	16.8	22.1	28.4	36.0	42.7	50.0

Note: The EKE results is the *BetaGeneral* (0.66105, 3.9915, 0, 80) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infected 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 (ortho)tospoviruses 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	9950					9982		9994		9997					10,000
EKE results	9950	9957	9964	9972	9978	9983	9987	9993	9996	9997.7	9998.8	9999.4	9999.8	9999.9	10,000.0

Note: The EKE results are the fitted values.

(A)

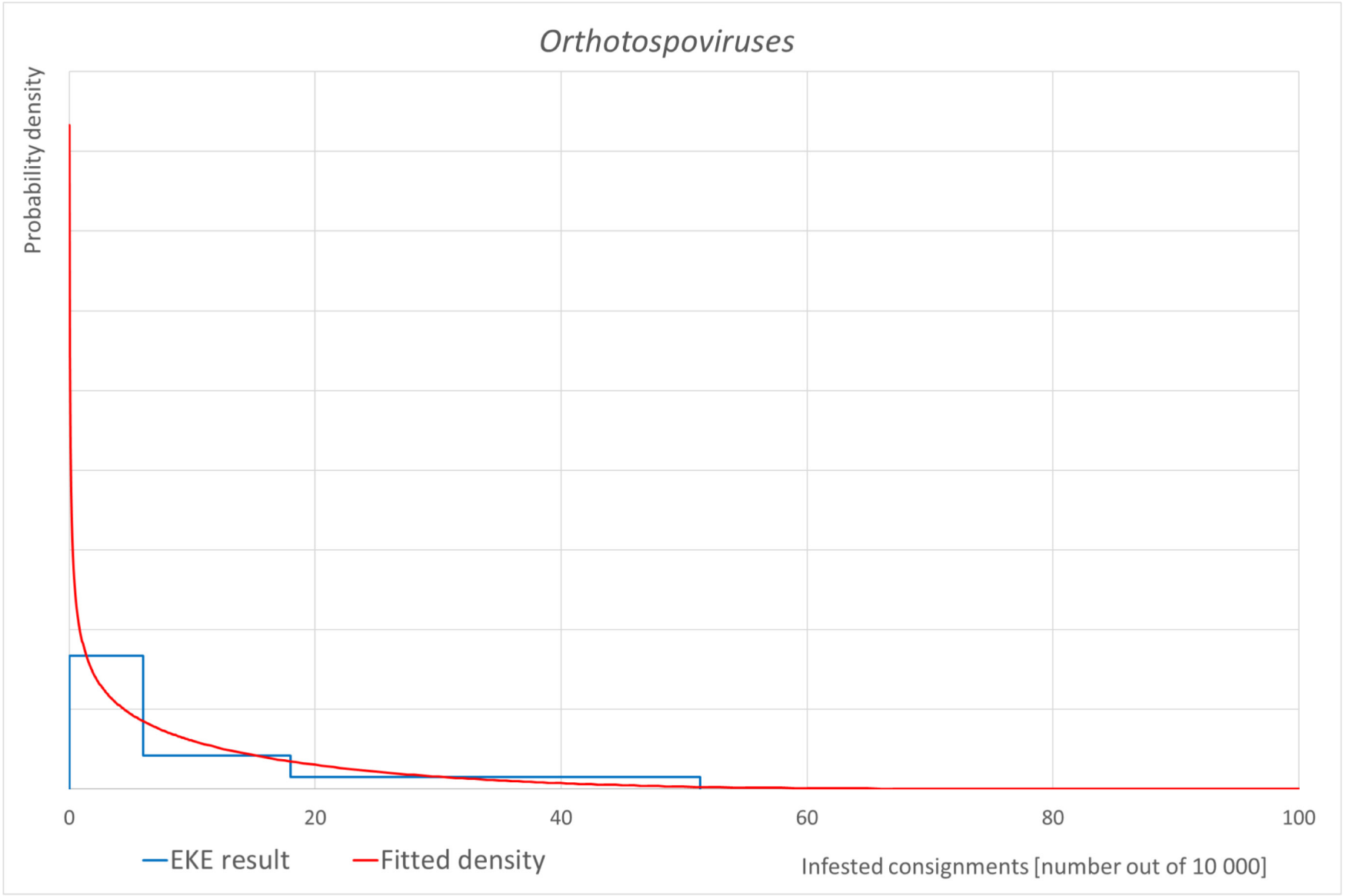

FIGURE A.8 (Continued)

(B)

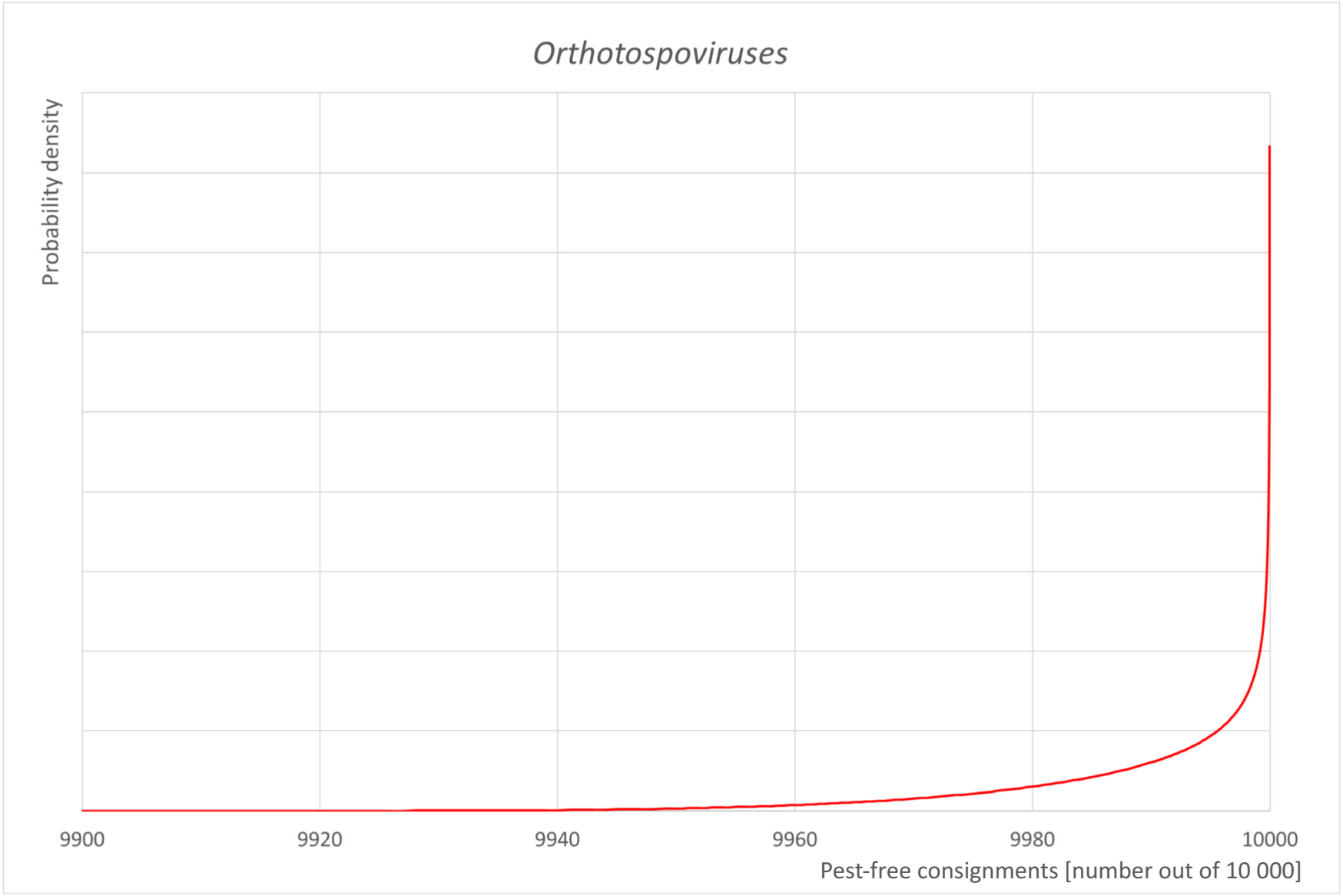

FIGURE A.8 (Continued)

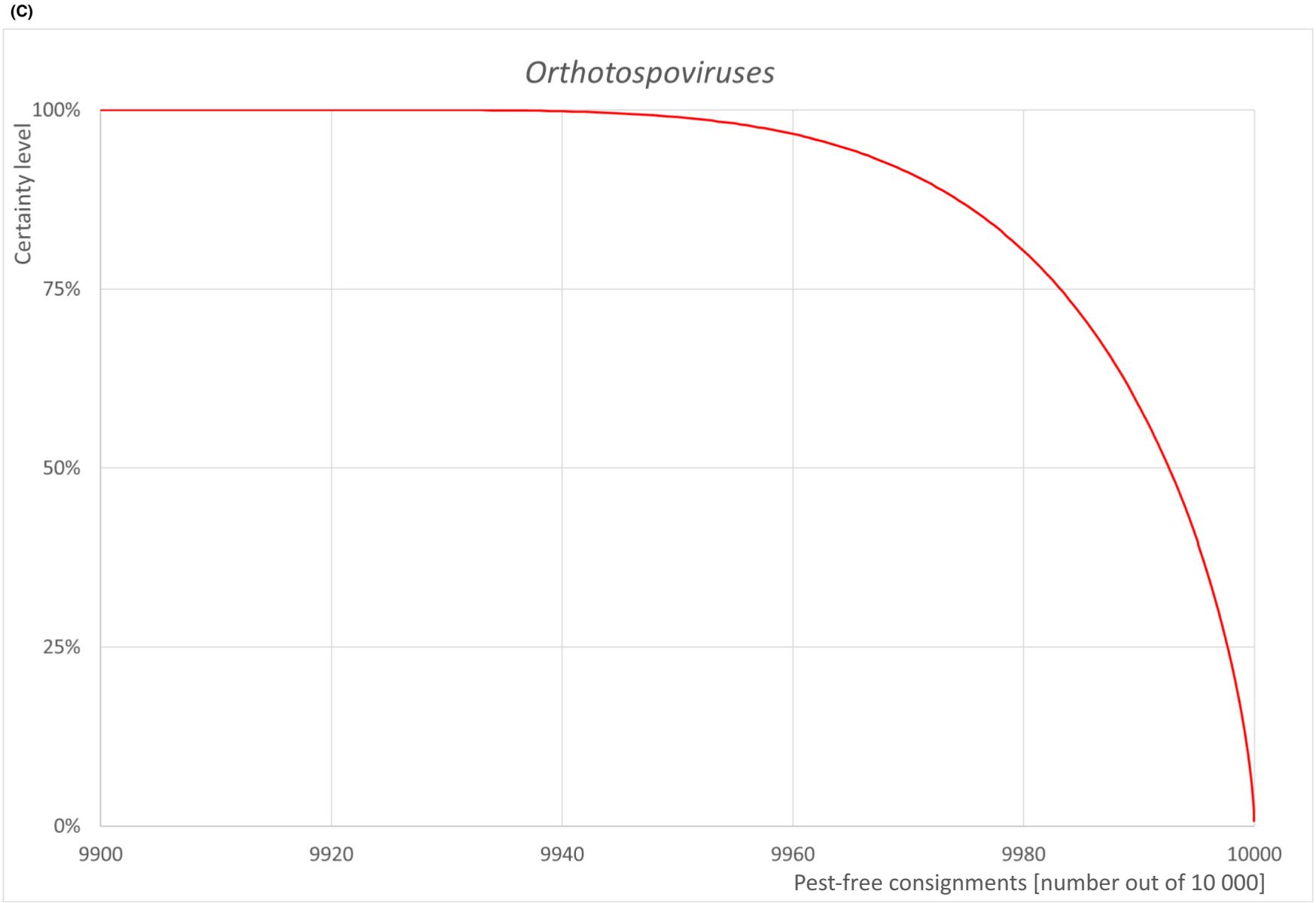

FIGURE A.8 (A) Elicited uncertainty of pest infection per 10,000 bags (containing 105 unrooted cuttings per bag) for (ortho)tospoviruses (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection per 10,000 bags.

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A.9 | Potato spindle tuber viroid

A.9.1 | Organism information

Taxonomic information	Group: Virus and viroids **Potato spindle tuber viroid (PSTVd)** Species: *Potato spindle tuber viroid* EPPO code: PSTVD0 Synonyms: potato gothic virus; potato spindle tuber pospiviroid; potato spindle tuber virus; PSTVd; tomato bunchy top viroid (CABI, EPPO, online) Common name: bunchy top of tomato (CABI, EPPO, online) Name used in the EU legislation: Potato spindle tuber viroid [PSTVD0] Family: *Pospiviroidae* *Genus: Pospiviroid* Name used in the Dossier: Potato spindle tuber viroid

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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 Kenya		Present (EPPO, CABI, online)
Pest status in the EU		Present (CABI, EPPO, online)
Host status on *Petunia* sp.		*Petunia* spp. plants are hosts of PSTVd (CABI, EPPO, online)
Host status on *Calibrachoa* sp.		*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)
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, 1924) 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 mechanically transmitted to many plant species essentially by contact and cutting tools, especially at temperatures above 25°C (Verhoeven et al., 2010). 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., 2017, 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). In general, insect transmission is incidental and non-specific, as it happens through contaminated mouth parts and feet of insects visiting the plants (Hoshino et al., 2006; Van Bogaert et al., 2016; Verhoeven et al., 2010)
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 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 PSTVd infection of solanaceous ornamental plants is usually symptomless (Verhoeven et al., 2008). On most commercial cultivars of *P. hybrida* infections are asymptomatic; only the very sensitive cv 'Mitchell' is reported to exhibit a severe stunting, 1–2 months after inoculation (Matsushita and Tsuda, 2015) and the cv. 'Burpee Blue' to develop vein necrosis and a crinkled appearance only when infected with a severe but not with a mild strain of PSTVd (Singh et al., 1973)
	Presence of asymptomatic plants	PSTVd infection of solanaceous ornamental plants is usually symptomless (Verhoeven et al., 2008) and the same applies for most of the commercial cultivars of *P. hybrida* infected with most of PSTVd strains (Matsushita and Tsuda, 2015)
	Confusion with other pathogens/pests	Symptoms induced by PSTVd (if any) on potato and tomato can be confused with those induced by other pospiviroids (Verhoeven et al., 2004)
Host plant range		PSTVd has a broad host range (EPPO) including numerous solanaceous (tomato, pepper, potato, tobacco) and herbaceous species, among which several ornamentals (petunia and calibrachoa are reported as natural hosts) The host range of PSTVd includes the following plant 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* sp.,** *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 tricolour* (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* sp.,** *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)

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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 for the entry of the viroid in the EU territory
Surveillance information	There are no targeted surveys for PSTVd in Kenya

A.9.2 | Possibility of pest presence in the nursery

A.9.2.1 | Possibility of entry from the surrounding environment

PSTVd is present in Kenya (CABI, online). Its natural host range includes a lot of hosts and many weeds that can act as reservoirs of PSTVd (CABI, EPPO, online) and may be present in the surrounding environment of the nursery. PSTVd is mechanically (by contact) transmitted (Verhoeven et al., 2010); therefore, it can enter the nursery by crop handling by staff, insects 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 of defects in the greenhouse structure.
- Presence and distribution of host plants in the surroundings.
- Infection (viroid) and infestation (contaminated insects) pressure in the surroundings.
- Strictness of application of hygiene measures.

A.9.2.2 | 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 the Germany, Portugal, Spain and Israel. PSTVd is present in Germany and Spain in the EU and in Israel (EPPO GD). From all countries 'Elite planting material' according to the Naktuinbouw certification programme is imported. 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:

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

A.9.2.3 | Possibility of spread within the nursery

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.) or by contaminated insects. Strict hygiene measures are in place to prevent spread of PSTVd by mechanical transmission.

Uncertainties:

- The presence and density of the PSTVd and contaminated insects 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.9.3 | Information from interceptions

There was one interception of PSTVd on Solanum laxum plants intended for planting imported into the EU from Kenya. Furthermore, there were six interceptions of PSTVd on Calibrachoa spp. and 10 interceptions on Petunia spp. cuttings intended for planting from Israel (EUROPHYT and TRACES, online).

A.9.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: Insects may facilitate the mechanical transmission of PSTVd. 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	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. 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 applied
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: Because mother plants are tested for PSTVd as part of the certification scheme, it is assumed that the starting material is pest free. PSTVd monitoring (inspections, testing) is also included in the certification schemes. However, no specific data are available (sampling scheme) for the evaluation of the efficacy of the sampling and testing. The fact that no sample was tested positive shows that the measures in place are efficient Uncertainties: • The presence of symptoms caused by PSTVd on *Petunia* spp. and *Calibrachoa* spp. • The efficiency of the applied sampling and detection methods to detect asymptomatic infections caused by PSTVd on *Petunia* spp. and *Calibrachoa* spp.
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp. 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. and *Calibrachoa* spp. Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogens

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: Insect may facilitate the mechanical transmission of PSTVd; therefore, it can be expected that the application of products against a range of insects may limit its spread Uncertainties: The efficiency of the applied insecticides against insects and their possible effect in viroid spread
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment 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 presence of symptoms on PSTVd-infected *Petunia* spp. and *Calibrachoa* spp. • The length of the latent period necessary to the expression of symptoms (if any).
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, **PSTVd**, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Imported mother plants and propagated plants are tested for PSTVd. No samples of *Petunia* spp. and *Calibrachoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned in the dossier Uncertainties: The efficiency of sampling scheme to detect low prevalence and/or asymptomatic PSTVd infections
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Most PSTVd infections are asymptomatic on ornamentals. The NPPO is testing for PSTVd before release of the imported certified material to the production units and during the production phase (every 3 weeks) Uncertainties: The efficiency of sampling scheme to detect low prevalence and/or asymptomatic PSTVd infections
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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.9.5 | Overall likelihood of pest freedom

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

- PSTVd has not been reported on *Petunia* spp. and *Calibrachoa* spp. in Kenya
- PSTVd has never been intercepted on produce from Kenya
- Low infection pressure (prevalence of host plants) of PSTVd in the surrounding environment
- No infection pressure (prevalence of host plants) of PSTVd species in other greenhouses/compartments of the nursery

- Transfer of contaminated insects from viroid 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 insects.
- Pest-free area of production.
- Physical separation of different lots offers in case of infection the restriction of the affected plants.
- Hygiene measures are in place, efficiently to prevent entry and spread of PSTVd and they are strictly and efficiently applied.
- The cultivated varieties of *Petunia* spp. and *Calibrachoa* spp. show distinctive symptoms when infected with PSTVd
- The scouting monitoring regime is effective and PSTVd-infected plants in the nurseries are expected to be easily detected.
- Application of the insecticides have a good efficacy against insect that facilitate PSTVd spread.
- At harvest and packing, cuttings with symptoms are easy to be detected.
- The inspection regime is effective for detection of infections

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

- *Petunia* spp. and *Calibrachoa* spp. are highly sensitive to PSTVd infections and infections are reported in Kenya.
- PSTVd infections of *Petunia* spp. and *Calibrachoa* spp. are asymptomatic.
- High infection pressure (e.g. abandoned infected field of an infected host close to the greenhouse).
- Presence of PSTVd in the environment is not monitored.
- Transmission of PSTVd via vegetative propagated material increases the probability of its entry and establishment in the nursery on other host plant species.
- It cannot be excluded that there are defects in the greenhouse structure or contaminated insects may hitchhike on greenhouse staff or materials.
- Insects that may facilitate the spread of PSTVd may have developed insecticide resistance to the applied insecticides.
- Early (asymptomatic) infections cannot be visually detected.
- Hygiene measures in place are not strictly and efficiently applied to prevent entry and spread of PSTVd.
- At harvest and packing, cuttings without symptoms cannot be detected.
- The inspection regime is not effective for detection of asymptomatic infections

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

- Infection of most of *Petunia* spp. and *Calibrachoa* spp. are asymptomatic for most PSTVd strains.
- The hygiene measures in place prevent the entry and spread of PSTVd.

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 strictness of the hygiene measures applied.

A.9.6 | 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 infection (Table A.17) and pest freedom (Table A.18).

TABLE A.17 Elicited and fitted values of the uncertainty distribution of pest infection 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 infected bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infected 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.177

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	10,000.00

Note: The EKE results are the fitted values.

(A)

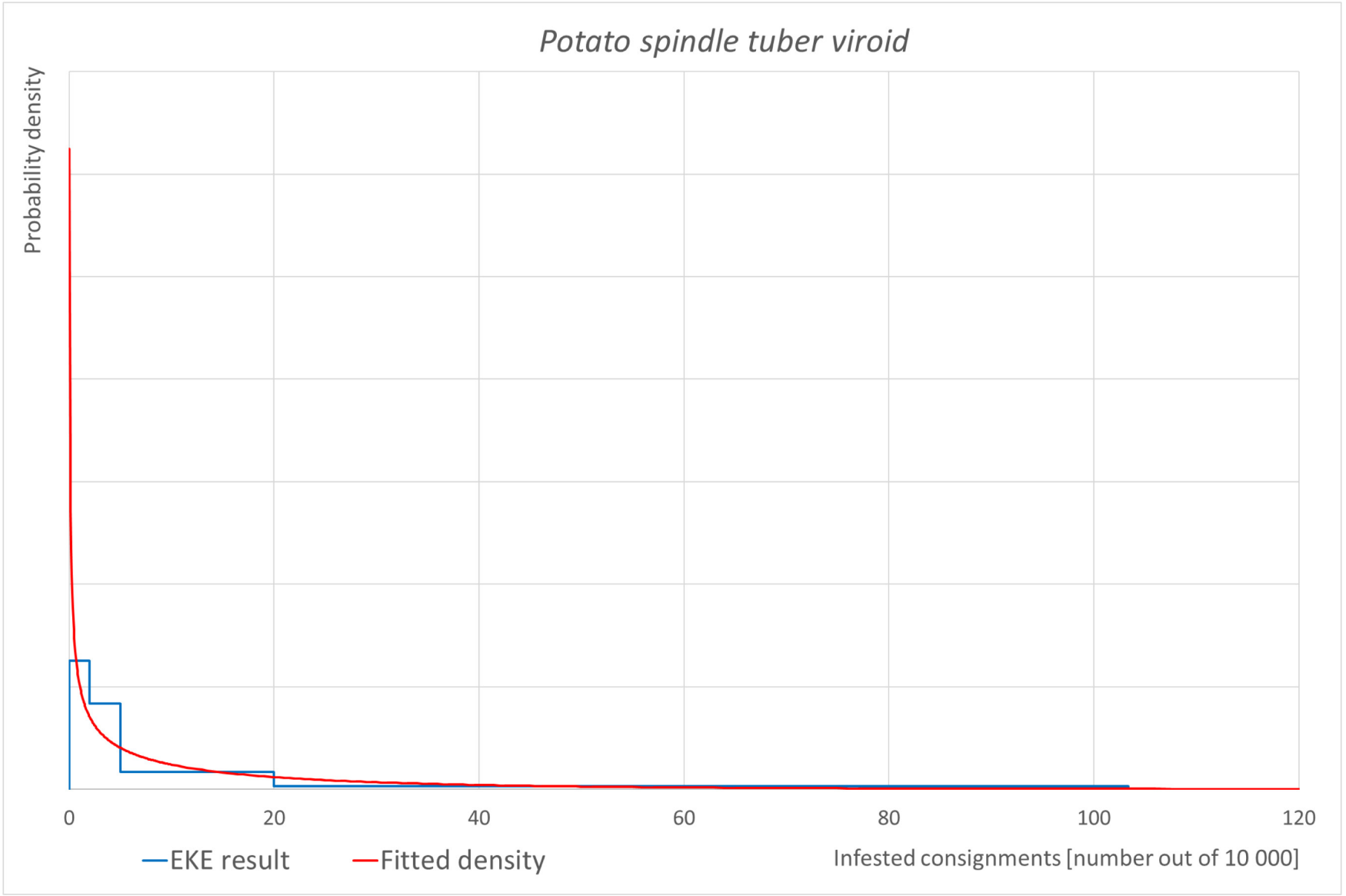

FIGURE A.9 (Continued)

(B)

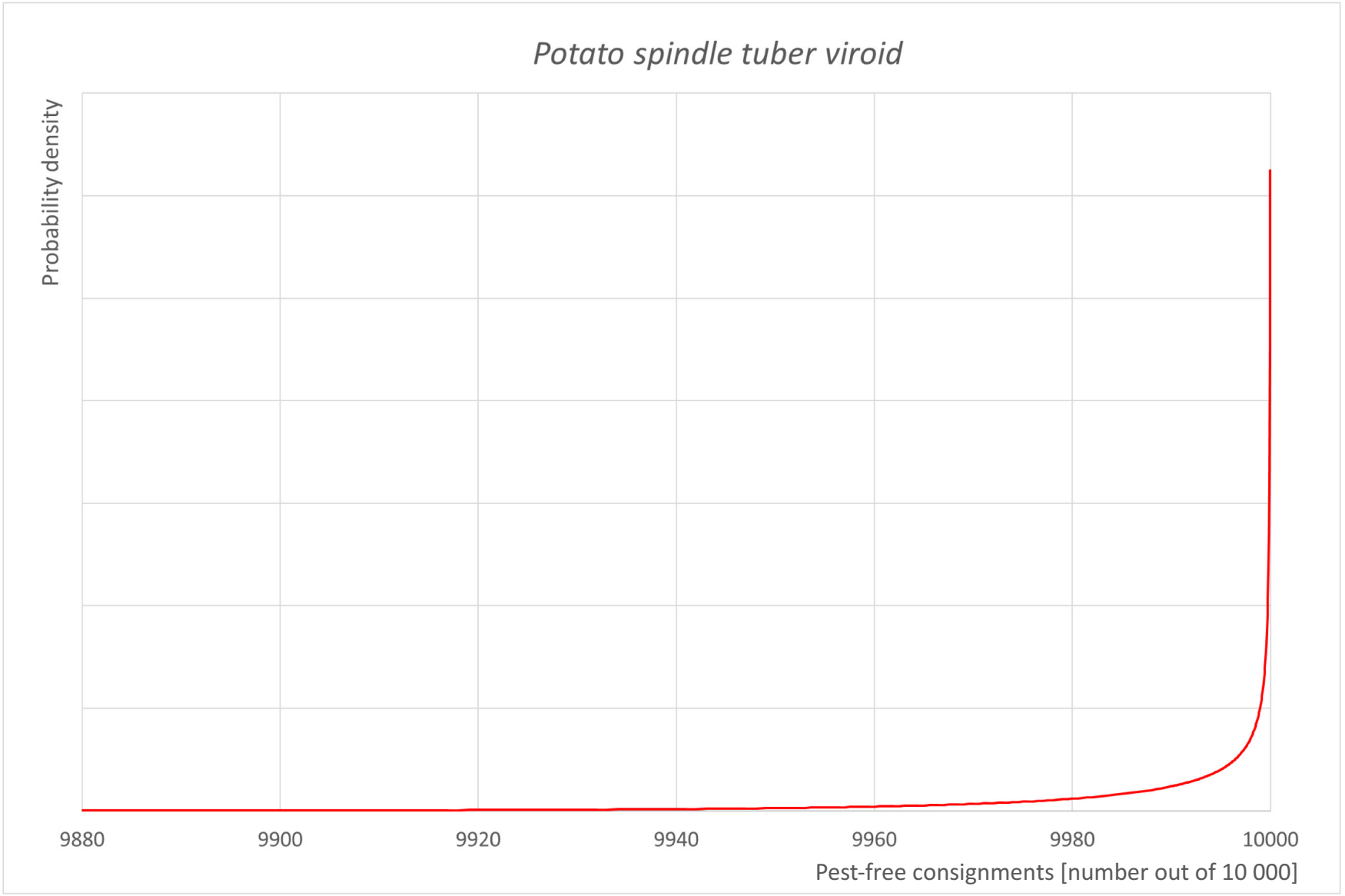

FIGURE A.9 (Continued)

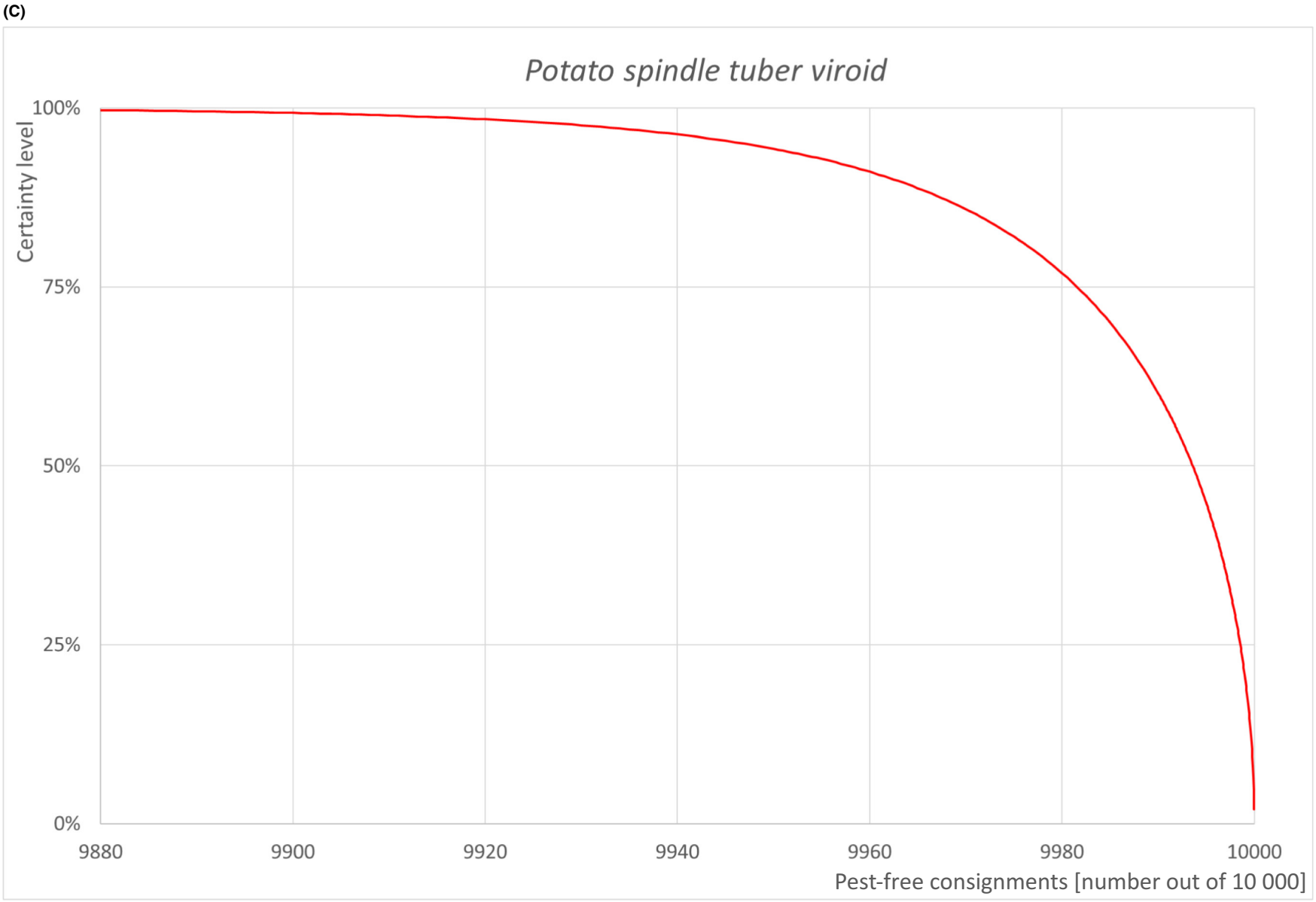

FIGURE A.9 (A) Elicited uncertainty of pest infection per 10,000 bags (containing 105 unrooted cuttings per bag) for potato spindle tuber viroid (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection per 10,000 bags.

A.9.7 | Reference list

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A.10 | *Ralstonia solanacearum* species complex

A.10.1 | Organism information

Taxonomic information of the organisms in the cluster	Group: Bacteria 1. Current valid scientific name: *Ralstonia solanacearum* EPPO code: RALSSL Synonyms: *R. solanacearum* phylotype II, Common name: brown rot of potato Name used in the EU legislation: *Ralstonia solanacearum,* (Smith) Yabuuchi et al. emend. Safni et al. Order: Burkholderiales Family: Burkholderiaceae Name used in the dossier: – 2. Current valid scientific name: *Ralstonia pseudosolanacearum* EPPO code: RALSPS Synonyms: *R. solanacearum* phylotypes I and III Common name: bacterial wilt Name used in the EU legislation: *Ralstonia pseudosolanacearum*, Safni et al. Order: Burkholderiales Family: Burkholderiaceae Name used in the dossier: – Reasons for clustering: These two *Ralstonia* species belong to Ralstonia solananearum species complex and share a lot of biological traits

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Regulated status	*Ralstonia solanacearum (Smith)* Yabuuchi et al. emend. Safni et al. [RALSSL] is listed in Annex II/B of Commission Implementing Regulation (EU) 2019/2072 *Ralstonia pseudosolanacearum*, Safni et al. [RALSPS] is listed in Annex II/A of Commission Implementing Regulation (EU) 2019/2072		
Host status on *Petunia* sp./*Calibrachoa* sp.	**Bacterium name**	***Petunia/Calibrachoa* host status**	**Solanaceae host plants**
	R. solanacearum	*Petunia hybrida* and *Calibrachoa* sp. are listed as host plants (CABI, online)	*Capsicum* spp., *Solanum* spp.
	R. 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. and *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. and *Calibrachoa* spp. for *R. solanacearum*.		
Pest status in Kenya	*R. solanacearum* and *R. pseudosolanacearum* according to EPPO/CABI are present and widespread in Kenya. The pests have been found in ornamental flower production facilities (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. 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 **Ecology and biology of the vectors** Transmission does not involve any vector. Entry into plants is usually through root and stem injuries from where the bacteria move by colonisation of the xylem. Blocking of the vessels by bacterial biofilm is the major cause of wilting **Symptoms on *Petunia/Calibrachoa*** 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* and *Calibrachoa* can be systemically infected. The bacteria colonise the xylem vessels		
Surveillance information	There is no knowledge of a surveillance programme for *R. pseudosolanacearum* and *R. solanacearum* in Kenya		

A.10.2 | Possibility of pest presence in the nursery

A.10.2.1 | 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. and *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.10.2.2 | Possibility of entry with new plants/seeds

Foundation stock used to establish mother plants for unrooted cuttings production originate from Germany, Portugal, Spain and Israel. *R. solanacearum* and *R. pseudosolanacearum* are present in Germany, Spain and Portugal but are not reported to be present in Israel. In all countries a certification scheme is in place for *Petunia* spp. and *Calibrachoa* spp. No test

is reported to be performed for *Ralstonia*. Propagation material is not reported to be tested for bacterial infection; however, it is unlikely that the imported certified (Elite) material from the EU and Israel is infected with *Ralstonia*.

Uncertainties: None.

A.10.2.3 | 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.

Uncertainties:

- Failure in the application of the strict hygiene measures.

A.10.3 | Information from interceptions

There were no interceptions of *R. pseudosolanacearum* or any other species member of the *R. solanacearum* species complex on *Petunia* spp. and *Calibrachoa* spp. in the EU from any country (EUROPHYT and TRACES, online).

A.10.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse 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 Uncertainties: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. 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
Treatment of growing media	Yes	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum Evaluation: Sterilisation by steam is reported to be efficient to reduce bacterial populations in volcanic pumice Uncertainty: It is not known if the heat treatment is applied homogeneously to the whole substrate

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Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non-EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: Propagation material is not reported to be tested for bacterial infection; however, it is unlikely that the imported certified (Elite) material from the EU and Israel is infected with *Ralstonia* Uncertainties: None
Crop rotation	No	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp.
Disinfection of irrigation water	Yes	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogens 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	No	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: No bactericidal treatments are applied during the production process
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment 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.
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: No sampling and testing targeting *R. solanacearum* and *R. pseudosolanacearum* is reported to be done during production process and at the exporting step Uncertainties: None

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility for the remainder of the season in line with the EU regulations. If tests are negative, exports of the plants will be recommended 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	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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.10.5 | Overall likelihood of pest freedom

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

- *Petunia* spp. and *Calibrachoa* spp. are not preferred hosts.
- *R. solanacearum* and *R. pseudosolanacearum* has never been intercepted on produce imported in the EU from Kenya.
- 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 new substrate is sterilised with steam treatment.
- The scouting monitoring regime is effective, wilting plants are expected to be easily detected.
- At harvest and packing, cuttings with symptoms will be detected.

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

- *R. solanacearum* and *R. pseudosolanacearum* are present throughout Kenya 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.
- It cannot be excluded that there are defects in the greenhouse structure and failures in the water treatment.
- Chemical treatments (insecticide, fungicide) are not targeting *R. solanacearum* and *R. pseudosolanacearum*.
- Sensitivity of cultivars of *Petunia* spp. and *Calibrachoa* spp. to *R. solanacearum* and *R. pseudosolanacearum* is not known. Some of these could be asymp'tomatically infected.

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

- The production system in place includes the control of inputs and the containment of the multiplication and packaging areas.
- Presence of *R. solanacearum* and *R. pseudosolanacearum* in the environment is not monitored.

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

- The high scenario is considered unlikely.

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 infection (Table A.19) and pest freedom (Table A.20).

TABLE A.19 Elicited and fitted values of the uncertainty distribution of pest infection by *R. 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					3		6		10					100
EKE	0.501	0.723	1.03	1.57	2.24	3.06	3.92	5.86	8.42	10.2	12.5	15.5	19.4	23.2	28.2

Note: The EKE results is the *BetaGeneral* (1.4156, 1963.6, 0.265, 10,000) distribution fitted with @Risk version 7.6.

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

TABLE A.20 The uncertainty distribution of plants free of *R. 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					9990		9994		9997					10,000
EKE results	9972	9977	9981	9985	9987	9990	9992	9994	9996.1	9996.9	9997.8	9998.4	9999.0	9999.3	9999.5

Note: The EKE results are the fitted values.

(B)

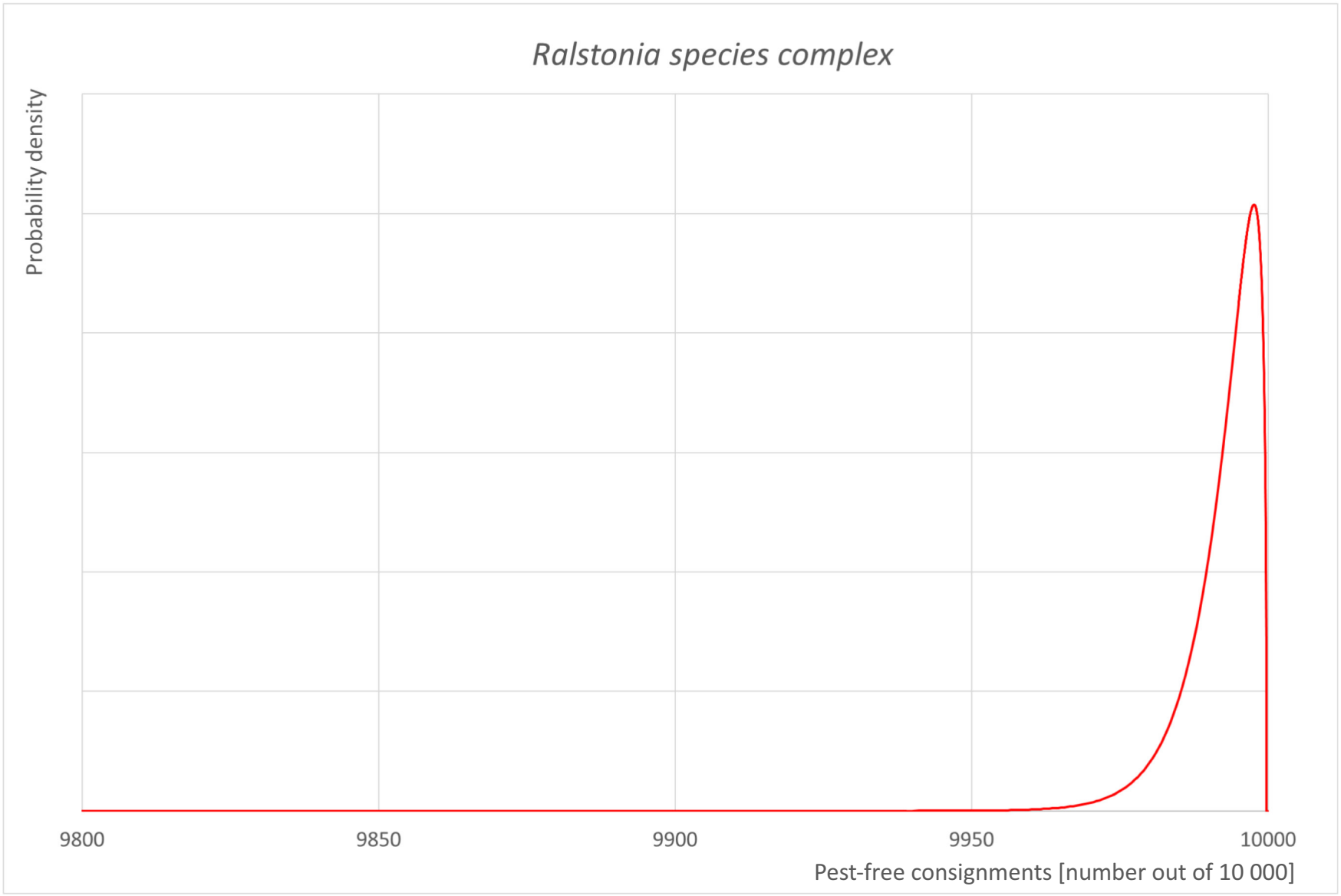

FIGURE A.10 (Continued)

(A)

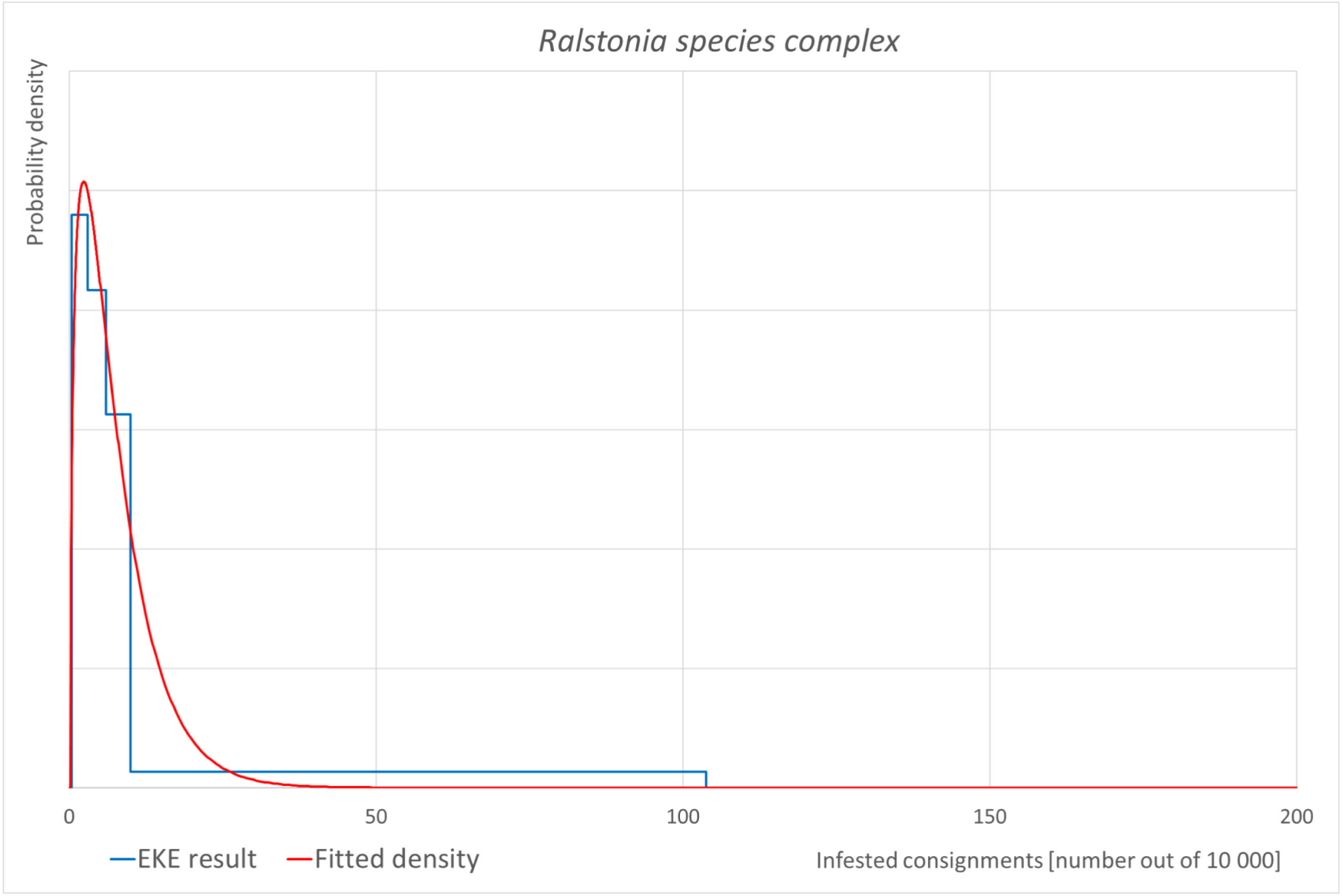

FIGURE A.10 (Continued)

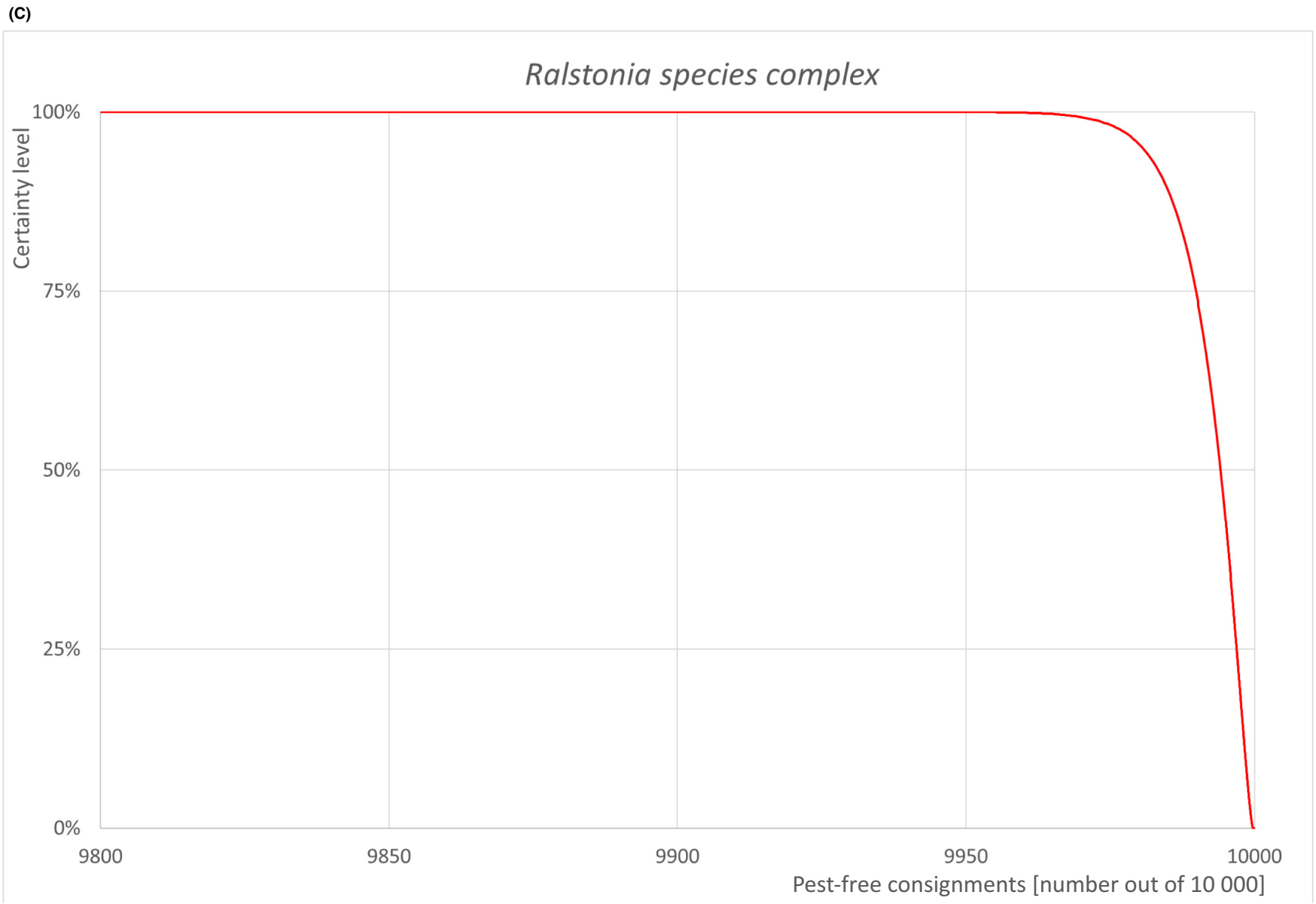

FIGURE A.10 (A) Elicited uncertainty of pest infection per 10,000 bags (containing 105 unrooted cuttings per bag) for *Ralstonia solanacearum* species complex (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection per 10,000 bags.

A.10.7 | Reference list

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A.11 | *Scirtothrips dorsalis*

A.11.1 | Organism information

Taxonomic information	Group: Insects Current valid scientific name: *Scirtothrips dorsalis* Hood EPPO code: SCITDO Synonyms: *Anaphothrips andreae*, *Anaphothrips dorsalis*, *Anaphothrips fragariae*, *Heliothrips minutissimus*, *Neophysopus fragariae*, *Scirtothrips andreae*, *Scirtothrips dorsalis padmae*, *Scirtothrips fragariae*, *Scirtothrips minutissimus*, *Scirtothrips padmae* Common name: Assam thrips, chilli thrips, flower thrips, strawberry thrips, yellow tea thrips, castor thrips Name used in the EU legislation: *Scirtothrips dorsalis* Order: Thysanoptera Family: Thripidae Name used in the Dossier: *Scirtothrips dorsalis*
Regulated status	The pest is listed in Annex II/A of Regulation (EU) 2019/2072 as *Scirtothrips dorsalis* Hood [SCITDO]
Pest status in Kenya	Present, restricted distribution (EPPO, online)
Pest status in the EU	Not relevant for EU Quarantine pest
Host status on *Petunia* and *Calibrachoa*	*Petunia* × *hybrida* is indicated to be host of *S. dorsalis* (EPPO GD, online)
PRA information	Available Pest Risk Assessments: • CSL Pest Risk Analysis for *Scirtothrips dorsalis* (MacLeod and Collins, 2006), • Pest Risk Assessment *Scirtothrips dorsalis* (Vierbergen and van der Gaag, 2009), • Scientific Opinion on the pest categorisation of *Scirtothrips dorsalis* (EFSA PLH Panel, 2014).
Other relevant information for the assessment	
Biology	The pest can have up to eight generations annually in temperate regions and up to 18 generations in warm subtropical and tropical areas (Kumar et al., 2013) The stages of the life cycle include egg, first and second instar larva, prepupa, pupa and adult (Kumar et al., 2013). They can be found on all the aboveground plant parts (Kumar et al., 2014). Temperature range for development is from 9.7°C to 32°C, with 265 degree days required for development from egg to adult (Tatara, 1994). The adult can live for 13–15 days (Kumar et al., 2013) Females can lay between 60 and 200 eggs in their lifetime (Seal and Klassen, 2012). Females develop from fertilised and males from unfertilized eggs (Kumar et al., 2013). The eggs are inserted into soft plant tissues and hatching nymphs appear between 2 and 7 days (Kumar et al., 2014) Larvae and adults tend to gather near the mid-vein or near the damaged part of leaf tissue. Pupae are found in the leaf litter, on the axils of the leaves, in curled leaves or under the calyx of flowers and fruits (Kumar et al., 2013; MacLeod and Collins, 2006) The pest cannot overwinter, if the temperature remains below –4°C for five or more days (Nietschke et al., 2008) Adults fly actively for short distances and are transported passively by wind currents, which enables long-distance spread (EFSA PLH Panel, 2014) *S. dorsalis* is a vector of plant viruses including peanut necrosis virus, groundnut bud necrosis virus, watermelon silver mottle virus, capsicum chlorosis virus and melon yellow spot virus (Kumar et al., 2013)

(Continued)

Symptoms	**Main type of symptoms**	The pest damages young leaves, buds, tender stems and fruits by puncturing tender tissues with their stylets and extracting the contents of individual epidermal cells leading to necrosis of tissue (Kumar et al., 2013) Main symptoms are: • 'sandy paper lines' on the epidermis of the leaves, • leaf crinkling and upwards leaf curling, • leaf size reduction, • discoloration of buds, flowers and young fruits, • silvering of the leaf surface, • linear thickenings of the leaf lamina, • brown frass markings on the leaves and fruits, • fruits develop corky tissues, • grey to black markings on fruits, • fruit distortion and early senescence of leaves, • defoliation (Kumar et al., 2013, 2014)
	Presence of asymptomatic plants	• Eggs and early stages of infestation may be difficult to detect • There are no baits/pheromones reported
	Confusion with other pathogens/pests	Due to small size and morphological similarities within the genus, the identification of *S. dorsalis,* using traditional taxonomic keys, is difficult. The most precise identification of the pest is combination of molecular and morphological methods (Kumar et al., 2013). Sometimes, infested plants appear similar to plant damaged by broad mites (Kumar et al., 2013)
Host plant range	*S. dorsalis* is a polyphagous pest with over 225 host plant species (see section 3.4.1 of EFSA (2014))	
Evidence that the commodity can be a pathway	All life stages, besides pupae, of *S. dorsalis* (eggs, larvae and adults) could be present on the leaves of *Petunia* spp. and *Calibrachoa* spp. unrooted cuttings	
Surveillance information	There is no official surveillance for the regional presence of these insects in Kenya	

A.11.2 | Possibility of pest presence in the nurseries

A.11.2.1 | Possibility of entry from the surrounding environment

In Kenya *S. dorsalis* is reported to be present (EPPO). Given the wide host range of this pest it is possible that local populations of *S. dorsalis* are present in the neighbouring environment of the greenhouses with *Petunia* spp. and *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 *S. dorsalis,* so the Panel assumes that *S. dorsalis* can be present in the production areas of *Petunia* spp. and *Calibrachoa* spp. destined for export to the EU.

Petunia spp. and *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 *S. dorsalis* in the neighbouring environment of the greenhouse.

Uncertainties:

- There is no surveillance information on the presence and population pressure of *S. dorsalis* in the area where the greenhouse is located.
- The proximity of the greenhouses to possible sources of populations of *S. dorsalis* is unknown.
- The presence of defects in the greenhouse structure

A.11.2.2 | Possibility of entry from the surrounding environment

The probability that *S. dorsalis* is present on the starting material is very low/negligible as the imported material is certified (elite) and is kept in the post-quarantine facility before released to the nursery.

A.11.2.3 | Possibility of spread within the nursery

S. dorsalis can be present on other host plants (perennials, bedding plants and succulents that are mainly intended to be exported to the EU, but not for the local markets) in other production units of the nursery. When present, hitchhiking life stages of the mealybugs can spread from infested host plants within the nursery. *Petunia* spp. and *Calibrachoa* spp. for

export are produced in a separate unit with hygienic standards (double doors, clean uniforms) with no mixing with the other ornamentals.

Uncertainties:

- Specific host plants of *S. dorsalis* other than *Petunia* spp. and *Calibrachoa* spp. that are grown in the nursery.
- Presence of defects within the greenhouse protective structure.

A.11.3 | Information from interceptions

There are 19 interceptions of *S. dorsalis* on plants from Kenya from 2009 to 2015, and two interceptions on plants imported from Kenya from 2020 to 2024 (EUROPHYT, online; TRACES, online).

A.11.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The thrips-proof netting prevents the introduction of *S. dorsalis* from the surrounding environment. However, *S. dorsalis* adults may be introduced through defects in the greenhouse Uncertainties: Presence of unnoticed defects in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. Evaluation: The measures prevent the entrance and spread in the nursery of *S. dorsalis* Uncertainties: Is not known if there is an additional change and disinfection area before entering the *Petunia* spp. and *Calibrachoa* spp. production units
Treatment of growing media	No	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: The probability that *S. dorsalis* is present on the certified starting material is very low/negligible Uncertainties: None

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Crop rotation	Yes	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp. Evaluation: No crop rotation with non-host plants takes place. In case of introduction into the greenhouse, populations of *S. dorsalis* may build up since the same unit is used for production of *Petunia/Calibrachoa* Uncertainties: None
Disinfection of irrigation water	No	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogens
Treatment of crop during production	Yes	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: Some of the products used may have an effect on populations of *S. dorsalis* Uncertainties: The efficacy of the plant protection products against the specific insect pest is not known
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: Populations of *S. dorsalis* are monitored through sticky traps and the presence of the pest in the nursery may be detected at an early stage. Early infestation of *S. dorsalis* in the crop may be difficult to detect Uncertainties: The efficiency of detecting the early infestations of *S. dorsalis*
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrachoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques Evaluation: Sampling for virus testing may detect the presence of *S. dorsalis* Uncertainties: The efficiency of detecting the early infestations of *S. dorsalis*
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 4 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: Inspections for *F. occidentalis* may help in the detection of populations of *S. dorsalis* Uncertainties: The efficiency of detecting the early infestations of *S. dorsalis*
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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 *S. dorsalis*. However, no specific data are available for the evaluation of the efficacy of the surveillance Uncertainty: Inclusion of *S. dorsalis* in the surveillance programme

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. is not a preferred host.
- *S. dorsalis* 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 treatments for *S. dorsalis*.
- 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.
- *S. dorsalis* 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

- *S. dorsalis* is present in Kenya 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).
- The pest has been intercepted on products from Kenya.
- 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 then Petunia 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.
- *S. dorsalis* is an EU-regulated pest; therefore, the exporting company is taking precautionary measures and paying particular attention to the detection.

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 *S. dorsalis* in the surrounding environment.

A.11.6 | Elicitation outcomes of the assessment of the pest freedom for *Scirtothrips dorsalis*

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 *S. dorsalis* 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					7		15		25					60
EKE	1.00	1.44	2.11	3.38	5.05	7.19	9.44	14.6	21.2	25.4	31.0	37.5	45.3	52.2	60.0

Note: The EKE results is the *BetaGeneral* (1.155, 5.8141, 0.65, 105) 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 *S. dorsalis* 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	9940					9975		9985		9993					9999
EKE results	9940	9948	9955	9962	9969	9975	9979	9985	9991	9993	9995	9996.6	9997.9	9998.6	9999.0

Note: The EKE results are the fitted values.

(A)

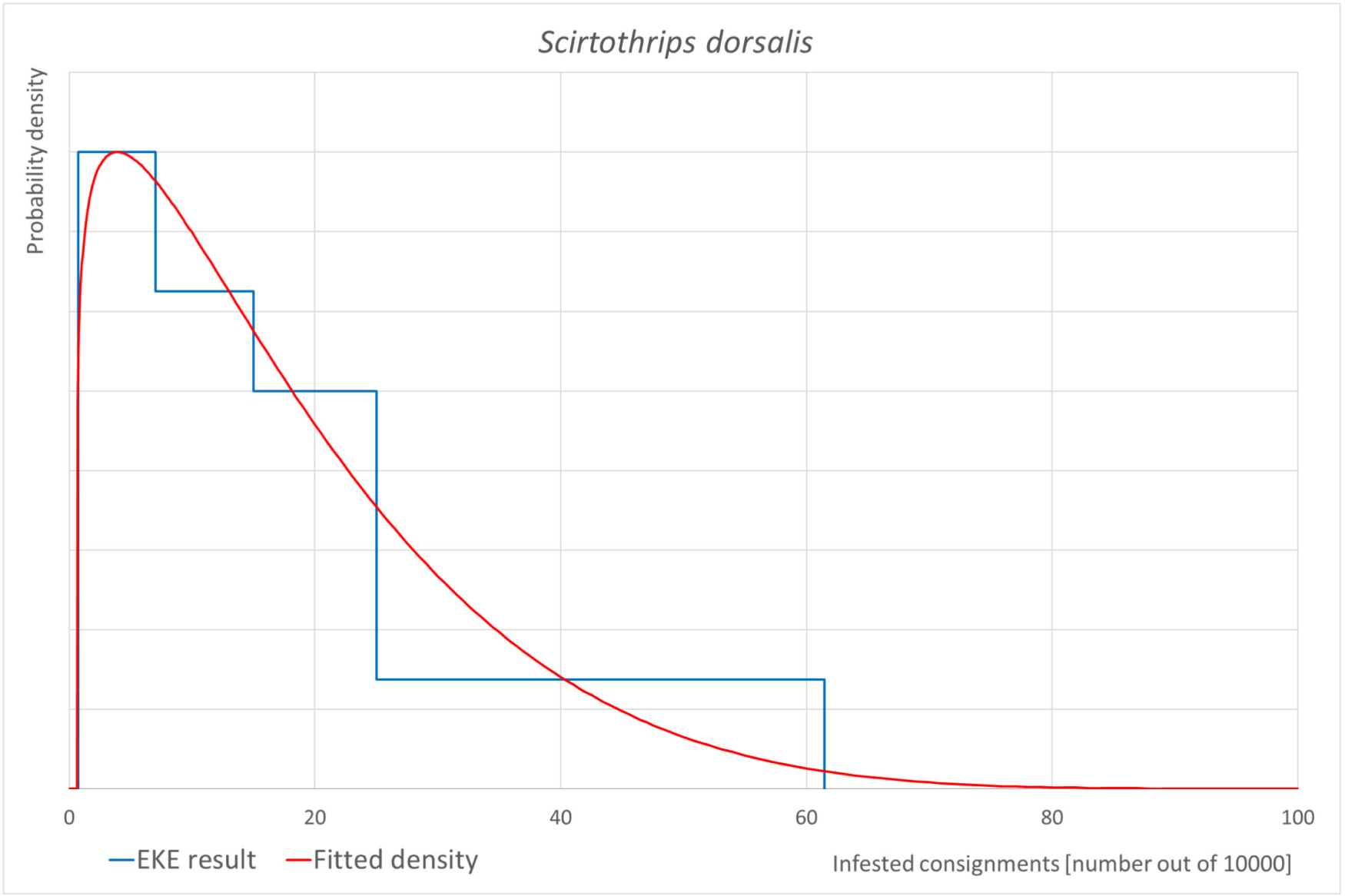

FIGURE A.11 (Continued)

(B)

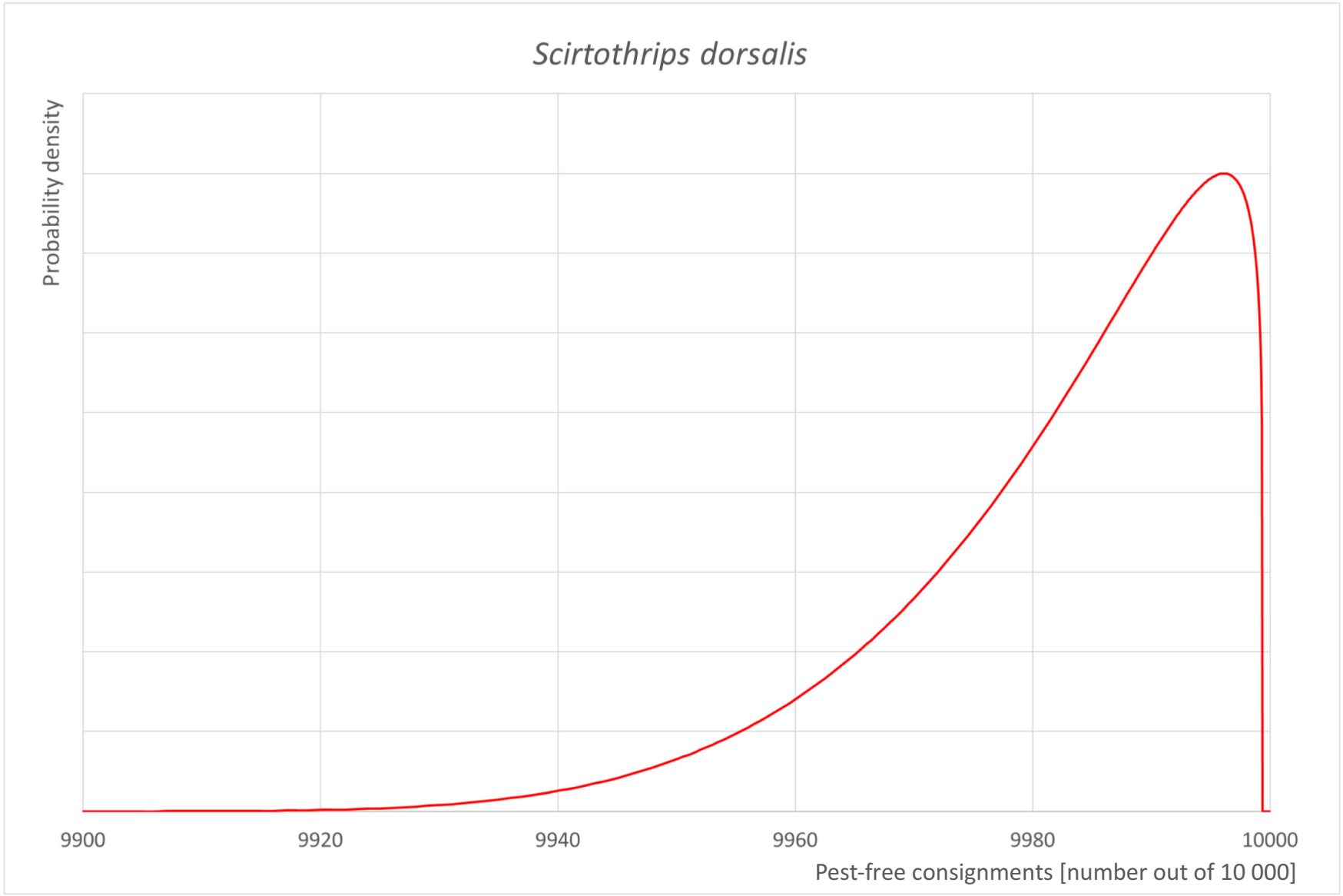

FIGURE A.11 (Continued)

(C)

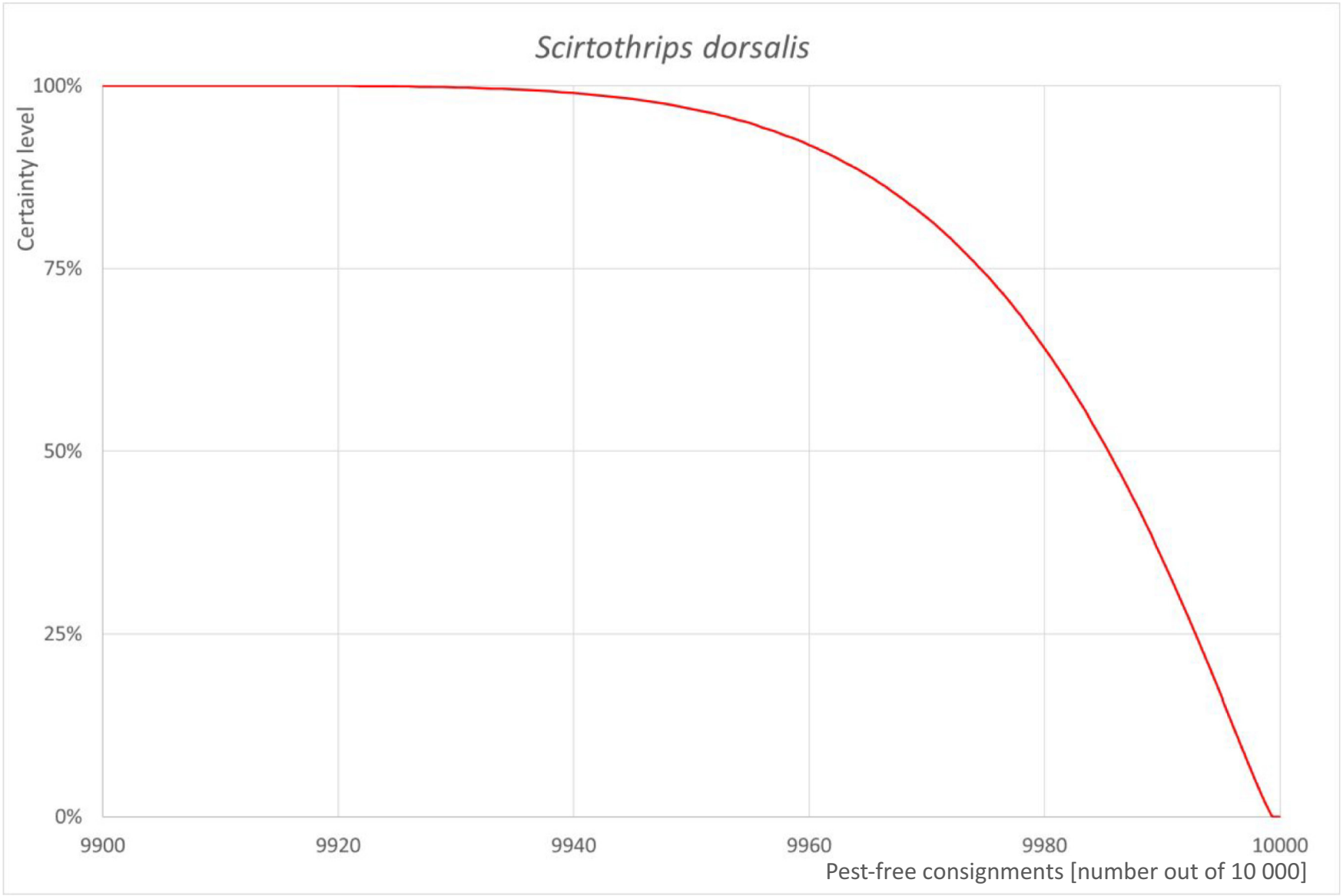

FIGURE A.11 (A) Elicited uncertainty of pest infestation per 10,000 bags (containing 105 unrooted cuttings per bag) for *Scirtothrips dorsalis* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (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 bag.

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A.12 | *Xanthomonas vesicatoria*

A.12.1 | Organism information

Taxonomic information	Group: Bacteria Current valid scientific name: *Xanthomonas vesicatoria* EPPO code: XANTVE Synonyms: *Pseudomonas exitiosa, Pseudomonas vesicatoria* Common names: bacterial leaf spot of tomato, bacterial scab of tomato, black spot of tomato, leaf spot of tomato, stem canker of tomato Name used in the EU legislation: *Xanthomonas vesicatoria* (ex Doidge) Vauterin et al Order: Lysobacterales Family: Lysobacteraceae Name used in the Dossier: *Xanthomonas vesicatoria*
Regulated status	The pest is listed in Annex IV of Commission Implementing Directive (EU) 2020/177 of 11 February 2020, as *Xanthomonas vesicatoria* (ex Doidge) Vauterin et al [XANTVE]
Pest status in Kenya	Present, no details (EPPO GD, online)
Pest status in the EU	The pest has been reported in 12 (12) European countries as present with restricted distribution, or no details, or no longer present. However, in Italy and Slovakia it is reported as widespread (EPPO GD, online)
Host status on *Petunia* sp. and *Calibrachoa* sp.	*Petunia hybrida* and *Calibrachoa* sp. are not listed as host plants for *Xanthomonas vesicatoria* (EPPO GD, online). However, the host plant range of *X. vesicatoria* as reported by EPPO, only includes solanaceous species, and therefore the Panel assumes that *Petunia* spp. and *Calibrachoa* spp. could be suitable host plants
PRA information	Scientific Opinion on the pest categorisation of *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye (EFSA, 2014) California Pest Rating Proposal for *Xanthomonas vesicatoria* (Doidge) Dowson 1939 (Bacterial spot of tomato and pepper) https://blogs.cdfa.ca.gov/Section3162/wp-content/uploads/2020/10/Xanthomonas-vesicatoria-ADA_PRP.pdf
Other relevant information for the assessment	
Biology	**Biology:** Bacteria that cause bacterial spot diseases are seed-borne bacteria, representing the primary inoculum, may be present and viable both on the teguments, if no sanitation or disinfection has been done during seed production, and under the tegument. Less frequently, primary infections may be caused by the presence of infected plant debris or volunteers from a previous crop. Secondary inocula released from lesions on leaves and stems are spread via splashing water and wind driven rain. Bacteria may penetrate the host through natural openings such as hydathodes, stomata and lenticels. Additionally, wounds, caused by agronomic operations (grafting, topping, clipping, tying, staking and harvesting, during spraying with pesticides and on clothes during crop handlings), are important penetration sites for the pathogens, especially for table tomato. In open-field cultivation systems, bacteria-supporting plant particles are produced during cultural practices and are exported from the field by ascendant air flux. The period between infection and symptom expression varies, ranging from 8 to 21 days, and is determined by temperature, plant age and soil characteristics, including the nutrient status of the plants. Conditions decreasing incubation periods also favour disease severity. The optimal growth temperature for xanthomonads is between 25°C and 30°C (EFSA, 2014)

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	Transmission: The pathogen moves principally on seeds of *Capsicum* or tomato, and possibly also on young seedlings of these crops. According to Bashan (1986), 'nearly all accidental agents passing through the infested field may act as vectors' (including insects, tools, soil) **Symptoms:** Symptoms of the bacteria are black spots on the leaves and cankers in the stems
Host plant range	According to EPPO GD (online), the host list of this bacterium includes *Capsicum annuum*, *Datura*, *Hyoscyamus niger*, *Lycium barbarum*, *Nicotiana rustica*, *Physalis*, *Solanum*, *Solanum lycopersicum* and *Solanum tuberosum*. Its major hosts, however, are *Capsicum annuum* and *Solanum lycopersicum*
Evidence that the commodity can be a pathway	The bacteria may be present on unrooted cuttings harvested from infected mother plants
Surveillance information	No specific information on *X. vesicatoria* in Kenya

A.12.2 | Possibility of pest presence in the nursery

A.12.2.1 | Possibility of entry from the surrounding environment

The main hosts of *X. vesicatoria* are tomatoes and peppers. The disease has mainly been observed in field crops that can be grown around the nurseries. A few infected plants can lead to outbreaks. At production sites, tomato volunteer plants, weeds and crop debris, in which *X. vesicatoria* can survive, are recognised as playing a key role as a source of inoculum. Greenhouse structure prevent the introduction of *X. vesicatoria* via aerosol. However, heavy rain and wind particularly during storms contributes to rapid spread and can allow the bacteria to enter the greenhouse in case of damage. Water disinfection prevents the introduction by 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:

- Infection pressure in the areas surrounding the nurseries
- Unnoticed failures in the water treatment and storage system.

A.12.2.2 | Possibility of entry with new plants/seeds

X. vesicatoria is a seed-borne bacterium and can be present in plants for planting (seeds and transplants) (EFSA, 2014). The pathogen is seed-borne and seeds are considered the major means for long-distance dispersal. The pathogen can survive for years on seeds. Transplants can also be a primary infection source where *X. vesicatoria* can survive epiphytically and endophytically and can serve as a means of long-distance dispersal.

Foundation stock used to establish mother plants for unrooted cuttings production originate from the Germany, Portugal, Spain and Israel. Propagation material is not reported to be tested for bacterial infection; however, it is unlikely that the imported certified (Elite) material from the EU and Israel is infected with *X. vesicatoria*.

Uncertainties: None.

A.12.2.3 | Possibility of spread within the nursery

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

Strict hygiene measures in place in production sites prevent the spread of *X. vesicatoria* within the nursery. Only failure in the application of the strict hygiene measures could lead to spread of the bacteria within the nursery.

Uncertainties: None.

A.12.3 | Information from interceptions

There were no interceptions of *X. vesicatoria* on different commodities imported into the EU from Kenya (EUROPHYT and TRACES, online).

A.12.4 | Risk mitigation measures applied in the nurseries

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Growing plants in isolation	Yes	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. The *Petunia* spp. and *Calibrachoa* spp. are produced in the separate greenhouse units. There is no mixing of solanaceous plants with other ornamental plants in the same greenhouse Evaluation: The isolated greenhouses with polytene roof and sidewalls fitted with insect proof nets as well as double door prevent passive introduction of *X. vesicatoria* by air movements Uncertainties: Presence of unnoticed damage in the greenhouse structure
Dedicated hygiene measures	Yes	For accessing the greenhouse there is a double door system. *Petunia* spp. and *Calibrachoa* spp. are produced in separate units. Plants are planted in new polythene bags or sterilised pots every season Growers have elaborated and documented hygiene protocols, and training undertaken for all workers on the protocol implementation. These hygiene protocols include: • Use of washable aprons, gumboots, head gears and gloves dedicated to each greenhouse. • Pruning tools are regularly disinfected and are dedicated to particular production benches. • Nursery staff enters the production facility in protective clothing. The protective clothing is kept within the double door entrance and disinfected after every use. • Available disinfection at entrances using footbaths and hand wash areas using portable water and disinfectant. • Regular training (biannual) of specific workers allocated to work in greenhouse holding solanaceous plants. • Traceability protocols developed and implemented. • The production area in the greenhouse is kept weed free. • The production benches have a side cover to avoid direct contact of the workers clothing with the plants. 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. Uncertainties: None
Treatment of growing media	Yes	New growing media are used every season. The media undergoes steaming at 80 or 90°C for 1–2 h after all 10 sensors reach 80°C. Farms steam at different temperatures with 80°C for a duration of 1 h being the minimum Evaluation: Although *X. vesicatoria* is not a soil-borne bacterium, pumice might passively transport bacterial cells. Sterilisation by steam is reported to be efficient to disinfect volcanic pumice Uncertainty: It is not known if the heat treatment is applied homogeneously to the substrate
Quality of source plant material	Yes	The propagation material used for establishing mother plants originates from EU countries (Germany, Portugal, Spain) and non- EU countries (Israel). The imported planting material consists of tissue culture plantlets or unrooted cuttings and is certified as 'Elite (Naktuinbouw)' and tested for several viruses [(tomato spotted wilt virus (TSWV), potato spindle tuber viroid (PSTVd), Impatiens necrotic spot virus (INSV), alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), beet curly top virus (BCTV), tomato mosaic virus (ToMV), tobacco mosaic virus (TMV), tobacco ringspot virus (TRSV), Arabis mosaic virus (ARMV), chilli pepper mild mottle virus (CPMMoV), turnip vein-clearing virus (TVCV), tomato brown rugose fruit virus (ToBRFV), potato virus Y (PVY), lettuce mosaic virus (LMV), potato virus A (PVA), Calibrachoa mottle virus (CbMV)] (Dossier section 1.0). Imported material is held in post entry quarantine facilities for 4 weeks and tested by the NPPO of Kenya for the above-mentioned viruses before being approved for further multiplication Evaluation: Only seeds are regulated by the Annex II. There is no certification in place for cuttings. Propagation material is not reported to be tested for bacterial infection; however, it is unlikely that the imported certified (Elite) material from the EU and Israel is infected with *X. vesicatoria* Uncertainties: None
Crop rotation	No	No crop rotation takes place. Specific greenhouses units are used for producing *Petunia* spp. and *Calibrachoa* spp.

(Continues)

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Disinfection of irrigation water	Yes	Water is mainly sourced from lakes or rivers. The water undergoes, sedimentation, flocculation and filtration; thereafter, the water is chlorinated and passed through ultraviolet irradiation before used on the plants. The treated water is stored in tanks that are well protected from contamination by soil. Quality Management System department established within the companies carry out periodic audits to confirm disinfection process. Records are kept and these are checked by NPPO inspectors during inspections/audits. Water is tested weekly to check for any pathogens Evaluation: *X. vesicatoria* might enter from the surrounding environment. The disinfection of irrigation water is effective in eliminating the presence of *X. vesicatoria* in the irrigation water. Irrigation water is a pathway if irrigation system implies overhead irrigation systems. There is no information if irrigation water is tested for the presence of *X. vesicatoria* Uncertainties: • Unnoticed failures in the water treatment and storage system. • Inclusion of *X. vesicatoria* in the weekly testing.
Treatment of crop during production	No	Biological control agents used to manage insect pests include *Phytoseiulus persimilis, Beauveria bassiana* and *Amblyseius* mites. The chemical pesticide sprays include Spinosad, Flonicamid, Pyrethrins and Abamectin. Furthermore, Benevia (cyantraniliprole) and neem oil are used to control *Frankliniella occidentalis* Evaluation: No bactericidal treatments are applied during the process
Pest monitoring and inspections	Yes	Daily scouting is conducted by nursery staff and pest incidences are recorded. Yellow and blue sticky traps are used to monitor for the presence of whiteflies, aphids and thrips. Pheromone and light traps are used to monitor lepidopterans, in particular *Duponchelia* spp. Some sticky traps are placed outside the greenhouse to monitor the population of whiteflies in the environment Evaluation: • Monitoring tests for the presence of *X. vesicatoria* are not mentioned on the arrival of plant material. No monitoring is performed during the propagation and production steps except visual inspections. • It is assumed that only visual inspection is performed in order to check the presence of bacterial infection due to *X. vesicatoria*. However, due to the potential epiphytic colonisation of plants by *X. vesicatoria* may go undetected. Uncertainties: The efficiency of monitoring and inspection due epiphytic colonisation
Sampling and testing	Yes	Three to four weeks after planting, mother plants are tested at 100% sampling and testing for TSWV, PSTVd, INSV, AMV, CMV, BCTV, ToMV, TMV, TRSV, ARMV, CPMMoV, TVCV, ToBRFV, PVY, LMV, PVA, CbMV (Dossier section 1.0). During active growth, routine testing of mother plants (10%–25%) is done throughout the production period at intervals of between either weekly or biweekly. Sampling intensity varies among the growers, but it is usually between 10% and 25%. Testing is done in EU-accredited laboratories No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) In the event of *B. tabaci* and *F. occidentalis* discovery, 10% of the plants are sampled and tested using molecular assays (conventional or real-time PCR): genus specific for begomoviruses and tospoviruses and species specific for TYLCV, TSWV and INSV. So far, no samples have been tested positive during routine testing for begomoviruses and tospoviruses. Potyviruses are tested using species-specific serological assays and molecular techniques.No samples of *Petunia* spp. and *Calibrochoa* spp. have tested positive (based on the NPPO, grower or external laboratory test reports) for any of the pathogens mentioned above (Dossier sections 1.0 and 2.0) Evaluation: No sampling and testing scheme in place for *X. vesicatoria* Uncertainties: none
Official Supervision by NPPO	Yes	Plants are grown in certified production sites for plants for planting. Imported material are held in post entry quarantine facilities for 4 weeks and tested by the NPPO for several viruses before being approved for further multiplication Official inspections during the production are conducted every 3 weeks. If monitoring indicates that *B. tabaci* or *F. occidentalis* is present in a production facility, appropriate pesticides will be applied and 10% of the plants will be sampled for testing of begomoviruses or tospoviruses respectively. Furthermore, any potential incursion into the greenhouses once detected leads to suspension of the production facility in line with the EU regulations. If tests are negative, exports of the plants will be recommended Evaluation: No tests specific to *X. vesicatoria* are reported to be done during production process and at the exporting step Uncertainties: None

(Continued)

Risk reduction option	Effect (Yes/No)	Evaluation and uncertainties
Surveillance of production area	Yes	Surveillance to detect the presence of insects is performed using sticky traps placed outside the greenhouse. 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 *X. vesicatoria*. However, no specific data are available for the evaluation of the efficacy of the surveillance Uncertainties: None

A.12.5 | Overall likelihood of pest freedom

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

- *X. vesicatoria* was never reported on *Petunia* spp. or *Calibrachoa* spp.
- *Petunia* spp. or *Calibrachoa* spp. are not preferred hosts.
- *X. vesicatoria* has never been intercepted on produce from Kenya.
- Natural dispersal capacity of *X. vesicatoria* is limited unless there are windy thunderstorms.
- Transfer of *X. vesicatoria* from sources in the surrounding environment to the greenhouse plants is very difficult because dispersal is mainly dependent on human-assisted movement, and hygienic measures are in place to prevent this.
- Greenhouse structure is insect proof and entrance is thus unlikely.

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

- *X. vesicatoria* is present throughout Kenya; therefore, it is likely that host plants are present in the surrounding environment.
- Greenhouses are located in areas where *X. vesicatoria* is present and abundant (e.g. tomato and pepper plantations).
- It cannot be excluded that there are defects in the greenhouse structure and bacteria hitchhike on greenhouse staff.
- Other solanaceous crops in the greenhouse could introduce epiphytic population of *X. vesicatoria,* which could spread inside the greenhouse by irrigation splashing and via staff clothing.
- *X. vesicatoria* host range covers several species in the solanaceous group. Therefore, it is likely that *Petunia* spp. and *Calibrachoa* spp. could be suitable host plants.

A.12.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The protective effect of the greenhouse structure.
- There are no records of interceptions from Kenya.

A.12.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- The high-risk scenario is considered unlikely.

A.12.6 | Elicitation outcomes of the assessment of the pest freedom for *Xanthomonas vesicatoria*

The following Tables show the elicited and fitted values for pest infection (Table A.23) and pest freedom (Table A.24).

TABLE A.23 Elicited and fitted values of the uncertainty distribution of pest infection by *X. vesicatoria* per 10,000 bags of unrooted cuttings.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Elicited values	0					2		4		7					25
EKE	0.173	0.334	0.556	0.941	1.42	2.00	2.61	3.99	5.80	7.02	8.70	10.8	13.5	16.2	19.8

Note: The EKE results is the *BetaGeneral* (1.4333, 2800.5, 0, 10,000) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected bags of unrooted cuttings the pest freedom was calculated (i.e. = 10,000 – number of infected 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 *X. vesicatoria* 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	9975					9993		9996		9998					10,000
EKE results	9980	9984	9986	9989	9991	9993	9994	9996	9997	9998.0	9998.6	9999.1	9999.4	9999.7	9999.8

Note: The EKE results are the fitted values.

(A)

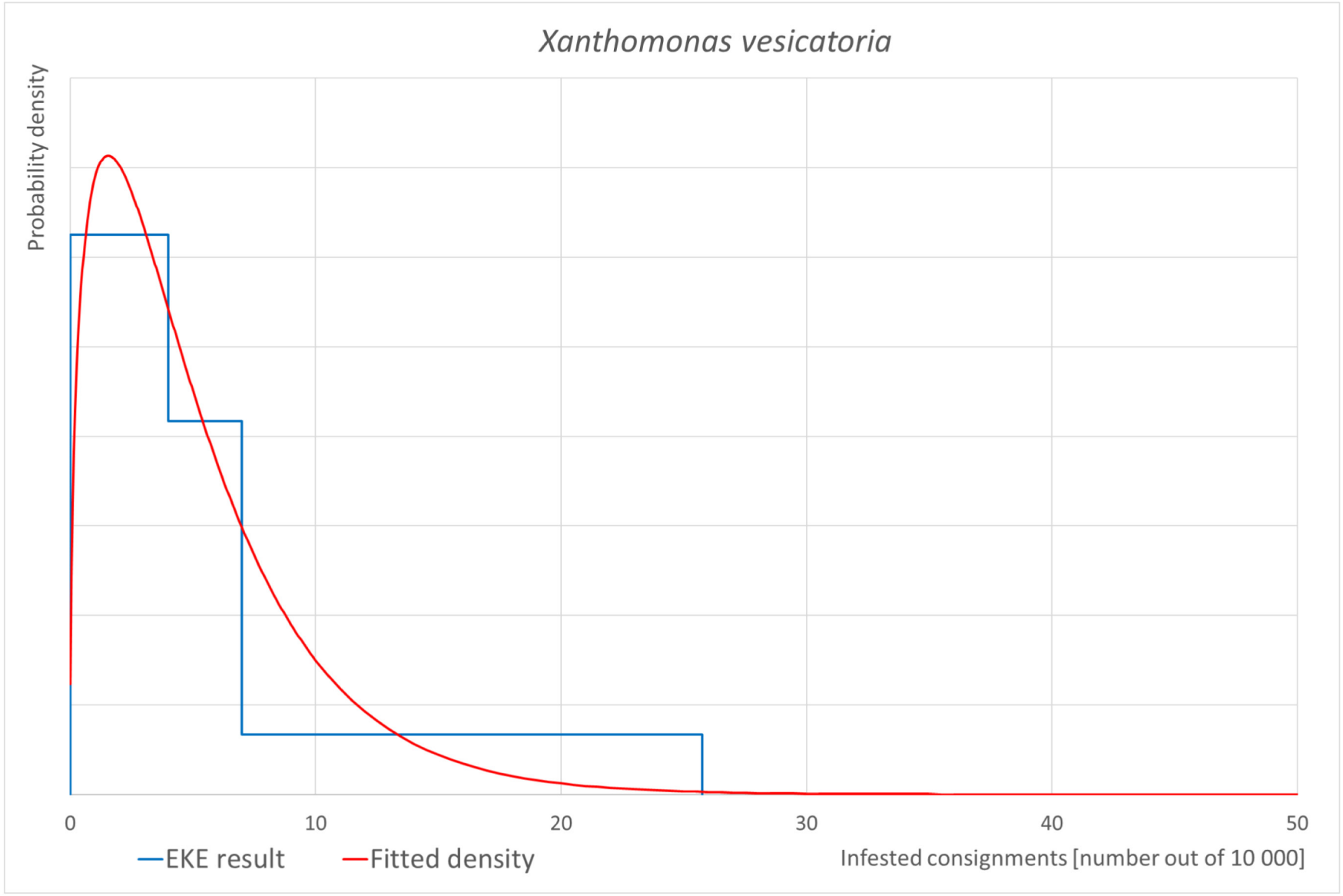

FIGURE A.12 (Continued)

(B)

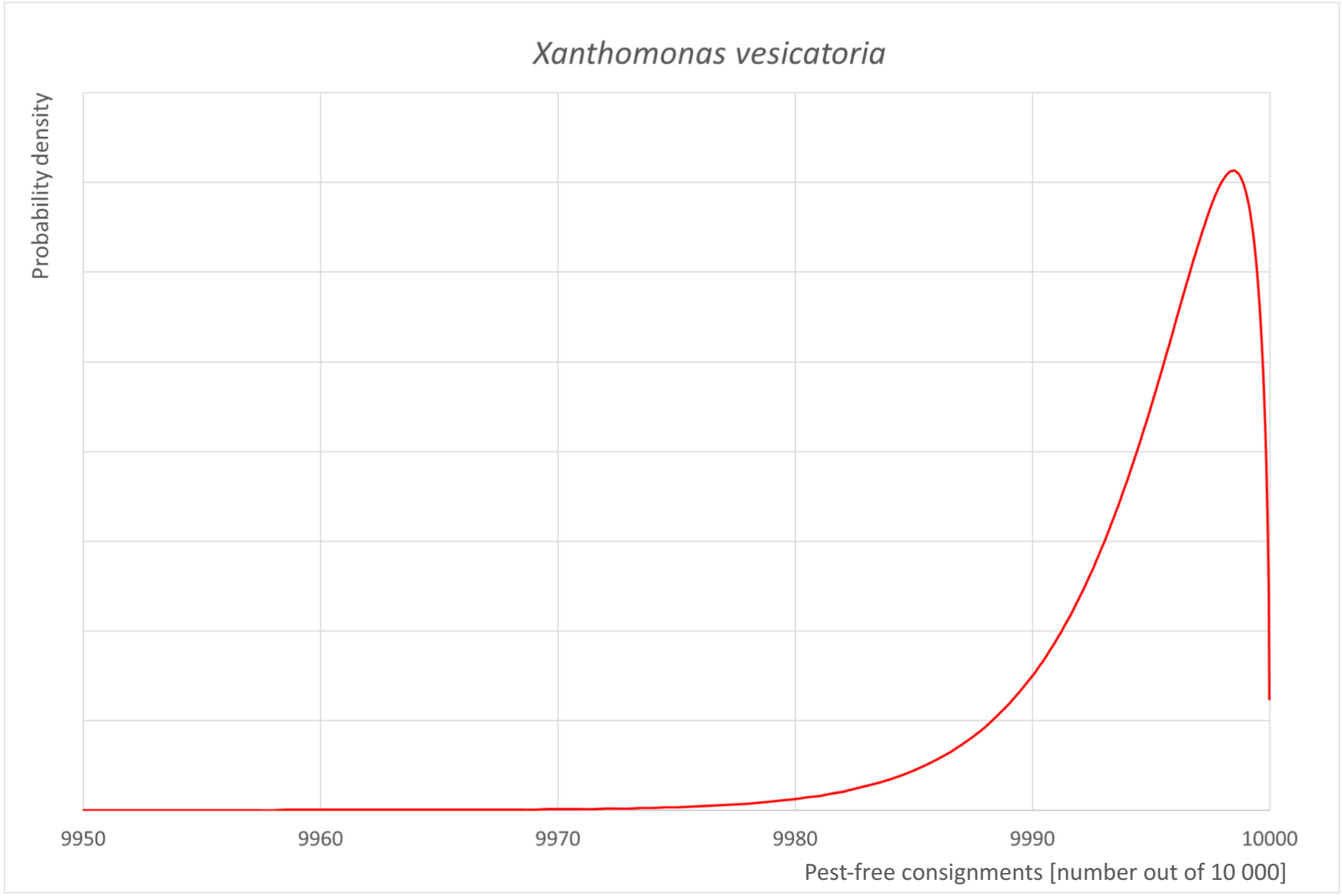

FIGURE A.12 (Continued)

(C)

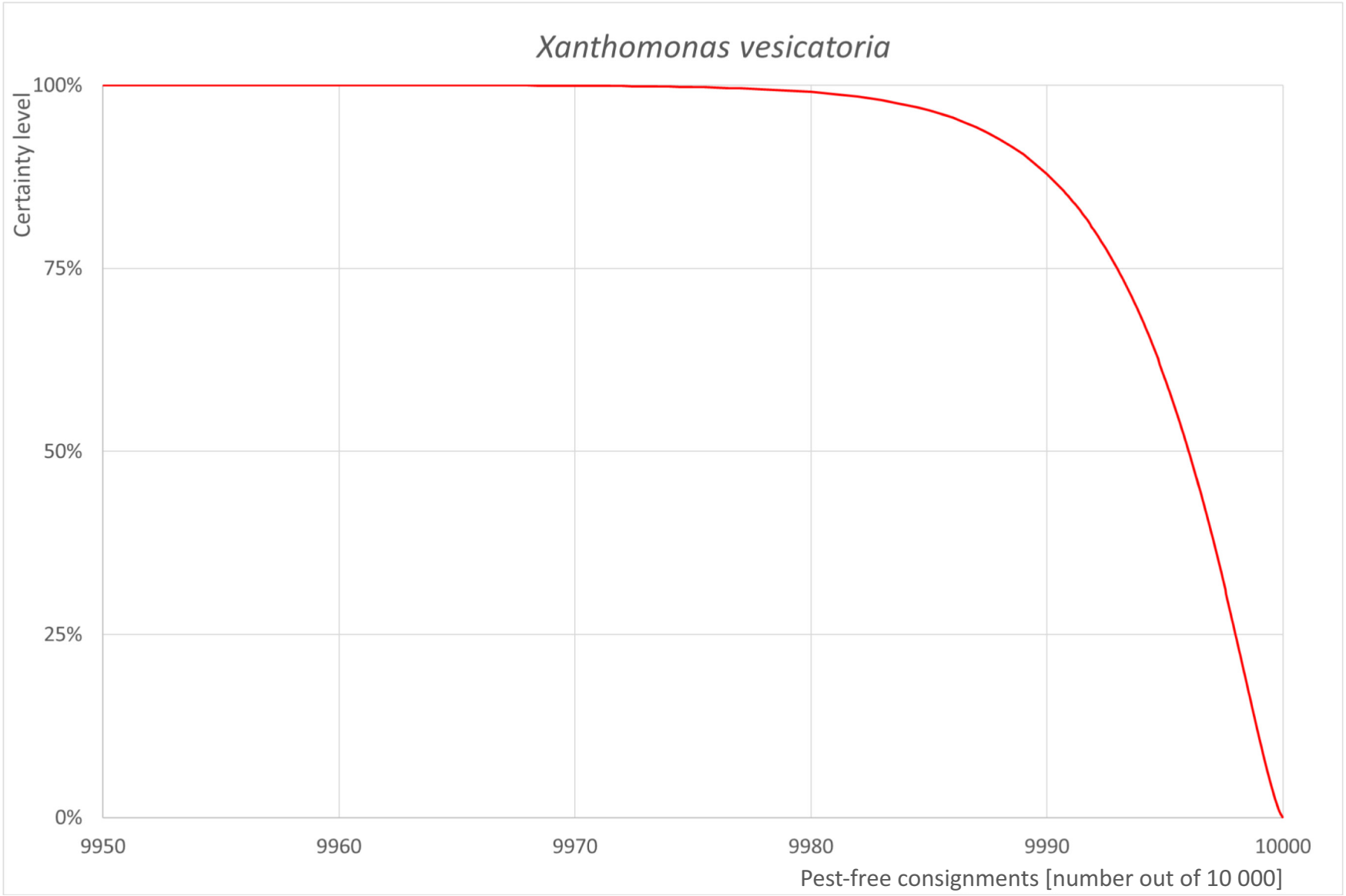

FIGURE A.12 (A) Elicited uncertainty of pest infection per 10,000 bags (containing 105 unrooted cuttings per bag) for *Xanthomonas vesicatoria* (histogram in blue – vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bags per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection 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 three pests were added to the list of pests (see Appendix D).

Web of Science All databases	TOPIC: "*Calibrachoa*" 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 mottle virus" OR "Chili Pepper Mild Mottle Virus" OR "Citrus exocortis viroid" OR "Columnea latent viroid" OR "Cucumber mosaic virus" OR "Hosta virus X" OR "Peach rosette mosaic virus" OR "Pepper chat fruit viroid" OR "Potato black ringspot virus " OR "Potato spindle tuber viroid" OR "Potato virus X" OR "Potato virus Y" OR "Potato yellow dwarf nucleorhabdovirus" OR "Tobacco mild green mosaic virus" OR "Tobacco mosaic virus" OR "Tobacco streak virus" OR "Tomato apical stunt viroid" OR "Tomato chlorotic dwarf viroid" OR "Tomato mosaic virus" OR "Tomato planta macho viroid" OR "Tomato spotted wilt virus" OR "*Alternaria porri*" OR "*Botrytis cinerea*" OR "*Botrytis paeoniae*" OR "*Euoidium longipes*" OR "*Nigrospora oryzae*" OR "*Phytophthora capsici*" OR "*Phytophthora cinnamomi*" OR "*Phytophthora citrophthora* " OR "*Phytophthora drechsleri*" OR "*Phytophthora infestans*" OR "*Phytophthora nicotianae*" OR "*Podosphaera xanthii*" OR "*Pseudoidium neolycopersici*" OR "*Sclerotinia sclerotiorum*" OR "*Stagonosporopsis andigena*" OR "*Thielaviopsis basicola*" OR "*Verticillium dahliae*" OR "*Phytophthora tropicalis*"

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

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

APPENDIX C

List of pests not further assessed (Reserve List)

TABLE C.1 List of potential pests not further assessed. In this list pest species are included if there is any uncertainty on: (a) the pest status in Kenya; (b) if *Petunia* spp. or *Calibrachoa* spp. can be a host for the pest; (c) if the pest could have impact.

Pest name	EPPO code	Group	Pest present in Kenya	Present in the EU	EU regulatory status	Justification for inclusion in this list
Calonectria ilicicola	CALOIL	Fungi & Chromista	Present in Kenya	Absent/Delimited	No	Uncertainty on host status
Coccidohystrix insolita	PHENIN	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant
Entyloma australe	ENTYAU	Fungi & Chromista	Present in Kenya	Absent/Delimited	No	Reported occasionally on *Petunia*, uncertainty on impact
Ferrisia virgata	PSECVI	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant.
Maconellicoccus hirsutus	PHENHI	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant
Paracoccus marginatus	PACOMA	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant
Phenacoccus parvus	PHENPA	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant
Planococcus minor	PLANMI	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant
Pseudocercospora atromarginalis	CERCAM	Fungi & Chromista	Uncertain	Absent/Delimited	No	Only one old record (1961) in Kenya. Reported occasionally on *Capsicum*, and mainly on *Solanum* spp., reported impact on *S. nigrum*
Pulvinaria psidii	PULVPS	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be host plant
Pulvinaria urbicola	PULVUR	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant
Scirtothrips aurantii	SCITAU	Insects & Mites	Present in Kenya	EU-Regulated Pest	A1 Quarantine pest (Annex II A)	Many Solanaceae host plant species; Petunia could be a host plant
Spodoptera frugiperda	LAPHFR	Insects & Mites	Present in Kenya	EU-Regulated Pest	A1 Quarantine pest (Annex II A)	Many Solanaceae host plant species; *Petunia* could be a host plant
Thaumatotibia leucotreta	ARGPLE	Insects & Mites	Present in Kenya	EU-Regulated Pest	A1 Quarantine pest (Annex II A)	Many Solanaceae host plant species; *Petunia* could be a host plant
Trialeurodes ricini	TRIARI	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; Petunia could be a host plant
Tomato brown rugose fruit virus	TOBRFV	Virus & viroids	Uncertain	EU-Regulated Pest	EU Emergency measures	Reported on *Petunia;* uncertainty on pest status in Kenya
Urentius hystricellus	URENHY	Insects & Mites	Present in Kenya	Absent/Delimited	No	Many Solanaceae host plant species; *Petunia* could be a host plant

APPENDIX D

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

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 International Committee on Taxonomy of Viruses (ICTV) 2021 taxonomy (ICTV_Master_Species_List_2021_v3.xlsx). The following viruses broad bean wilt virus, melon chlorotic spot virus, petunia chlorotic mottle virus and strawberry latent ringspot virus are also included, although not accepted ICTV species (ICTV_Master_Species_List_2021_v3.xlsx), because they are reported to systemically infect *Petunia hybrida* (as experimental host), they are described in EPPO GD and some are regulated. The same applies also for lucerne enation virus and tomato blistering, which infects major Solanaceae species (no data for petunia). Viruses belonging to the *Amalgavirus*, *Deltapartitivirus* and *Alphaendornavirus* 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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