SCIENTIFIC OPINION

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Pest risk assessment of *Eotetranychus lewisi* for the EU territory

EFSA Panel on Plant Health (PLH),
Michael Jeger, Claude Bragard, David Caffier, Thierry Candresse, Elisavet Chatzivassiliou, Katharina Dehnen-Schmutz, Gianni Gilioli, Jean-Claude Grégoire, Josep Anton Jaques Miret, Alan MacLeod, Bjoern Niere, Stephen Parnell, Roel Potting, Trond Rafoss, Vittorio Rossi, Gregor Urek, Ariena Van Bruggen, Wopke Van Der Werf, Jonathan West, Stephan Winter, Filippo Bergeretti, Niklas Bjorklund, Olaf Mosbach-Schulz, Sybren Vos and Maria Navajas Navarro

Abstract

Following the 2014 EFSA's Panel on Plant Health scientific opinion on the pest categorisation of the spider mite *Eotetranychus lewisi,* the European Commission requested the Panel to perform a pest risk assessment and evaluate the risk reduction options. A stochastic model was used to assess entry, establishment and spread and related uncertainties. In the EU, *E. lewisi* has only been reported to occur in Portugal (Madeira). Entry pathways assessed were strawberry plants for planting from the USA, poinsettia and raspberry plants for planting, and orange and lemon fruits from third countries. Entry is most likely via poinsettia. Under current EU phytosanitary requirements, there is around a one in ten chance that *E. lewisi* will establish outdoors over the next 10 years. Although unlikely, establishment would most likely occur in southern Europe where environmental conditions, temperature and host density, are most suitable. If *E. lewisi* did establish, pest spread is expected to be mainly human assisted, most likely the mite being transported long distances on plants for planting. Nevertheless, while remaining a regulated pest, spread would be slow and most likely confined to one NUTS 2 area after 10 years. Under a scenario with enhanced measures (pest free place of production) at origin, the Panel's assessment indicate that it is extremely unlikely that *E. lewisi* would establish within 10 years hence spread is also extremely unlikely. The absence of trade of host plants from Madeira to other parts of the EU could explain why *E. lewisi* has not spread to other EU Member States. *E. lewisi* is reported as reducing yield and quality of peaches and poinsettia and is regarded as a growing concern for strawberry and raspberry growers in the Americas. The Panel concludes that should *E. lewisi* be introduced in the EU similar impacts could be expected.

Keywords: Lewis mite, quarantine pest, plant health, quantitative risk assessment, pathway analysis, risk reduction options

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Correspondence: alpha@efsa.europa.eu

Panel members: Claude Bragard, David Caffier, Thierry Candresse, Elisavet Chatzivassiliou, Katharina Dehnen-Schmutz, Gianni Gilioli, Jean-Claude Grégoire, Josep Anton Jaques Miret, Michael Jeger, Alan MacLeod, Maria Navajas Navarro, Bjoern Niere, Stephen Parnell, Roel Potting, Trond Rafoss, Vittorio Rossi, Gregor Urek, Ariena Van Bruggen, Wopke Van Der Werf, Jonathan West and Stephan Winter.

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1. Introduction

1.1. Terms of Reference (ToR) as provided by the requestor

The European Food Safety Authority (EFSA) is requested, pursuant to Article 22(5.b) and Article 29 (1) of Regulation (EC) No 178/2002[1], to provide a scientific opinion in the field of plant health. Specifically, as a follow up to the request of 29 March 2014 (Ares(2014)970361) and the pest categorisations (step 1) delivered in the meantime for 38 regulated pests, EFSA is requested to complete the pest risk assessment (PRA), to identify risk reduction options and to provide an assessment of the effectiveness of current EU phytosanitary requirements (step 2) for (1) *Ceratocystis platani* (Walter) Engelbrecht et Harrington, (2) *Cryphonectria parasitica* (Murrill) Barr, (3) *Diaporthe vaccinii* Shaer, (4) *Ditylenchus destructor* Thorne, **(5) *Eotetranychus lewisi* (McGregor),** (6) Grapevine Flavescence dorée and (7) *Radopholus similis* (Cobb) Thorne.

During the preparation of these opinions, EFSA is requested to take into account the recommendations, which have been prepared on the basis of the EFSA pest categorisations and discussed with Member States in the relevant Standing Committee. In order to gain time and resources, the recommendations highlight, where possible, some elements which require further work during the completion of the PRA process.

Recommendation of the Working Group[2] on the Annexes of the Council Directive 2000/29/EC[3] – Section II – Listing of Harmful Organisms as regards the future listing of *Eotetranychus lewisi* (McGregor)

Based on the pest categorisation prepared by EFSA, *E. lewisi* has the potential to be both a quarantine pest, as it fulfils all ISPM 11 criteria, and a Non-Regulated Quarantine Pest, as it fulfils all ISPM 21 criteria. However, it is noted that information on the potential impact is very limited.

At the same time, the organism is currently regulated only for plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf. and their hybrids. However, the affected host range is broader than what is currently covered. There are major hosts such as plants of *Euphorbia*, *Rubus*, *Fragaria*, *Prunus, Vitis,* etc. which are not regulated for this specific organism. In the European Union (EU), it has been found, for example, also on plants of *Corokia cotoneaster* in 1999. The pathways of spreading are numerous.

The Working Group[2] recommends to keep this organism as **Union Quarantine Pest**.

To support further decisions on risk reduction options, the PRA process has to continue. In particular, EFSA is asked to focus further work on the probability of entry of the pest (identification of the pathways), its establishment, as well as further spread after its establishment in the EU. It is important to explore as well the reasons for its absence in the EU. Additional information as regards the degree of impact would be also relevant even though the Working Group[2] above acknowledges the absence of data in this respect.

At the same time, the Working Group[2] highlights for further analysis and consideration that it is important to address all possible host plants in the future legislation. Internal movement requirements on the host plants for planting from the infested areas (Madeira) would be needed (plant passport). Specific Annex IVAI and Annex IVAII requirements are considered to be important, particularly because it is difficult to detect the organism by naked eye. Specific measures could include Pest Free Area (PFA) or pest free place of production or site, or removal of diseased plants and appropriate treatments.

Lastly, the Working Group[2] believes that if surveys demonstrated that the organism has a much wider distribution than is officially known, the Regulated Non-Quarantine Pest status could be considered. However, at the present, this status has to be excluded.

1.2. Interpretation of the Terms of Reference

1.2.1. Pest categorisation

In 2014, the Panel on Plant Health performed a pest categorisation of the Lewis spider mite, *E. lewisi* for the EU (EFSA PLH Panel, 2014a). The Lewis spider mite is a well-defined and

[1] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31, 1.2.2002, p. 1–24.

[2] PAFF Committee Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms.

[3] Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community. OJ L 169, 10.7.2000, p. 1–112.

distinguishable pest species that has been reported from a wide range of hosts, including cultivated species. Its distribution in the EU territory is restricted to Madeira in Portugal. In the UK, an outbreak was reported and eradicated as confirmed by MacLeod A., DEFRA, UK (personal communication). The pest is listed in Annex IIAI to Council Directive 2000/29/EC.[3] A potential pathway of introduction and spread is plants traded from outside Europe and between EU Member States. The Lewis spider mite has the potential to establish in large parts of the EU territory based on climate similarities with the distribution area outside the EU and the widespread availability of hosts present both in open fields and in protected cultivations. With regard to the potential consequences, a few studies provide quantitative data on impact showing that the pest can reduce yield and affect quality of peaches and poinsettias, while a few studies describe the general impact of the pest on cultivated hosts. Although chemical treatments are reported to be effective in controlling the Lewis spider mite, it is mentioned as a growing concern for peaches, strawberries, raspberries and vines in the Americas.

Based on the pest categorisation of *E. lewisi*, and in the context of the revision of the listing of harmful organisms in the Annexes to Council Directive 2000/29/EC[3] – Section II – the Standing Committee on Plants, Animals, Food and Feed (PAFF Committee) – section Plant health –, provided recommendations to EFSA to take into account in the risk assessment of *E. lewisi.*

1.2.2. Interpretation of ToR

The scope of this scientific opinion is to assess the risk posed to plant health in the EU territory of *E. lewisi.* Information already provided in the pest categorisation of *E. lewisi* (EFSA PLH Panel, 2014a) is not repeated here unless necessary.

The pest distribution in the EU is currently restricted to Madeira Island in Portugal. The Panel first considers reasons why *E. lewisi* has not spread from Madeira before, then focusing the assessment on the probability of introduction from Third Countries and on the potential impact of the pest as a consequence of introduction in the PRA area.

The Panel on Plant Health (hereinafter referred to as the Panel) interprets the ToR as a request from the European Commission to conduct a full PRA, to identify risk reduction options and to provide an assessment of the effectiveness of current EU phytosanitary requirements.

In view of the recommendations provided by the PAFF committee to continue the risk assessment process, several objectives and related questions have been defined for performing the assessment:

1) Assess the distribution of *E. lewisi*
   - Is *E. lewisi* currently present in Madeira?
   - What is the distribution of *E. lewisi* in the EU excluding Madeira?
   - What is the world distribution of *E. lewisi*?
2) Assess the potential impact of *E. lewisi* in the EU
   - What is the host range for the pest?
   - What is the host-pest association in the world?
   - What is the host occurrence in Madeira?
   - What is the host occurrence in the EU excluding Madeira?
   - What is the trade activity and the main flows related to the hosts from Madeira to the rest of the EU?
   - What is the trade activity and the main flows related to the hosts from third countries to the EU excluding Madeira?
3) Conduct a full pest risk assessment under different scenarios
   - What are the scenarios to be considered?
   - What is the probability of entry?
   - What is the probability of establishment?
   - What area is the pest likely to establish in during the time horizon of the risk assessment?
   - What is the magnitude of the potential consequences?
4) Explore reasons for a possible absence of *E. lewisi* in the EU (excluding Madeira)
   - Which are the pathways that remain open for internal movement?

In this scientific opinion, the PRA area is defined as the area of application of Council Directive 2000/29/EC[3] composed of the continental territory of the European Union (hereinafter referred to as the EU) with 28 Member States (hereinafter referred to as EU MSs), excluding the overseas countries and territories and outermost regions except Madeira and Açores islands.

2. Data and methodologies

2.1. Methodologies

2.1.1. Pilot case for new pest risk assessment methodology

The Panel performed the risk assessment for *E. lewisi* following the guiding principles defined in

i) the International Standard for Phytosanitary Measures (ISPM) No. 11 (FAO, 2013), and in,
ii) the EFSA guidance documents.

- PLH Panel guidance on a harmonised framework for risk assessment (EFSA PLH Panel, 2010);
- Scientific Committee Guidance on Transparency in the Scientific Aspects of risk assessments carried out by EFSA. Part 2: General Principles (EFSA, 2009);
- Scientific Committee Guidance on the structure and content of EFSA's scientific opinions and statements (EFSA Scientific Committee, 2014a);
- Scientific Committee Guidance on Statistical Reporting (EFSA Scientific Committee, 2014b);
- Scientific Committee working draft of the guidance on uncertainty (EFSA Scientific Committee, 2016);
- Guidance on Expert Knowledge Elicitation in Food and Feed Safety Risk Assessment (EFSA, 2014a).
- Application of systematic review methodology to food and feed safety assessments to support decision making (EFSA, 2010).

EFSA recommends that efforts should be made to work towards more quantitative expression of both risk and uncertainty whenever possible (EFSA Scientific Committee, 2012), i.e. where possible the expression of the probability of the negative effect and the consequences of the effect should be reported quantitatively.

In this context, a quantitative approach for pest risk assessment is currently being developed by the Panel to increase the transparency and objectivity of the assessment. At the time of the finalisation of this opinion, the framework for quantitative assessment is still under development, and this pest risk assessment constitutes a test case for the new approach and it is anticipated that further refinements may be made to the method before it is published in 2018 as a new guidance document for the EFSA PLH Panel. The methodology used for this risk assessment is quantitative and produces quantitative results (Gilioli et al., in press). As in all quantitative science, the results are reported in a manner that appropriately reflects the degree of precision or approximation of the data used. Plant health risk assessment data are often limited and some input parameters have been assessed by expert judgement, which is necessarily approximate in nature. The risk assessment outputs are thus also approximate. Therefore, outputs have been rounded to an appropriate degree to reflect the degree of approximation that is present in the assessment.

Although the model outputs generated by the spreadsheet model are precise numbers for each point in a distribution, given the uncertainties feeding into the outputs, they should not be taken as absolute values but do reflect, express and show, the Panel's thinking, with supporting text and reasoning. Therefore, outputs have been rounded to an appropriate degree to reflect the degree of approximation that is present in the assessment.

In this assessment, a stochastic model for risk assessment with quantitative expression of the risks and probabilities and related uncertainties is used.

This opinion uses probability to express knowledge, belief and related uncertainty of experts about parameters in models for entry, establishment and spread. The outcomes of the models are in the form of probability distributions of calculated measures of entry, establishment and spread. These distributions reflect the Panel's expectation of the event under scrutiny and are expressions of uncertainty of the calculated outcome variables. Both available data and expert judgement were considered in the estimated distributions. Each distribution is characterised by a median value and four additional percentiles of the distribution. The median is the value for which the probability of over- or underestimation of the actual true value is judged as equal. Calculations with the model are made by stochastic simulation, whereby values are drawn randomly from the distribution specified for each parameter. The Monte Carlo simulations are repeated at least 20,000 times to generate a probability distribution of outcomes, i.e. the outcome of the entry process in a given time period in the future. The Panel used the @Risk software version 7.5.1[4] for this work.

In the model calculation, the uncertainty of each component is passed through the model equation, so that its contribution to the uncertainty of the final result can be shown. The decomposition of uncertainty calculates the relative contribution of each individual input to the overall uncertainty of the result.

Section 3 of the assessment reports the outcomes of the analyses for the different scenarios. The distributions indicate the possible range of outcomes at the time horizon of the opinion.

The distributions of the uncertain components are characterised by different values and ranges:

The median is a central value with equal probability of over- or underestimating the actual value. In the opinion, the median is also referred as 'best estimate'.

The interquartile range is an interval around the median, where it is as likely that the actual value is inside as it is likely that the actual value is outside that range. The interquartile range is bounded by the 1st and 3rd quartile (the 25th and 75th percentile) of the distribution. This range expresses the precision of the estimation of interest. The wider the interquartile range, the greater is the uncertainty on the estimate. In this opinion, we refer to the interquartile range by using the term 'uncertainty interval'.

For experimental designs, it is common to report the mean (m) and the standard error (s) for the precision of the estimate of a measured parameter. The interval: $m \pm s$ ($[m - s, m + s]$) is used to express an interval of likely values. This estimation concept is based on replicated measurements. In the context of uncertainty, it is not reasonable to assume replicated judgements. Therefore, the median and interquartile ranges are used instead of the mean and the interval $m \pm s$, but the interpretation of the precision of judgements is similar.

In addition to the median and interquartile range, a second range is reported: the credibility range. The credibility range is formally defined as the range between the 1st and 99th percentile of the distribution allowing the interpretation that it is extremely unlikely that the actual value is above the range, and it is extremely unlikely that it is below the range.

Further intervals with different levels of coverage could be calculated from the probability distribution, but these are not reported as standard in this opinion.

Please note that the number of significant figures used to report the characteristics of the distribution does not imply the precision of the estimation. For example, the precision of a variable with a median of 13 could be reported using the associated interquartile range, perhaps 3–38, which means that the actual value is below a few tens. In the opinion, an effort was made to present all results both as a statement on the model outcome in numerical expressions and as an interpretation in verbal terms.

The fitted distributions for all the estimated parameters are presented in the Annex B (EFSA, 2017b). Annex B is the calculation file developed in @RISK that was used for running the Monte Carlo simulations and that provides the models run used by the Panel to perform the risk assessment.

2.1.2. Pilot case for EFSA PROMETHEUS project

Moreover, this pest risk assessment is performed in accordance to the principles described in the EFSA PROMETHEUS (PROmoting METHods for Evidence Use in Scientific assessments) project where recommendations are provided both for the systematic and reasoned search of the evidence required by the risk assessors and the use of such evidence in the risk assessment (EFSA, 2015). This is an organisational development project which aims to improve further the methods for 'evidence use' (collecting, appraising and integrating data and evidence) in EFSA's scientific assessments and to increase their consistency. Drawing upon EFSA's mission and core values, the project promotes innovation in EFSA's scientific assessments and fosters the principles of impartiality, scientific excellence, transparency, openness and at the same time responsiveness. Greek for 'Forethought', in particular PROMETHEUS emphasises the importance of planning in a protocol the strategy for the scientific assessment (i.e. what evidence to use and how to use it). In the context of this pilot exercise, a protocol for the risk assessment has been prepared and is presented in the PROMETHEUS protocol for *E. lewisi* of this scientific opinion in Annex A[5] (EFSA, 2017a).

[4] @Risk, Risk Analysis Add-in for Microsoft Excel, Version 7.5.1 Professional Edition. Palisade Corporation.

[5] *Eotetranychus lewisi* PROMETHEUS protocol, Supporting document to EFSA Scientific opinion on the risk assessment of *Eotetranychus lewisi* for the EU territory, Annex A. Available online: https://doi.org/onlinelibrary.wiley.com/wol1/doi/10.2903/j.efsa.2017.4878/suppinfo

2.1.3. Specification of the scenarios

The different scenarios assessed within the pest risk assessment were identified based on the interpretation of the ToR and after discussion with the European Commission so as to provide a 'fit for purpose' risk assessment for European phytosanitary risk managers (European Commission and EU Member States). The detailed scenarios are briefly presented below and more in details in Section 3.2.1.

Scenario A0: Current regulation in place: specific requirements laid down in Annex IIAI of Council Directive 2000/29/EC[3] for the pest (only for plants of the genera *Citrus*, *Fortunella* and *Poncirus*, and their hybrids, other than fruit and seeds) and host prohibitions according to Annex IIIA to Council Directive 2000/29/EC[3].

Scenario A1: Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]) and in addition all imported host commodities should come from Pest Free Areas (PFA) in the country at origin (ISPM 4 (FAO, 1995)) and enforced measures on specific pathways.

Scenario A2: Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]) and in addition all imported host commodities should come from Pest Free Places of Production (PFPP)/Pest Free Production Sites (PFPS) in the country at origin (ISPM 10 (FAO, 1999)) enforced measures on specific pathways.

2.1.4. Specification of the pathways

Within the pest categorisation of *E. lewisi* (EFSA PLH Panel, 2014a), the Panel provided a list of 69 plants species on which *E. lewisi* had been reported. The Panel indicated that the report of the mite on a plant did not mean that the plant was a true host, i.e. a plant on which the mite can complete its life cycle. Therefore, uncertainty was expressed regarding the exact host status of many species on the list.

However, on the basis of the initial scoping activities conducted when developing the pest categorisation, poinsettia plants for planting seemed to be the most likely pathway for introduction, this pathway includes both potted plants and cuttings.

E. lewisi is reported as a rising concern in the USA on strawberry and raspberry. Importing strawberry plants and raspberry plants for planting from regions where the mite occurs provides an additional potential pathway. Such pathways remain open for import into the EU and are therefore considered as relevant pathways.

The pest is reported as having impact on citrus fruits (lemons and oranges) and this is an open pathway and therefore considered as relevant.

Plants for planting of the genera *Prunus* and *Vitis* are also potential pathways. However, these commodities are prohibited for import into the EU as laid down in Annex III to Council Directive 2000/29/EC[3]. As a consequence, these pathways are considered closed and therefore are not addressed in this pest risk assessment.

In conclusion, the potential pathways for entry of the pest that were retained for the assessment are:

i) poinsettia plants (unrooted cuttings and rooted cuttings and young plants) imported from third countries where the pest occurs;
ii) strawberry plants for planting imported from the USA;
iii) raspberry plants for planting imported from third countries where the pest occurs;
iv) citrus (oranges and lemons) fruits imported from third countries where the pest occurs.

2.1.5. Specification of different units used

Table 1 provides a summary of the units that have been used for each risk assessment step. The choice of the units was performed in order to perform the analyses on homogeneous pathway, transfer and production units in terms of exposure and potential infestation with the *E. lewisi*.

Table 1: Summary table of the specifications of the assessment

Pathways	**Poinsettia plants (unrooted cuttings and rooted cuttings and young plants) imported from third countries where the pest occurs**	**Strawberry plants for planting imported from the USA**	**Raspberry plants for planting imported from third countries where the pest occurs**	**Citrus (oranges and lemons) fruits imported from third countries where the pest occurs**
Units for entry	No infested packs imported per year			No of infested fruits per year
Units for establishment	No of infested glasshouses with at least one established population	No of infested ha with at least one established population		
Units for spread	No of newly infested NUTS 2 areas for 10 years			
Units for impact	Yield losses on host crops			
Production unit	No potted plants per ha	No plants per ha	No plants per ha	Tonnes per ha
Time step	1 year			
Time horizon	10 years			
Spatial resolution	1 ha/NUTS 2 level			

2.1.6. Risk assessment framework

To perform the risk assessment of *E. lewisi* for the EU territory, the Panel applies the newly developed approach that consists of a stochastic model and a quantitative expression of the risk and related uncertainties. This assessment is done for each step and sub-step of the risk assessment in line with the guidelines provided in ISPM 11 (FAO, 2013).

2.1.6.1. Entry and establishment

In this opinion, the assessment of the introduction of the pest in the EU territory is performed separately for entry and establishment for the four different pathways because the intended use of the plant material on each pathway affects the likelihood of establishment. Moreover, the data available for analysing each pathway is variable and the models for entry and establishment have been developed separately each pathway. Regarding the raspberry plants for planting pathway, the Panel provides a narrative assessment and did not implement the quantitative approach as the evidences found are sufficient and robust enough to assume that this commodity is not a pathway for entry of the pest into the EU territory. Three models for entry and establishment were developed in this opinion, one for the poinsettia plants for planting, strawberry plants for planting, and citrus fruit pathways.

The outcome of these models is expressed in a number of infestation units resulting from each pathway. The infestation unit represents a potential founder population. Following an assessment of likelihood of establishment, potential founder populations that enter can become actual founder populations.

The sum of actual founder populations from all pathways are combined and used as the starting point of the assessment of the spread in the EU territory.

2.1.6.2. Spread

The dispersal of the mite under scrutiny is assessed using a spread model that takes into account the 10-year time horizon considered within this assessment. The objective of the assessment of the spread is to estimate the number of spatial units likely to be occupied by the pest at the time horizon. Two components of spread can be distinguished, the long distance dispersal and the short distance dispersal. The dispersal strategies can be described using complex mathematical models integrating the contribution of both continuous dispersal and long distance dispersal (Shigesada et al., 1995). In this scientific opinion, the Panel used a simplified approach for the spread assessment. Like other mites, the natural dispersal of *E. lewisi* is slow and the detailed process of local spread and population increase within each spatial unit is not quantitatively assessed. The Panel considers mainly the long distance dispersal that essentially depends on human assisted spread (e.g. trade of the host plants or parts of them, movement of machinery, conveyances, hitch-hiking, wood packaging material) as responsible for the colonisation of territory across the whole area of the EU. The Panel assessed the spread running a logistic growth model.

2.1.6.3. Potential consequences

Following the assessment of spread, the potential consequences the pest could cause on the main host crops in the EU territory is addressed narratively: namely production of strawberry, poinsettia, citrus, raspberry, *Prunus* and grapevine, using a global approach and taking into consideration other relevant potential hosts including some weeds. Here, the Panel limits the approach, as requested in the ToR, to providing additional information that was identified after the systematic screening both of the peer-reviewed and grey literature as presented in Annex A[5] (EFSA, 2017a) as compared to the pest categorisation of *E. lewisi* (EFSA PLH Panel, 2014a).

2.1.6.4. Risk assessment framework

Figure 1 summarises the framework that has been followed in this scientific opinion for the different scenarios of the risk assessment.

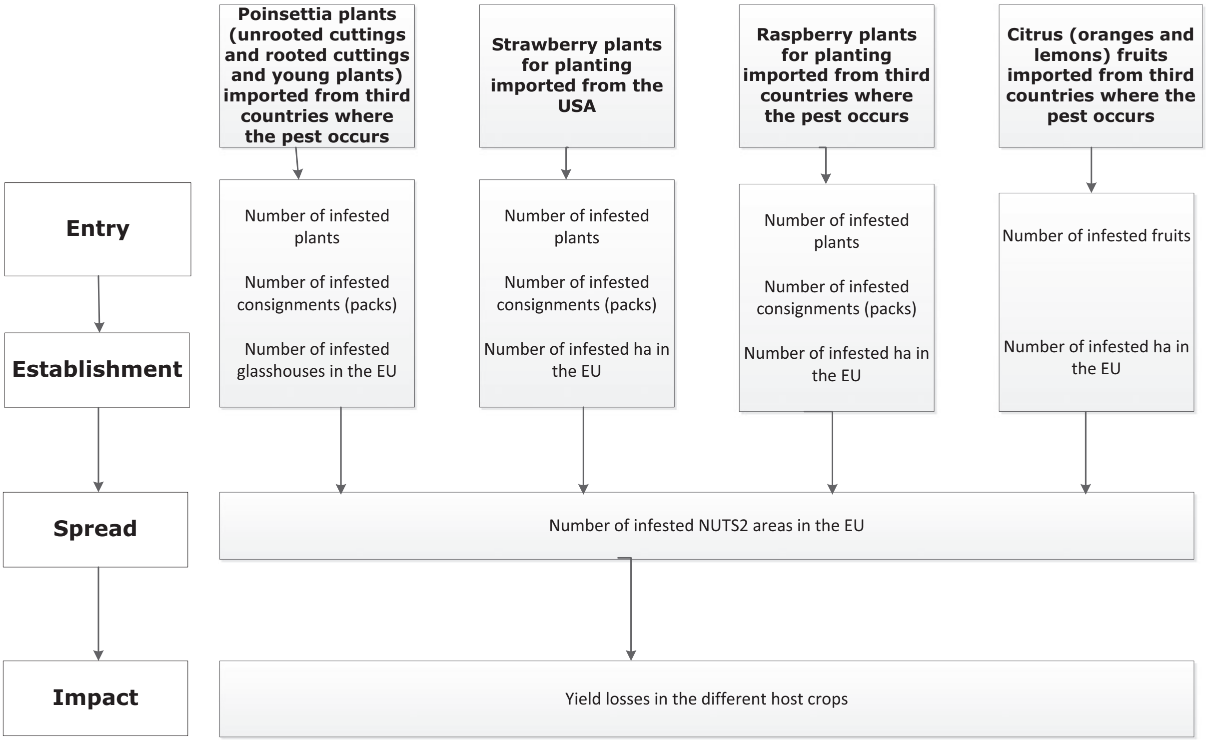

Figure 1: Risk assessment framework developed for assessing the risk posed by *E. lewisi* to the EU territory under different scenarios

In this opinion, the Panel present the results of the assessments and the respective discussions. Appendix A describes the notations and the units used in this document. The details of the quantitative analyses for the different pathways are presented in separate Appendices B, C and D.

2.2. Data and literature searches

Regarding the literature searches, in the context of the pilot exercise of the PROMETHEUS project, a report has been prepared in the form of a protocol for the systematic retrieval of the evidence for the purpose of the risk assessment of *E. lewisi* for the EU territory and is presented in Annex A[5] (EFSA, 2017a). This report includes the search strategies that were used for collecting the data, the documented data extraction process and the corresponding results.

Trade data have been collected and used from different sources:

- Dutch trade inspection data[6] (hereinafter referred to as NL-NPPO, 2017);
- European Commission, Statistical Office of the European Communities (EUROSTAT, online);
- ISEFOR trade data (Increasing Sustainability of European Forests: Modelling for security against invasive pests and pathogens under climate change);

[6] Data were kindly provided by the Dutch National Plant Protection Organisation.

- International Statistics on Flowers and Plants 2016 (AIPH, 2016);
- Spanish Strawberry and raspberry import data[7] (hereinafter referred to as MAPAMA, 2017).

Also, the Panel was informed about the situation and the experience of the Lewis mite in California and the data were used to better understand the potential risks posed by the pest under scrutiny to the EU territory.

In 2016, several member states performed surveys for confirming the pest status in their territories. However, at the time of publication of this scientific opinion, the results are still incomplete and the Panel therefore in this risk assessment considers the same pest status as indicated in the pest categorisation of *E. lewisi* (EFSA PLH Panel, 2014a), i.e. the pest is not known to occur in the pest risk assessment area except for in Portugal with a restricted distribution to the island of Madeira.

3. Assessment

In 2014, the Panel on Plant Health performed a pest categorisation of the Lewis spider mite, *E. lewisi*, for the EU, where a comprehensive description of the biology of the pest has been provided and serves as a basis of the pest risk assessment presented in this document. Information presented in the pest categorisation document (EFSA PLH Panel, 2014a) is repeated in this scientific opinion only when necessary.

3.1. Distribution of *Eotetranychus lewisi*

3.1.1. Update on the world distribution of *Eotetranychus lewisi*

The Panel performed a systematic literature search and corresponding data extraction, for defining and updating the world distribution of the mite (Annex A[5] (EFSA, 2017a)). This activity was based on the reports available both in peer-reviewed and grey literature and complemented with the information available at the EPPO Global database (EPPO, 2017). The latter was updated on 23/5/2017 with the additional information resulting from the Panel's systematic literature search and appraisal of the evidence.

A summary of these findings is presented in Table 2 and Figure 2.

Table 2: World distribution of *Eotetranychus lewisi* based on the Panel's systematic literature search and appraisal of the evidence (Annex A[5] (EFSA, 2017a)) and EPPO global database (updated on 23/5/2017)

Continent	Country	References
Africa	Libya	Damiano (1964), Vacante (2010)
	South Africa	Smith Meyer (1974), Vacante (2010)
Asia	Japan	Ehara (1999), Smith Meyer (1974)
	Philippines	Corpuz-Raros (2001)
	Taiwan	EPPO (2007), Ho (2007), Ho and Shih (2004), Ho et al. (2005), Vacante (2010)
	Portugal (*Madeira)*	Borges et al. (2008), Carmona (1992), Vacante (2010)
Europe	*Poland*[(a)]	Karnkowski (2004)
	United Kingdom[(b)]	EPPO (2014)
North America	Canada	Costello (1996), OMAFRA (2014)
	USA	Baker and Tuttle (1994), Anonymous (1982), Doucette (1962), Ehara (1999), Garrett and Haramoto (1967), Helle et al. (1981), Howell and Daugovish (2013), Jeppson et al. (1950), Jeppson (1951, 1953, 1958a,b), McGregor (1943), Dara (2011), Vacante (2010), Zalom (2016)
		Baker and Tuttle (1994)
	California	McGregor (1943), Jeppson (1951), Doucette (1962), Baker and Tuttle (1994)
	Florida	Doucette (1962)

[7] Data were kindly provided by the Spanish Ministry of Agriculture and Rural Affairs.

Continent	Country	References
	Hawaii	Garrett and Haramoto (1967)
	Maryland	Anonymous (1998)
	Michigan	CAB International (2000)
	Arizona	Baker and Tuttle (1994)
	Illinois	
	Massachusetts	
	Oregon	
	Washington	
South America	Central and South America	Ehara (1999), Pantoja (2001)
	Bolivia	Vacante (2010)
	Chile	Gonzalez (1989), SAG (2014), Sazo Rodríguez et al. (2003), Vacante (2010)
	Colombia	Urueta (1977), Vacante (2010)
	Costa Rica	Baker and Pritchard (1962), Doucette (1962), Vacante (2010)
	El Salvador	Andrews and Poe (1980), Vacante (2010)
	Guatemala	Ochoa et al. (1991), Vacante (2010)
	Honduras	Baker and Pritchard (1962), Vacante (2010)
	Mexico	Abato-Zárate et al. (2014), Abato-Zárate (2011), Baker and Tuttle (1994), Citalan Estrada and Sanchez Valdez (1998), Mena Covarrubias and Zegbe Domínguez (2007), Doucette (1962), Ehara (1999), Pérez-Santiago et al. (1998, 2007), Quintero and Acevedo (1991), Tuttle et al. (1974), Vacante (2010)
	Nicaragua	Baker and Pritchard (1962), Vacante (2010)
	Panama	Ochoa et al. (1991), Vacante (2010)
	Peru	Vacante (2010)

(a): Detection of this organism has not been confirmed by SPHSIS (Central Laboratory of Polish Plant Health and Seed Inspection Service). All such foci were successfully controlled.
(b): 2014 Outbreak in England was eradicated MacLeod A., DEFRA, UK (personal communication).

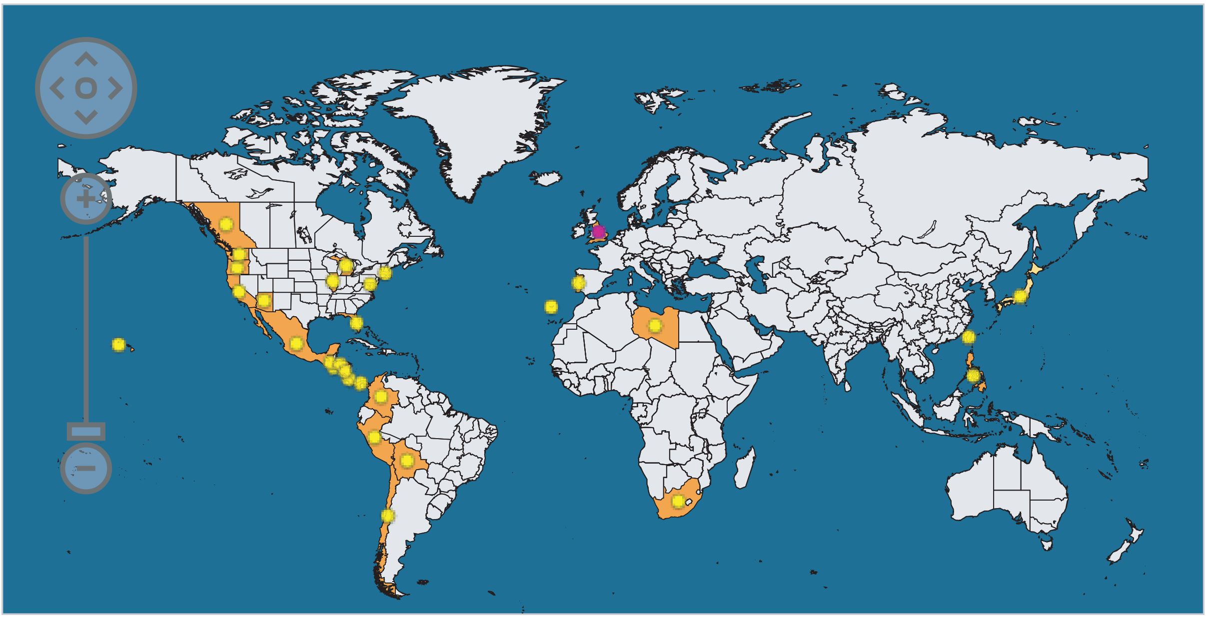

Figure 2: World distribution of *Eotetranychus lewisi* from EPPO Global Database (accessed on 23/5/2017) (Yellow circle indicate present status; Purple circles indicate transient status)

3.1.2. Occurrence of *Eotetranychus lewisi* in the EU

In 2013, EFSA consulted the EU Member States through a questionnaire sent to the National Plant Protection Organizations (NPPOs) to confirm or revise the pest status in their territory as indicated in the EPPO PQR database.[8] Only one EU Member State confirmed the absence of the pest through survey. In the absence of reply, the Panel considered the pest status indicated in the EPPO PQR. The results of the 2014 questionnaire are presented in the pest categorisation of *E. lewisi* (Table 2 of EFSA PLH Panel, 2014a) as well as in Table 3 below.

This information from the 2014 pest categorisation was updated and the currently in the EU, *E. lewisi* is only present in Portugal with a restricted distribution in the Island of Madeira. In Poland, Labanowski (2009) reported some outbreaks on poinsettia in glasshouses but the identification of the pest had not been confirmed and all such foci were successfully controlled.

In 2014, an outbreak in England in a poinsettia glasshouse was reported (EPPO, 2014) and successfully eradicated (MacLeod A., DEFRA, UK, personal communication).

In 2016, with regard to surveillance of *E. lewisi*, the Lewis spider mite in the EU, 12 Member states were included in the list of Member States applying to the Union co-financing for the survey programmes 2016 according to EC (2015: i.e. the Annex II of the European Commission working document SANTÉ/12127/2015). However, it was not possible based on preliminary surveys results kindly provided by EU Member States to EFSA, to determine if *E. lewisi* was present or absent in the different Member States. The survey designs are not comparable and the Panel recognises the need for harmonising the pest surveillance activity across the EU as analysed and concluded in EFSA PERSEUS Project (Bell et al., 2014). From the analysis of the preliminary results, the Panel can highlight some key issues:

i) the target population of the surveys were different across the EU as the Member States did not sample the same host plants;
ii) the detection methods used are variable;
iii) the design prevalence and confidence levels are not indicated.

For these reasons, the Panel considers for its risk assessment the pest status in the EU as described in Table 3 and concludes that *E. lewisi* is not known to occur in the risk assessment area except for Portugal with a restricted distribution in the Madeira Island.

Table 3: Current distribution of *Eotetranychus lewisi* in the risk assessment area, (Updated and modified Table 2 of EFSA PLH Panel (2014a))

Member states	NPPO answers in 2013
Austria	**Absent**, no pest records
Belgium	**Absent**, no pest records
Bulgaria	**Absent**
Croatia[(b)]	**Absent,** no pest records
Cyprus	–
Czech Republic[(b)]	**Absent**, no record
Denmark[(b)]	Known not to occur
Estonia[(b)]	**Absent**, no pest records
Finland[(b)]	**Absent,** no pest records
France[(a)]	—
Germany[(b)]	**Absent**, no pest records
Greece[(a)]	—
Hungary	**Absent**, no pest records
Ireland	**Absent**, no pest record
Italy	No data
Latvia[(a)]	–
Lithuania[(a),(b)]	–
Luxemburg[(a)]	–

[8] PQR – EPPO Plant Quarantine Data Retrieval system: https://www.eppo.int/DATABASES/pqr/pqr.htm

Member states	NPPO answers in 2013
Malta[(b)]	**Absent**, no pest records
Netherlands[(b)]	**Absent**, confirmed by survey
Poland[(b)]	**Present,** few occurrences (in glasshouses only) Detection of this organism has not been confirmed by SPHSIS (Central Laboratory of Polish Plant Health and Seed Inspection Service) All such foci were successfully controlled
Portugal[(b)]	**Present**, restricted distribution (in Madeira)
Romania[(a)]	–
Slovak Republic	**Absent**, no pest record
Slovenia	**Absent**, no pest records on *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf.
Spain	**Absent**
Sweden[(b)]	**Absent**, no pest record
United Kingdom	**Absent** Outbreak in poinsettia glasshouse (EPPO, 2014) successfully eradicated (MacLeod, DEFRA, UK, personal communication)
Iceland[(a)]	–
Norway[(a)]	–

–: No information available; EPPO PQR: European and Mediterranean Plant Protection Organization Plant Quarantine Data Retrieval System; NPPO: National Plant Protection Organization.
(a): When no information was made available to EFSA, the pest status in the EPPO PQR (2012) was used.
(b): Member states included in the list of Member States applying to the Union co-financing for the survey programmes 2016 according to EC (2015).

3.2. Definition of the assessments performed by the Panel

3.2.1. Scenarios

The different scenarios identified for this risk assessment are the following:

- **Scenario A0:** Current regulation in place: specific requirements laid down in Annex IIAI of Council Directive 2000/29/EC[3] for the pest (only for plants of the genera *Citrus*, *Fortunella* and *Poncirus*, and their hybrids, other than fruit and seeds) and host prohibitions according to Annex IIIA to Council Directive 2000/29/EC.[3]

E. lewisi being a regulated quarantine pest, this scenario assumes that, when detected eradication measures would be implemented. This was the case when the mite was detected in the UK (EPPO, 2014) and Poland (Labanowski, 2009).

- **Scenario A1:** Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]), and in addition, all imported host commodities should come from Pest Free Areas (PFA) in the country at origin (ISPM 4 (FAO, 1995)) and enforced measures on specific pathways.

Same as scenario A0, scenario A1 assumes that *E. lewisi* is a regulated quarantine pest and if detected, would be subjected to eradication.

- **Scenario A2:** Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]) and in addition all imported host commodities should come from Pest Free Places of Production (PFPP)/Pest Free Production Sites (PFPS) in the country at origin (ISPM 10 (FAO, 1999)) enforced measures on specific pathways.

In the country at origin, for ensuring that the raspberry and strawberry plants for planting imported into the EU are free from *E. lewisi*, similar requirements as the ones against American *Anthonomus* spp. laid down in point 21.3 of Annex IVAI to Council Directive 2000/29/EC[3] for strawberry plants for planting (see Appendix G, Section G.3) could be envisaged. Same as previous scenarios, A2 assumes that *E. lewisi* is a regulated quarantine pest and if detected, would be subjected to eradication.

A summary of the different risk reduction options pertaining to the three scenarios above is presented in Appendix G.

3.2.2. Pathways

Four potential pathways for entry and establishment of the pest were retained for the assessment:

i) poinsettia plants (unrooted cuttings and rooted cuttings and young plants) imported from third countries where the pest occurs;
ii) strawberry plants for planting imported from the USA;
iii) raspberry plants for planting imported from third countries where the pest occurs;
iv) citrus (oranges and lemons) fruits imported from third countries where the pest occurs.

E. lewisi has other hosts of major commercial importance in the EU which would be potentially impacted were the pest could establish and spread within the EU, i.e. *Prunus* and *Vitis*. Regarding plants for planting of *Prunus*, according to point 9 of Annex IIIA to Council Directive 2000/29/EC[3] only imports into the EU from non-European countries of dormant plants free from leaves flowers and fruit are possible. Therefore, the *Prunus* pathway is closed at present as the mite occurs on leaves and would not be found on dormant plants. Regarding plants for planting of *Vitis* other than fruits, their import into the EU are prohibited from third countries other than Switzerland according to point 15 of Annex IIIA to Council Directive 2000/29/EC[3]. *Prunus* and *Vitis* plants were not considered as pathways for entry in the assessment.

The ToR (Section 1.1) informs the Panel that *E. lewisi* was found in 1999 in the EU on *C. cotoneaster* but no further information was provided. However, during the literature searches performed in the frame of the PROMETHEUS protocol (Annex A[5] (EFSA, 2017a)), no information about this plant species was retrieved. In this context, the Panel considers the finding of *E. lewisi* on *C. cotoneaster* as incidental and assessing *C. cotoneaster* as a specific pathway is not warranted. Nevertheless, it does add to the overall uncertainty regarding likelihood of entry and the precise host range of *E. lewisi*.

3.2.3. Summary of the objects of the assessment

Table 4 shows a summary of the different assessments presented by the Panel in this document. The table also indicates in which sections and corresponding appendices the detailed assessments are presented.

Table 4: Summary of the objects of the assessment

Risk assessment step	Pathways	Scenario	Type of assessment	Section and Appendix
Entry and establishment	Poinsettia plants from third countries where *Eotetranychus lewisi* occurs	A0 + A2	Quantitative	Section 3.3.1 and Appendix B
Entry and establishment	Strawberry plants for planting from the USA	A0	Quantitative	Section 3.3.2 and Appendix C
Entry and establishment	Raspberry plants for planting from third countries where *E. lewisi* occurs	A0	Narrative	Section 3.3.4
Entry	Citrus fruits from third countries where *E. lewisi* occurs	A0	Quantitative	Section 3.3.5 and Appendix D
Establishment	Abiotic and Biotic factors for assessing establishment including climate suitability and host availability in the EU			Appendix E
Spread	All hosts	A0	Quantitative	Section 3.4 and Appendix F
Impact	Additional information		Narrative	Section 3.5

3.3. Risk of introduction of *Eotetranychus lewisi* into the EU

The suitability of the environment for the pest in the EU in terms of climate suitability and host plants availability is relevant for the analyses of all the pathways under scrutiny and is described under Section 3.3.5 and in more in details in Appendix E.

3.3.1. Introduction of *Eotetranychus lewisi* through poinsettia plants (unrooted cuttings, rooted cuttings and young plants) imported from third countries where the pest occurs

The Panel developed a model for this pathway identifying the parameters that are relevant for the survival and development of the Lewis spider mite (Figure 3).

Many of the model parameters have been estimated using a semi-formal expert knowledge elicitation technique described in EFSA Scientific Committee (2016). For each parameter, the Panel provides the evidence used for its estimation and the uncertainties that were considered. The detailed results for these analyses are presented in Appendix B. In this section, the Panel provides only a summary of the key results.

3.3.1.1. Assessment of entry for the A0 scenario for the poinsettia pathway

The international trade in poinsettia has previously been very strongly implicated in the spread of *Bemisia tabaci* that occurred during the 1980s and 1990s (Dalton, 2006; Bethke et al., 2009). Given the role of poinsettia in spreading a plant pest, the finding of *E. lewisi* in glasshouse of ornamentals in the UK, linked to the import of poinsettia from Guatemala (EPPO, 2014) provided good reason to focus on poinsettia as a potential pathway for the introduction of *E. lewisi* into the EU. When considering the poinsettia pathway, the aim of the entry step in the quantitative model is to estimate the average number of infested packs of poinsettia plants (unrooted cuttings, rooted cuttings and young plants) arriving in the EU each year over the next 10 years and the average number of infested glasshouses that result from this. EU statistics reporting imports of plants for planting generally do not record information at a species level. Fortunately, import data regarding plants for planting at species level were available from the Netherlands (NL-NPPO, 2017). Given that the Netherlands import approximately 66% all EU imports of ‘other ornamentals plants’ (CN 0602 9070) which includes poinsettia (Table 6.2 in AIPH, 2016), the Dutch data provided very useful in informing an estimate of the amount of poinsettia imported into the whole of the EU (Appendix B).

The entry step is composed of eight sub-steps.

P_N0a. Poinsettia demand – Average number of poinsettia plants marketed per year in the EU

↓

P_N0b. Percentage of poinsettias imported from third countries into the EU

↓

P_N0c. Percentage of poinsettia from third countries where *E. lewisi* occurs

↓

P_E1. Conversion of pieces of poinsettia into packs as a pathway unit (including both rooted and unrooted plants)

↓

P_E2a. Percentage of packs that are infested prior to export

↓

P_E2b. Percentage of infested packs surviving (remaining infested) following export checks

↓

P_E3. Percentage of infested packs surviving (remaining infested) following transport, shipping and storage (assume transport and storage conditions are not affecting the number of packs infested by mites but could increase the density of mites within the packs) – fixed at 100%

↓

P_E4. Percentage of infested packs that remain infested after EU import checks – i.e. percentage of infested packs passing border inspection into the EU

↓

P_N1: **Entry result**: Average number of infested packs of poinsettia entering EU (per year)

Figure 3: *Eotetranychus lewisi* conceptual model for entry via poinsettia plants for planting imported from countries where the pest occurs

3.3.1.1.1. Entry assessment results

Appendix B provides a brief explanation for each sub-step and provides supporting evidence and identifies uncertainties associated with model inputs for each sub-step. Results from multiplying the inputs for each entry sub-steps in the stochastic (Monte Carlo) simulation, are provided below. We begin with results for the baseline scenario (A0) which suggest that between one pack and a few tens of packs of poinsettia would, on average, be expected to arrive in the EU each year infested with *E. lewisi*. It would be a great surprise if no infested packs, or 100 or more infested packs, arrived in a single year.

Figure 4 reflects the Panel's expectations in terms of the descending cumulative probability distribution for the number of infested packs arriving each year in the EU. The red (solid) line indicates scenario A0 (baseline). The blue (broken) line indicates scenario A2 (with additional RROs). Annotation is provided to aid interpretation of the chart.

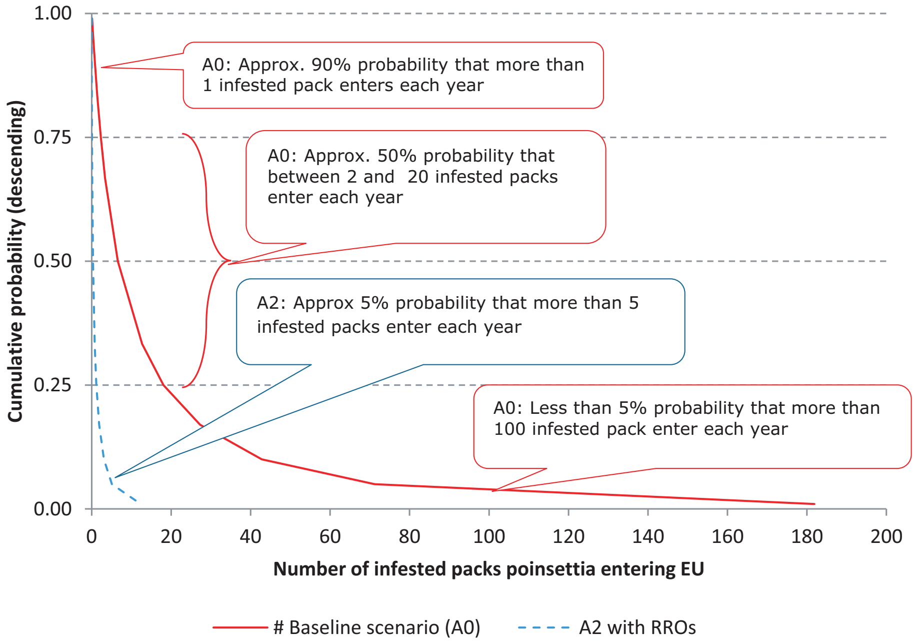

Figure 4: Panel's expectation in terms of descending cumulative probability distribution of the mean number of packs of poinsettia entering the EU each year infested with *E. lewisi* (baseline scenario A0; scenario A2 with additional RRO)

Scenario A2 considered additional RROs whereby poinsettia plants are sourced from sites purporting to be pest free places of production or pest free production sites. The difficulties and challenges in maintaining such conditions are summarised in Appendix B. There is a residual likelihood that a place of production, or a production site, certified as free from *E. lewisi* is not actually free of the pest. The results of including these RROs are indicated in Figure 4 by the blue broken line. Results from Panel estimates suggest that whilst it is unlikely that an infested pack of poinsettia will arrive in the EU from sites certified as pest free, there is approximately a 25% chance that over the time horizon, a mean of 1 or more infested packs could enter the EU each year from such sites. There is approximately a 5% likelihood that 5 or more infested packs enter from infested sites each year (Figure 4).

Comparing A0 and A2: In scenario A0, there is a 50% likelihood that on average, between 2 and 20 infested packs enter each year, while in scenario A2, there is a 50% likelihood that 0–1 infested packs enter each year.

A benefit of the quantitative model is the promulgation of uncertainty through the model. Within the model for entry via poinsettia, there are four major sub -steps that contribute the most to uncertainty (Figure 5). Three of the four sub-steps are not related to the biology of *E. lewisi* but concern the international trade in poinsettia. The uncertainties are about the average amount of poinsettia marketed each year in the EU, the amount that is imported, and the amount that is imported from countries where *E. lewisi* occurs. Improved knowledge about the future trends of where poinsettia could be sourced from, and the amount imported would narrow uncertainty in the estimate of the number of packs arriving each year in the EU infested with *E. lewisi*. As seen in other recent quantitative assessments (EFSA PLH Panel, 2016), the single greatest uncertainty regarding entry is the level of infestation of the commodity at pathway origin.

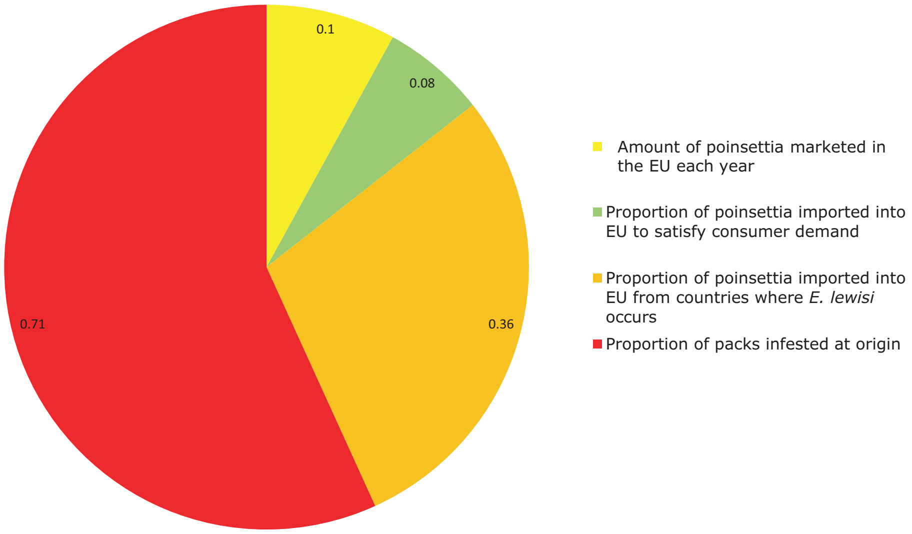

Figure 5: Entry sub-steps estimates contributing most to the overall uncertainty regarding the number of packs of poinsettia entering the EU each year infested with *E. lewisi*

3.3.1.1.2. Unquantified uncertainties in the entry assessment

i) Potential for import of infested poinsettia from countries where *E. lewisi* is not currently known to occur although it is actually present.
ii) Variation in pack size, a fixed number of plants is used for rooted and a different fixed number used for unrooted poinsettia.

3.3.1.1.3. Entry assessment conclusions

Given the uncertainties noted in the Appendix B for each sub-step, in this step of the assessment and recognising that some uncertainties have not been quantified, model output results should be interpreted in a more approximate manner than indicated in Figure 4. Hence, the Panel thinks that it is very unlikely that on average, over the next 10 years, all packs of poinsettia entering the EU from countries where *E. lewisi* is known to occur could enter free from *E. lewisi*. On the other hand, it is also very unlikely that the average number of packs that enter and are infested will be 100 or more. It is more likely that between one pack and a few tens of packs of poinsettia would, on average, enter the EU each year infested with *E. lewisi*. To put this in context, the model assumes up to approximately 80,000 packs of poinsettia enter the EU each year from third countries of which several hundred to a few thousand packs come from countries where *E. lewisi* is known to occur.

Sourcing poinsettia plants for planting from pest free places of production, or pest free production sites in countries where *E. lewisi* is known to occur is likely to prevent infested packs entering the EU altogether. However, there is a chance that *E. lewisi* is undetected at such sites allowing a small number of infested packs to enter the EU each year. The number of infested packs that could enter is estimated to be less than 10, and if not nil, is most likely to be one.

3.3.1.2. Assessment of establishment for the A0 scenario for the poinsettia pathway

Establishment is assessed by considering the proportion of potential founder populations that enter the EU and successfully transfer to hosts and are able to survive for the foreseeable future taking abiotic and biotic factors into account. Establishment includes assessing the potential founder populations that remain on a host within a glasshouse environment wherein they survive for the foreseeable future (at least until the 10 year time horizon for this risk assessment), and those populations that transfer to hosts, crops and wild plants, in the wider environment where they survive for the foreseeable future.

When considering establishment and the intended use of poinsettia plants, the establishment step is composed of five sub-steps (Figure 6). The assessment of establishment first considers establishment in EU glasshouses over the next 10 years, and uses potentially infested glasshouses, i.e. the number of glasshouses that receives a pack of poinsettia which is infested, as a starting point before considering establishment outdoors in the wider environment. Having estimated the number of infested poinsettia packs that arrive in the EU during the entry step, we now consider what happens to such packs so as to estimate the average number of founder populations that could potentially establish each year in glasshouses, or having 'escaped' from infested glasshouses that establish outdoors.

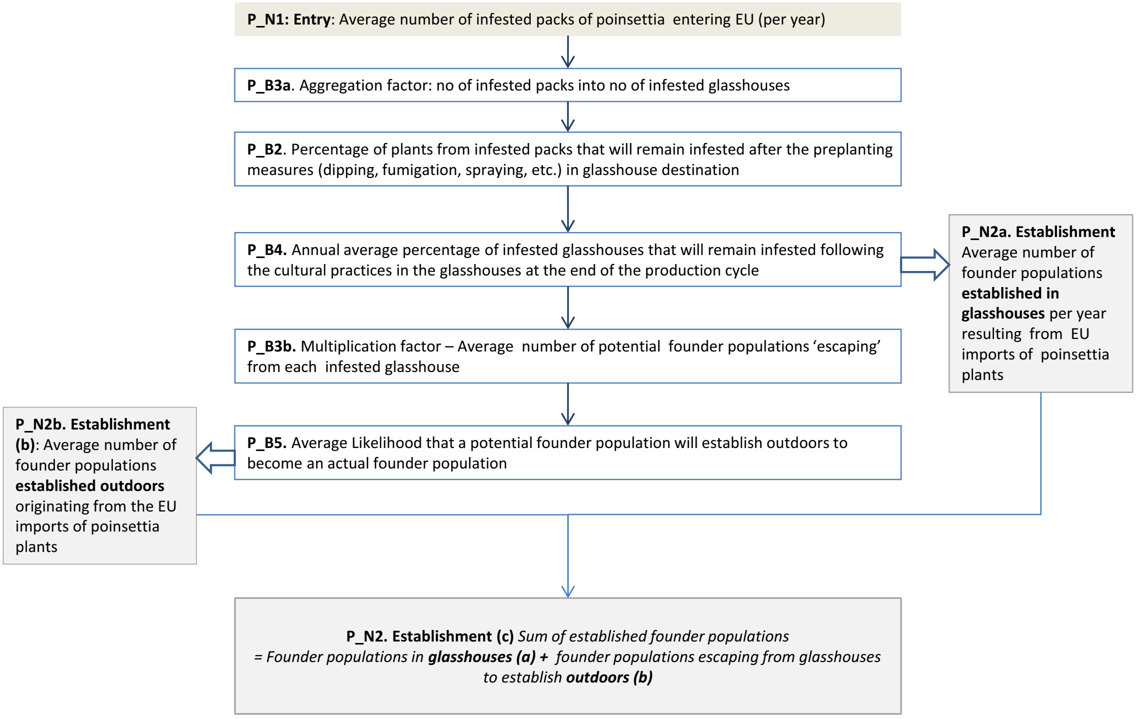

Figure 6: Conceptual model for establishment considering the intended use of poinsettia

3.3.1.2.1. Establishment assessment results

Appendix B provides a brief explanation for each sub-step shown in Figure 6 and provides supporting evidence and identifies uncertainties associated with model inputs for each sub-step. Results are provided below. We begin with results for establishment in glasshouses for baseline scenario (A0).

- **Establishment in glasshouses**

This baseline scenario A0 assumes that *E. lewisi* remains a regulated quarantine pest and that if detected in EU glasshouses action would be taken to eradicate it, as occurred in the UK and Poland. Multiplying the establishment sub-steps together in the stochastic (Monte Carlo) simulation, results show that, in the opinion of the Panel, it is unlikely that *E. lewisi* will establish in EU glasshouses and remain undetected over the next 10 years, the time horizon of this risk assessment. However, occasional incursions can be expected and outbreaks may occur; indeed the results from the assessment of entry suggest that a few infested packs are likely to arrive each year, but treatments, detection of symptoms and eradication measures applied to the quarantine pest is very likely to prevent the pest from establishing under glass in the EU. Nevertheless, a few infested plants could be marketed mistakenly from infested premises before eradication measures are applied.

Figure 7 reflects the Panel's expectations showing the descending cumulative probability distribution for the estimated number of glasshouses in which *E. lewisi* establishes. The red (solid) line indicates results for scenario A0 (baseline). The blue (broken) line indicates scenario A2 (with additional RROs).

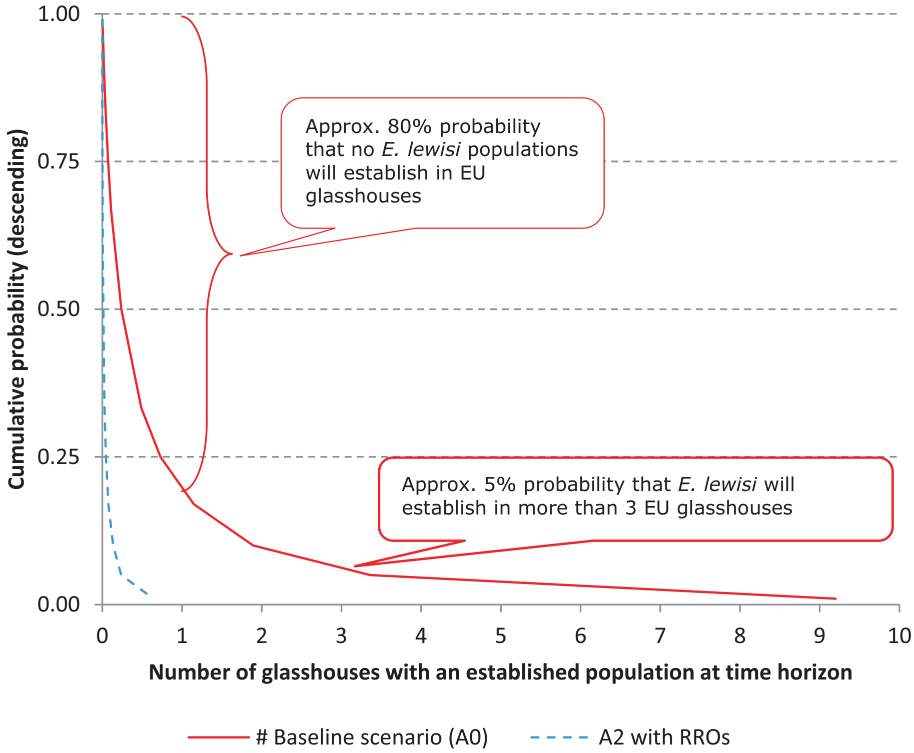

Figure 7: Panel's expectation in terms of descending cumulative probability distribution for number of glasshouses in which *E. lewisi* establishes in the EU each year (baseline scenario A0; scenario A2: poinsettia plants imported from pest free places and sites of production)

Figure 7 shows for scenario A0 that establishment of *E. lewisi* within an EU glasshouse is not expected within the next 10 years, i.e. there is less than 20% chance that *E. lewisi* will establish in an EU glasshouse each year within 10 years. With regard to scenario A2, with additional RROs in place, the Panel does not expect *E. lewisi* to establish in an EU glasshouse each year for the next 10 years (x-axis < 1 number of glasshouses).

- **Establishment outdoors**

Before the presence of *E. lewisi* in an EU glasshouse is detected, infested plants could be transferred outdoors from where the mite could transfer to other plants and potentially establish. The likelihood of such a scenario is considered in Appendix B. Model results suggest that this is unlikely to happen in scenario A0 and very unlikely to happen in scenario A2. Figure 8 reflects the Panel's expectation showing the descending cumulative probability distribution for the number of founder populations establishing each year in the EU.

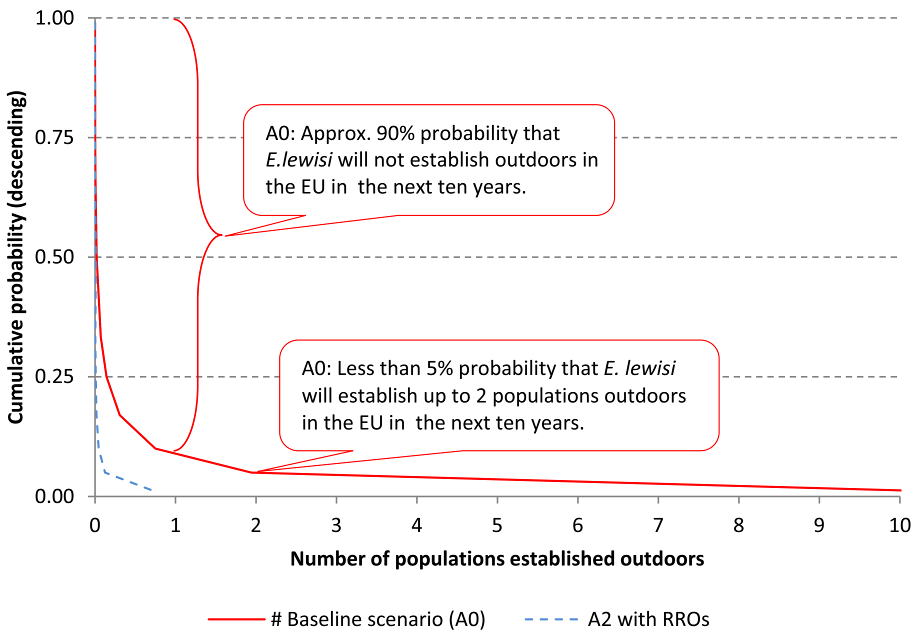

Figure 8: Panel's expectation in terms of descending cumulative probability distribution for number of founder populations of *E. lewisi* establishing outdoors in the EU each year (baseline scenario A0; scenario A2: poinsettia plants imported from pest free places and sites of production)

3.3.1.2.2. Uncertainties

With regard to the establishment in glasshouses, two factors contribute to the uncertainty around establishment in EU glasshouses; the confidence in the efficacy of initial treatment and checking conducted on recently arrived cuttings and young plants, but more significantly, the Panels estimate of the ability of *E. lewisi* to survive cultivation practices in EU glasshouses. 96% of the uncertainty around the likelihood of establishment in EU glasshouses comes from this sub-step.

With regard to the establishment outdoors, 95% of the uncertainty in the estimate of *E. lewisi* establishing outdoors in the EU is related to the number of populations of *E. lewisi* that 'escapes' from infested glasshouses. The Panel recognises that *E. lewisi* has been found on poinsettia in EU glasshouses on a number of occasions (EFSA PLH Panel, 2014a; EPPO, 2014) but was eradicated on each occasion. *E. lewisi* is not known to occur outdoors within continental EU. Nevertheless, the Panel notes that in the EU in recent years a number of exotic mite species (not quarantine listed) have established outdoors (Navajas et al., 2014).

3.3.1.3. Entry and establishment for the poinsettia pathway under A1 ('Pest Free Area') and A2 ('Pest Free Places of Production') scenarios

The current conditions (scenario A0) of cultivation of mother plants to produce cuttings (both rooted and unrooted) and young plants in third countries from which the EU imports plants for planting provide a level of protection of the crop against *E. lewisi* that is very similar to a 'Pest Free Area' situation (A1 scenario). These plants are a high value crop produced in nurseries, under controlled conditions, where the incidence of *E. lewisi* is presumed to be extremely low with measures in place to detect the presence of the mite were it would arrive in such production facilities. Furthermore, *E. lewisi* being a quarantine organism, if detected in the EU, eradication measures would apply under both scenarios A0, and A1, and successful eradication of this mite has been already achieved in recent years in the EU (Labanowski, 2009; EPPO, 2014). Therefore, the assessment of the A1 scenario for the poinsettia pathway was not performed.

A targeted control of the plant material specifically for *E. lewisi* could be also achieved through a certification scheme for producing plant material in the third countries from which the EU imports these plants, further reducing the number of infested packs leaving these countries, ideally to 0. Regarding the A2 scenario, in view of the assessment of the A0 scenario, establishment of the pest seems very unlikely in the EU.

3.3.2. Introduction of *Eotetranychus lewisi* into the EU through strawberry plants for planting imported from the USA

The Panel developed a model for this pathway identifying the parameters that are relevant for the survival and development of *E. lewisi* the Lewis spider mite (Figures 9 and 12). Many of the model parameters have been estimated using a semi-formal expert knowledge elicitation technique described in EFSA Scientific Committee (2016). For each parameter, the Panel provides the evidence used for its estimation and the uncertainties that were considered. The detailed results for these analyses are presented in Appendix C. In this section, the Panel provides only a summary of the key results.

3.3.2.1. Assessment of entry for the A0 scenario for the strawberry pathway

The EU imports strawberry plants for planting from the USA. Within the USA, the state of California is the largest producer of strawberry plants for planting, with 1,600 out of 2,000 ha in the whole country (García-Sinovas et al., 2012). As *E. lewisi* can reach pest status in strawberries in California (Strand, 2008), the Panel focused on Californian nurseries as the origin of a potential pathway for the introduction of *E. lewisi* into the EU.

The assessment of the pathway begins by considering the imports of mother plants (runners) from the USA into the EU over the next 10 years.

The aim of the entry step is to estimate the average number of *E. lewisi*-infested packs of strawberry plants for planting (plants imported into the EU to produce another generation of runners and that generation being used as plants for berry production) arriving in the EU each year over the next 10 years. The entry step is composed of four sub-steps and two conversion factors, as shown in Figure 9.

S_N0. Average kg of plants for planting of strawberry per year from the USA for the EU strawberry plants for planting production

↓

S_E1a. Conversion of kg of strawberry P4P (runners) into strawberry plants (constant)

↓

S_E1b. Conversion of strawberry plants for planting into packs as a pathway unit (constant)

↓

S_E2. Average proportion of infested packs from production places in the USA intended for export to the EU

↓

S_E3. Average proportion of infested packs after storage in the country at origin (USA) and transport to destination in the EU

↓

S_E4. Average proportion of infested packs where the pest remains undetected after border inspection

↓

S_N1. Entry result: Average number of infested packs entering into the EU per year

Figure 9: *Eotetranychus lewisi* conceptual model for entry via strawberry plants for planting imported from the USA

3.3.2.1.1. Entry assessment results

Appendix C provides a brief explanation for each sub-step and provides supporting evidence and identifies uncertainties associated with model inputs for each sub-step. Results from multiplying the inputs for each entry sub-steps in the stochastic (Monte Carlo) simulation, are provided below. We begin with results for the baseline scenario (scenario A0).

Figure 10 reflects the Panel's expectation in a descending cumulative probability distribution for the number of infested packs from the USA arriving each year in the EU. The red (solid) line indicates scenario A0 (baseline). Annotation is provided to aid interpretation of the chart. These results suggest that we would expect to receive between one infested pack every 5 years to four every year. It would be a great surprise if more than four *E. lewisi*-infested packs arrive during one single year and also not to receive any infested pack during more than 5 consecutive years.

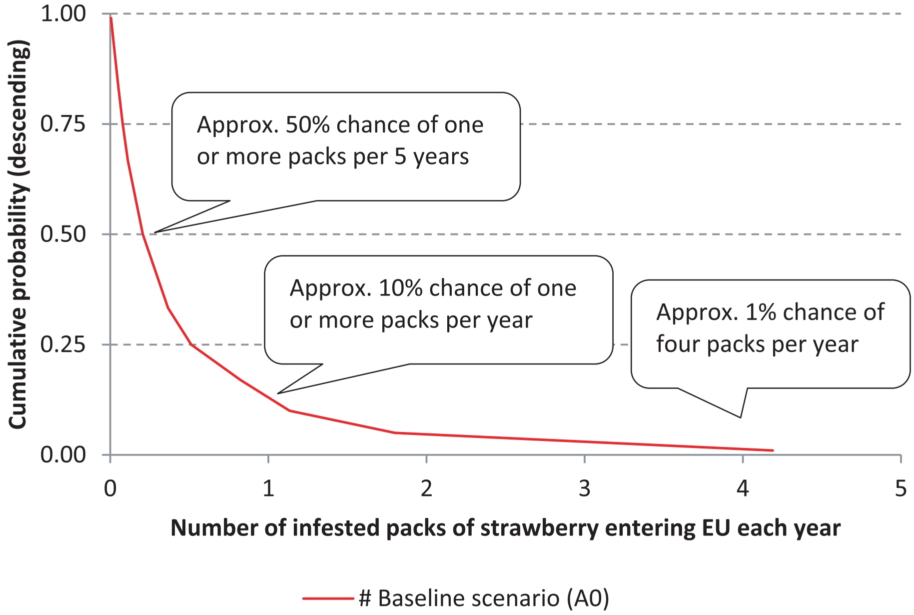

Figure 10: Panel's expectation in terms of descending cumulative probability distribution for the number of infested strawberry plants for planting packs arriving in the EU from the USA per year (scenario A0)

Figure 11 shows that three major sub-steps contribute the most to the uncertainty on the entry assessment. The main one is the proportion of infested packs at origin (74%), followed by the survival of the mite during transport (24%), which takes place at chilling conditions (−2 to −1.5°C) (Lieten et al., 2005; EFSA, 2014b). Although these conditions are quite detrimental for the mite, the fact that the pathway unit is a pack (made of 1,200 plants) and not a single plant should be kept in mind to interpret this uncertainty (survival of one single mite per pack means that the pack would remain infested; only with 100% mortality would an infested pack become uninfested). For the same reason, the uncertainty about the efficacy of border inspection is almost 0. Future trends in trade of strawberry plants for planting imported from the US have a small contribution to overall uncertainty (2%).

Similar to the previous pathway (poinsettia plants for planting), the greatest uncertainty regarding entry is the level of infestation of the commodity on the pathway at origin.

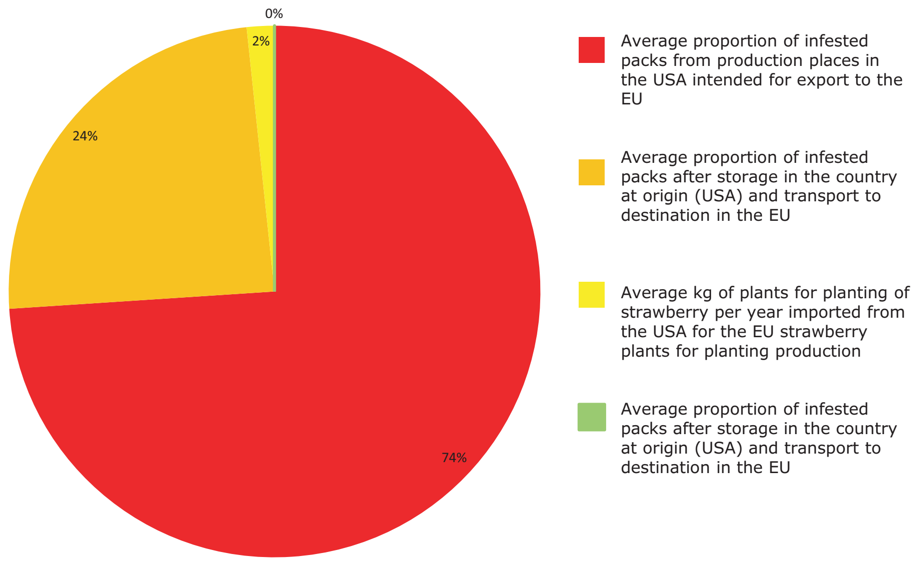

Figure 11: Entry sub-steps contributing the most to overall uncertainty regarding the number of packs of strawberry plants for planting imported from the USA into the EU each year infested with *E. lewisi*

3.3.2.1.2. Unquantified uncertainties in the entry assessment

i) Potential for import of infested strawberry plants for planting from countries where *E. lewisi* is not currently known to occur although it might be actually present.
ii) Potential for import of infested strawberry plants for planting from states in the USA other that California where agricultural practices could lead to a different level of infestation of the commodity.
iii) Variation in pack size. An average size of 1,200 plants per pack has been assumed. However, there is a wide range of sizes (see Appendix C). The smaller the size of the pack, the easier to detect and eliminate infested plants.

3.3.2.1.3. Entry assessment conclusions

Given the uncertainties, noted in the Appendix C, for each sub-step of the entry and recognising that some uncertainties have not been quantified, the model outputs should be interpreted in a more approximate manner than indicated in Figure 10. Hence the Panel expectation is that it is very unlikely that on average, over the next 10 years, all packs of strawberry plants for planting entering the EU from the USA could enter free from *E. lewisi*. On the other hand, it is also very unlikely that the average number of packs that enter and are infested will be more than four per year. It is estimated that about one pack of strawberry plants (containing 1,200 plants) could, on average, enter the EU every 4 years infested with *E. lewisi*. Because the main factor affecting the uncertainty of these figures is the proportion of infested packs at origin, any action aimed at reducing this uncertainty (i.e. including *E. lewisi* in a certification scheme) would have an effect on the overall risk estimations.

3.3.2.2. Assessment of establishment for the A0 scenario for the strawberry pathway

The aim of the establishment assessment is to estimate the average number of hectares with at least one established founder population of *E. lewisi* per year, for the next 10 years.

Spain is the largest importer of strawberry plants for planting in the EU (90% of the total EU imports). Therefore, the Panel focused on this Member state. In Spain, imported plants are used to produce a second generation of plants for planting in the highlands of the Castilla y León Spanish community (around 1,200 m above sea level). From there, runners produced following a certification scheme are transferred to the province of Huelva (South West of Spain), where 86% of Spanish strawberry production concentrates. Therefore, the Panel estimated establishment at both locations:

i) the place of production of plants for planting (Castilla y León highlands) and
ii) the berry production area where plants for planting infested at the place of production would eventually go (Huelva).

As shown in Figure 12, establishment is decomposed in three common sub-steps and one conversion factor, plus one specific sub-step for Castilla y León and five specific sub-steps for Huelva.

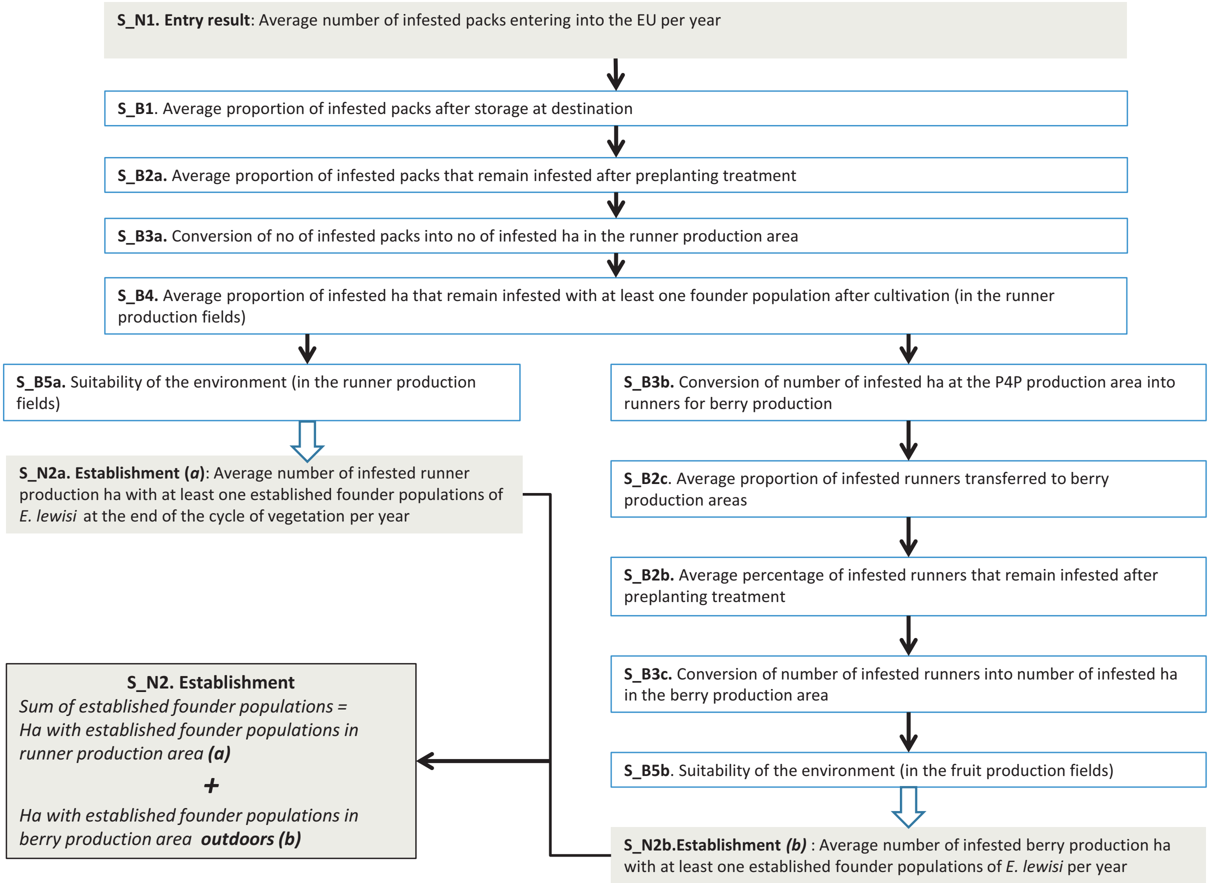

Figure 12: Conceptual model for establishment of *Eotetranychus lewisi* considering the intended use of strawberry plants for planting

3.3.2.2.1. Establishment assessment results

- **in Castilla y León (Spain)**

Following the detailed assessment presented in Appendix C, the Panel concludes that *E. lewisi* is very unlikely to establish in the runner production areas of the EU such as the Castilla y León area in Spain. This assessment was mainly driven by the following arguments:

i) Plant material used for producing strawberry plant propagation material must be certified material (Annex IV part A, Section 1, point 21.1 to Council Directive 2000/29/EC[3]). Although the mite under scrutiny is not object of the certification, the cold storage (−2 to −1.5°C) of the runners before planting (up to 4 months), the very strict cropping requirements including as the preplanting treatments of the runners (dipping of the plant material prior to planting), the crop monitoring (including at least two obligatory field inspections) and isolation requirements would negatively affect establishment. (Appendix C)
ii) Strawberry plants for planting produced in Spain are produced following the certification scheme requirements laid down in the Real Decreto 929/1995[9]. Although *E. lewisi* is not object of the certification, the strict cropping requirements and crop monitoring (including at least two obligatory field inspections) for *Phytonemus pallidus* (a tarsonemid mite smaller and more difficult to detect than *E. lewisi*, specifically mentioned in the certification scheme would negatively affect mite populations in the propagation material.

[9] Spanish regulation: Real Decreto 929/1995, de 9 de junio, por el que se aprueba el Reglamento técnico de control y certificación de plantas de vivero de frutales. ANEXO I Parte B.

iii) Production of plants for planting follow strict specifications, symptoms caused by the pest would have been detected early during cultivation and appropriate pest control measures implemented.
iv) At the end of the cycle of vegetation, the cropping practices and good agricultural practices would lead to the disposal of all type of contaminated material in the fields.
v) The climate conditions are not suitable for the pest to overwinter even if it has successfully transferred to another suitable host in the vicinity of the crop.
vi) As the A0 scenario assumes that *E. lewisi* remains a regulated quarantine pest, if detected, it would be subjected to eradication, as occurred in the past in poinsettias in the UK and Poland.

- **in Huelva (Spain)**

Following the detailed assessment presented in Appendix C, the Panel concludes that although environmental conditions (climate and host availability) are conductive for the establishment of *E. lewisi* in the berry production areas of the EU, such as the province of Huelva in Spain, other factors act against establishment of the pest such that overall establishment is an unlikely event. Primarily this is because of the following reasons:

i) Strawberry plants produced in the Spanish highlands have been subjected to certification (see above).
ii) Cropping practices, including chemical and/or biological control of other mite pests that may occur in the EU berry production areas (i.e. *Tetranychus urticae*) would have an effect on *E. lewisi* in case that it would be present.
iii) Cropping practices, including regular monitoring, would lead to early detection of any infested focus in the crop and would allow for action to be taken.
iv) As the A0 scenario assumes that *E. lewisi* remains a regulated quarantine pest, if detected, it would be subjected to eradication, as occurred in the past in poinsettias in the UK and Poland.

3.3.2.2.2. Unquantified uncertainties in the establishment assessment

i) Potential for import of infested strawberry plants from the USA into different EU MS (10% of total imports from the USA) where both environmental and cropping conditions could have a different effect on the mite.
ii) Potential for climate change to provide better conditions (higher winter temperatures) for the mite to establish.

3.3.2.2.3. Establishment assessment conclusions

Given the uncertainties noted in the Appendix C, for each sub-step of the establishment assessment and recognising that some uncertainties have not been quantified, the Panel expectation is that it is very unlikely that on average, over the next 10 years, *E. lewisi* will be able to establish in the EU via the strawberry plants for planting pathway. This is mostly due to a combination of two factors, on the one hand, the strict certification programmes that strawberry plants for planting produced in the EU are subjected to, and on the other hand, the low entry figures estimated in the previous step. Because climate conditions and host availability are highly conductive for establishment at the places where strawberry fruit production is located, it is important to maintain pest prevalence in the imported material as low as possible by keeping certification schemes in place for ensuring the quality of the plant propagating material.

3.3.2.3. Entry and establishment for the strawberry pathway under A1 ('Pest Free Area') and A2 ('Pest Free Places of Production') scenarios

The current conditions (scenario A0) for producing runners in the USA for export to the EU are very similar to a 'Pest Free Area' situation (scenario A1). The runners are produced in California in nurseries located in the highlands were conditions are unfavourable for the pest to establish and under strict certification scheme. Therefore, the Panel did not to perform the assessment of the A1 scenario for strawberry plants for planting. For ensuring a control of the plant material specifically for *E. lewisi*, the Panel noted that the absence of the mite could be also ensured through the certification scheme of the plants for planting in California (this should reduce the number of infested packs leaving the USA, ideally to 0).

In the current situation (scenario A0), establishment of the pest seems very unlikely in the EU and therefore the more stringent scenario A2 was also disregarded.

3.3.3. Introduction of *Eotetranychus lewisi* into the EU through raspberry plants for planting imported from third countries where the pest occurs

The Panel concluded, from the analyses of the strawberry plants for planting imported from the USA, that the probability that this pathway would lead to established populations of *E. lewisi* would be extremely unlikely. The raspberry production and trade patterns being very similar to the ones of strawberry, a similar model could be developed for the raspberry pathway. However, the Panel considered that the risk associated with each sub-step was assessed to be lower or at most similar (see assessments below), and it was therefore not considered necessary to perform a specific quantitative assessment. The Panel provides below a narrative assessment of this pathway.

3.3.3.1. Assessment of entry for the A0 scenario for the raspberry pathway

With regard to the entry, the key elements to consider in the analysis of this pathway compared to the entry of the pest via the strawberry plants for planting imported from the USA are the following:

i) Fewer infested plants for planting of raspberry are leaving the countries of origin compared to the strawberry pathway.
   - Fewer plants for planting of raspberry are imported into EU from all countries compared to the number of plants for planting of strawberry imported from countries where *E. lewisi* occurs (EFSA, 2014b).

ii) There is a lower or at most a similar proportion of infested plants after storage in the country at origin and after transport to destination in the EU.
   - Plants of raspberry are dormant and without leaves when exported to the EU which does not provide a suitable habitat for *E. lewisi*.
   - During transport and storage, the mite is exposed to unfavourable temperatures (−2°C) for longer time since raspberry plants are usually transported by ship, whereas strawberry plants are usually transported by air (EFSA, 2014b).

iii) The effect of border inspections on the proportion of infested plants that remains undetected is similar for raspberry and strawberry plants.

3.3.3.2. Assessment of establishment for A0 scenario

With regard to the establishment, the key elements to consider in the analysis of the raspberry pathway compared to the establishment of the pest via the strawberry plants for planting imported from the USA are the following:

i) The effect of storage at destination on *E. lewisi* is similar on raspberry and strawberry plants.
ii) The effect on *E. lewisi* of the preplanting treatments is similar on raspberry as for strawberry plants for planting. Raspberry plants are produced, similarly to strawberry plants, under strict certification schemes which include visual inspection, isolation requirements, etc. Although *E. lewisi* is not on the list of organisms addressed by the certification schemes neither for raspberry plants nor for strawberry plants, the Panel still assessed the certification schemes to be efficient against *E. lewisi* (Annex IV part A Section I point 21.1 and 24 to Council Directive 2000/29/EC[3]; EFSA, 2014b; EPPO, 2009).
iii) The effect on *E. lewisi* of post-planting cropping practices in terms of good agricultural practices, pest monitoring and control and during vegetation is similar for raspberry as for strawberry.

3.3.3.3. Conclusion on entry and establishment

In conclusion, the probability that the import of raspberry plants for planting from third countries where the pest occurs would lead to established populations of *E. lewisi* is even lower than the extremely low probability for the imports of strawberry plants for planting from the USA. For this reason, the Panel did not assess the entry and establishment under the scenarios A1 and A2 that include more stringent requirements for the import of the plant propagation material into the EU.

The main uncertainties of this assessment are:

i) The lack of data on infestation levels in the nurseries in the countries where plants for planting for export are produced.

ii) The very limited information available about the yearly import of raspberry plants, i.e. the statement in the technical hearing (EFSA, 2014b) and the EUROSTAT data where raspberry plants constitutes an unknown proportion of the plants in included under its CN code, i.e. CN 0602 2090 (trees, shrubs and bushes, grafted or not, of kinds which bear edible fruit or nuts (excl. vine slips)).

3.3.4. Introduction of *Eotetranychus lewisi* into the EU through citrus fruits (oranges and lemons) imported from third countries where the pest occurs

The Panel developed a model for this pathway identifying the parameters that are relevant for the survival and development of *E. lewisi* the Lewis spider mite (Figures 13). Many of the model parameters have been estimated using a semi-formal expert knowledge elicitation technique described in EFSA Scientific Committee (2016). For each parameter, the Panel provides the evidence used for its estimation and the uncertainties that were considered. The detailed results for these analyses are presented in Appendix D. In this section, the Panel provides only a summary of the key results.

3.3.4.1. Assessment of entry for the A0 scenario for the citrus fruit pathway

E. lewisi has been reported on lemon (*Citrus lemon*) and oranges (*Citrus sinensis*) fruits (Jeppson et al., 1975) and it has been also reported on grapefruits leaves (Meagher, 2008). Every year many different species of citrus fruits are imported into the EU, with the main citrus varieties reported in Figure D.1 in Appendix D. Given that no reports on the effect of the mite on grapefruits, pomelos and mandarins were found in the literature, the pathway analysis focusses on lemons and oranges, hereinafter referred to as 'citrus fruits' for the introduction of *E. lewisi* in the EU.

C_N0. Tonnes of imported citrus oranges and lemons to the EU from third countries where *Eotetranychus lewisi* occurs

↓

C_E1. Conversion of Tonnes to No of fruits as a pathway unit

↓

C_E2a. Percentage of fruits that are infested preharvest prior to export

↓

C_E2b. Percentage of infested fruits where the pest survives the post-harvest treatment

↓

C_E2c. Percentage of infested fruits escaping pre-export quality checks

↓

C_E3. Percentage of infested fruits where the pest survives transport, shipping and storage

↓

C_E4. Percentage of infested fruits that remain infested after EU Import checks – i.e. percentage of infested fruits passing border inspection into the EU

↓

C_E5. Likelihood (in percentage) of successful transfer from citrus fruits to other hosts grown outdoors, establishing and leading to a founder population, over the next 10 years

↓

C_N1. Average number of infested citrus fruits (oranges and lemons) from which the pest has successfully transferred to a suitable host and establishing outdoors in the EU per year, for the next 10 years.

Figure 13: Model for entry and establishment of *Eotetranychus lewisi* into the EU through citrus fruits (lemons and oranges) imported from third countries where the pest occurs

The aim of the assessment of entry is to estimate:

i) the average number of infested citrus fruits (without leaves and peduncles) imported in the EU each year over the next 10 years,

ii) the average number of infested citrus fruits (without leaves and peduncles) that infests other hosts in the assessed pest risk assessment area.

The assessment of the citrus pathway begins with the volumes (in tonnes) of imported citrus fruits from third countries where *E. lewisi* occurs. Seven other sub-steps are considered (see Figure 13). Entry finalises with the estimate of the average number of citrus fruits that infests other hosts (mite transfer to a new host) in the EU.

3.3.4.1.1. Entry assessment results

Appendix D provides an explanation for each sub-step and provides supporting evidence and identifies uncertainties associated with model inputs for each sub-step. Results from multiplying the inputs for each entry sub-steps in the stochastic (Monte Carlo) simulation, are provided for the baseline scenario (A0).

Figure 14 shows the Panel's expectation in term of a descending cumulative probability distribution for the number of infested fruits arriving each year in the EU. There is a probability of 1% that there will be one infested citrus fruit in 10 years. Accordingly, it is extremely unlikely that any infested citrus fruit will arrive in EU from third countries where *E. lewisi* occurs, during the 10 years time horizon for this risk assessment.

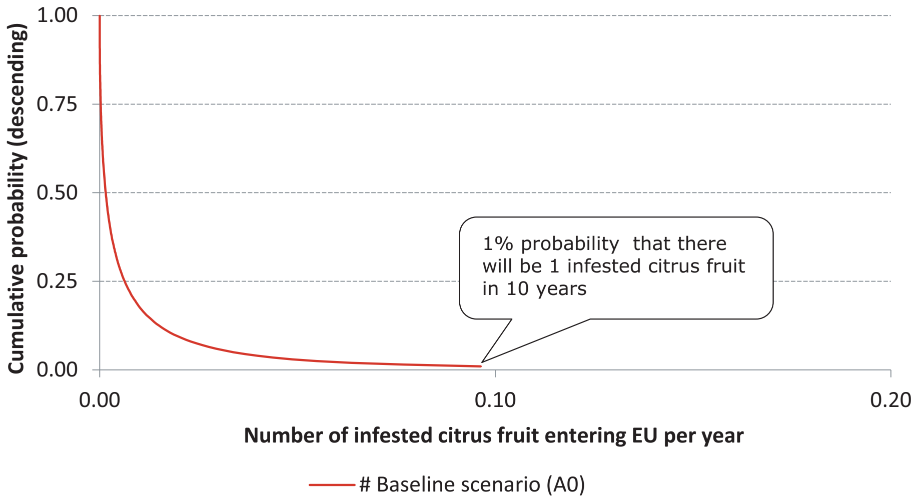

Figure 14: Panel's expectation in terms of a descending cumulative probability distribution for the number of infested citrus fruits arriving in the EU from countries where *E. lewisi* occurs each year (scenario A0)

Within the model for entry via citrus fruits, there are three major sub-steps that contribute the most to uncertainty (Figure 15). The main factor is the proportion of infested fruits before harvest in the country of origin (59%), followed by the survival of the mite after post-harvest treatments (31%). The proportion of infested fruits that will successfully operate a pest transfer to other hosts grown outdoors leading to a founder population contributes by 10% to the overall uncertainty. Uncertainties of estimates of the proportion of infested fruits, which remain infested following pre-export quality checks or transport, shipping and storage measures, are close to 0.

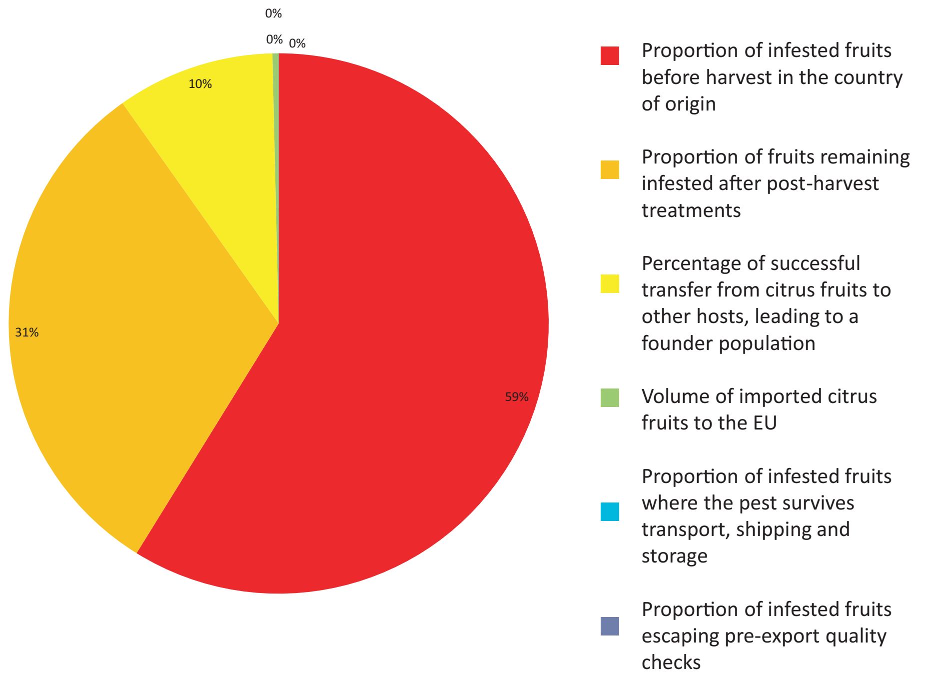

Figure 15: Entry sub-steps contributing the most to overall uncertainty regarding the number of infested citrus fruits imported into the EU each year from third countries where *E. lewisi* occurs

3.3.4.1.2. Unquantified uncertainties in the entry assessment

With regard to the potential entry into the EU of the pest with citrus fruits carried by passenger traffic, the frequency of passengers carrying 'one' citrus fruit was estimated as 0.1% on average (EFSA PLH Panel, 2014b). Thousands of passengers arriving daily in the EU, the frequency of passenger checks would have to be high to reduce the rate of entry of citrus fruit by passengers. The movement of *E. lewisi* on fruit carried by passengers cannot be excluded but has not been assessed here.

3.3.4.1.3. Conclusion on the entry assessment

The Panel concludes on the assessment of entry for scenario A0 (current regulatory situation) that the risk that any infested citrus fruit enters into the EU and that a founding population of *E. lewisi* establishes in the EU is extremely unlikely during the time horizon for this risk assessment, despite the described uncertainties and that the Panel's estimates are based in several cases on evidences from other spider mite species than *E. lewisi*.

3.3.4.2. Entry and establishment for the citrus pathway under A1 ('Pest Free Area') and A2 ('Pest Free Places of Production') scenarios

The current conditions (scenario A0) for citrus production in third countries where *E. lewisi* occurs and for exporting fresh fruit to the EU, result in an extremely low infestation rate when leaving the country of origin. Therefore, the Panel did not to perform the assessment of the A1 scenario for citrus fruit.

In the current situation (scenario A0), establishment of the pest seems extremely unlikely in the EU and therefore the more stringent scenario A2 was also disregarded.

3.3.5. Overall Risk of establishment of *E. lewisi* in the EU

The three pathways considered in the assessments (strawberry plants for planting from the USA, raspberry plants for planting and citrus fruits from third countries where the pest occurs), whilst providing routes for possible pest entry to the EU do not realistically provide opportunities for *E. lewisi* to establish within the EU during the time horizon of this assessment. Establishment of *E. lewisi* in the EU is most likely to result from mites entering on poinsettia plants for planting, then escaping from such plants onto other hosts growing outdoors, particularly in southern Europe.

Appendix E details the biotic and abiotic factors considered when assessing the likelihood that *E. lewisi* would establish in the EU. A summary is presented below.

Factors considered when assessing establishment within the EU include:

- Suitable temperature: Lai and Lin (2005) report a threshold temperature for development of 8.3°C (± 2.1°C). Threshold temperatures of 10°C or less are typical for species in Europe. An analysis of minimum daily temperatures suggests that for each year 2009–2014 the climate in much of southern Europe would have supported the development of at least six or more generations each year (see maps in Appendix E).
- Availability of hosts: Commercial hosts on which *E. lewisi* has been reported causing damage in third countries are grown in a variety of managed systems across the EU, e.g. strawberry in both protected cultivation and field grown across the EU; raspberry field grown in central and northern EU; orange, lemon, peach and vine, field grown mainly in southern Europe. Although hosts are fairly widespread, *E. lewisi* would nevertheless face a challenge in successfully transferring to such hosts because mites disperse relatively poorly; success depends on the number of dispersing individuals and successful colonisation of a host requires the production of a large number of colonisers (Kennedy and Smitley, 1985). However, only plants that have low numbers of mites on them which escape detection are assumed to exit from an infested poinsettia nursery.
- Host cultivation: *E. lewisi* was noted as a pest of strawberry in the USA within organic production (Howell and Daugovish, 2013). Conventional crop management is assumed to contribute to suppression of the mite. Conventional crop husbandry practices across the EU are assumed to inhibit establishment.
- Timing: As noted above, entry of *E. lewisi* into the EU is most likely via poinsettia plants for planting. The majority of poinsettia plants are marketed in a short period before Christmas and will be kept indoors. If disposed of outdoors after Christmas, in northern Europe, individuals are not expected to survive.
- Competition from other mites: In California, *T. urticae* is the common mite pest of strawberries (Oatman, 1971; Oatman et al., 1982). Howell and Daugovish (2013) conducted laboratory trials showing *T. urticae* populations beginning to displace *E. lewisi* populations when both mites were originally on the same strawberry leaf. *T. urticae* occurs widely in Europe (Migeon and Dorkeld, 2006–2017) and could therefore potentially inhibit the establishment of *E. lewisi.*

Taking the above factors into account the model results indicate a 10% likelihood that one or more founder populations will establish outdoors in the EU over the next 10 years, establishment is most likely to result from pest entry on poinsettia plants for planting. Establishment is most likely in southern Europe where temperature and host density is highest.

3.4. Assessment of spread of *Eotetranychus lewisi* within the EU

Having described the area where establishment of *E. lewisi* could occur, and estimated the likelihood that a founder population could establish outdoors in the EU, the next step of the assessment estimates the number of NUTS 2 regions that *E. lewisi* could spread to over a 10-year period, the time horizon for the assessment.

Most knowledge about dispersal of tetranychid mites relates to *T. urticae*. Whether *E. lewisi* behaves in the same way is unknown. Dispersal of phytophagous mites from a host is driven by or affected by specific stimuli, such as deterioration of food resource, predation, mite density, temperature, light and humidity (Smitley and Kennedy, 1985; Azandémè-Hounmalon et al., 2014).

Crawling is a mean of dispersal used by mites and allows individuals to spread to different parts of a host plant or between host plants if hosts, such as crops, grow closely together with the canopy in contact (Margoles and Kennedy, 1985). Spread from an initial site of colonisation is largely likely to occur via crawling (Kennedy and Smitley, 1985). Spread by active dispersal will therefore remain localised in the short term.

Aerial dispersal has the potential to disperse mites great distances, but most fall from the air stream fairly soon after they become airborne and hence do not travel far (Boykin and Campbell, 1984; Kennedy and Margolies, 1985). Aerial dispersal by mites is passive with the likelihood of landing on a host related to the number of dispersing mites and the abundance and distribution of hosts (Kennedy and Smitley, 1985). Smaller populations are therefore less likely to successfully disperse than larger populations.

Mites are inconspicuous organisms and easily can be transported by humans, e.g. agricultural activities in the field, commodity transport, etc. Human-assisted dispersion is recognised as an effective long-distance dispersion mean for spider mites.

There is little information specifically in relation to *E. lewisi* and its ability to disperse. In assessing the potential extent of spread of *E. lewisi* in the EU, the Panel considered how three other mites that were recently introduced into the EU have spread.

3.4.1. Conceptual model for spread

The dispersal of the mite under scrutiny is assessed using a spread model that takes into account the 10-year time horizon considered within this assessment. The objective of the assessment of the spread is to estimate the number of spatial units likely to be occupied by the pest at the time horizon. Two components of spread can be distinguished, the long-distance dispersal and the short-distance dispersal. The dispersal strategies can be described using complex mathematical models integrating the contribution of both continuous dispersal and long distance dispersal (Shigesada et al., 1995). In this scientific opinion, the Panel used a simplified approach for the spread assessment. Like other mites, the natural dispersal of *E. lewisi* is slow and the detailed process of local spread and population increase within each spatial unit is not quantitatively assessed. The Panel considers mainly the long-distance dispersal that essentially depends on human assisted spread (e.g. trade of the host plants or parts of them, movement of machinery, conveyances, hitch-hiking, wood packaging material) as responsible for the colonisation of territory across the whole area of the EU.

Given the low number of populations that are likely to establish from the various pathways considered, it is assumed that establishment is a rare even and that there will be no aggregation. Thus, each population that initially establishes will establish in a different NUTS 2 region. From the initial number of NUTS 2 regions that an individual founder population occupies, spread to other NUTS 2 regions follows logistic growth; the carrying capacity is the number of NUTS 2 regions potentially suitable for establishment. The extent of pest spread up to the time horizon of the assessment is simply the sum of the number of NUTS 2 regions initially occupied by founder populations (one NUTS 2 region per founder population) plus the number of regions newly occupied up to the time horizon for the assessment (Figure 16).

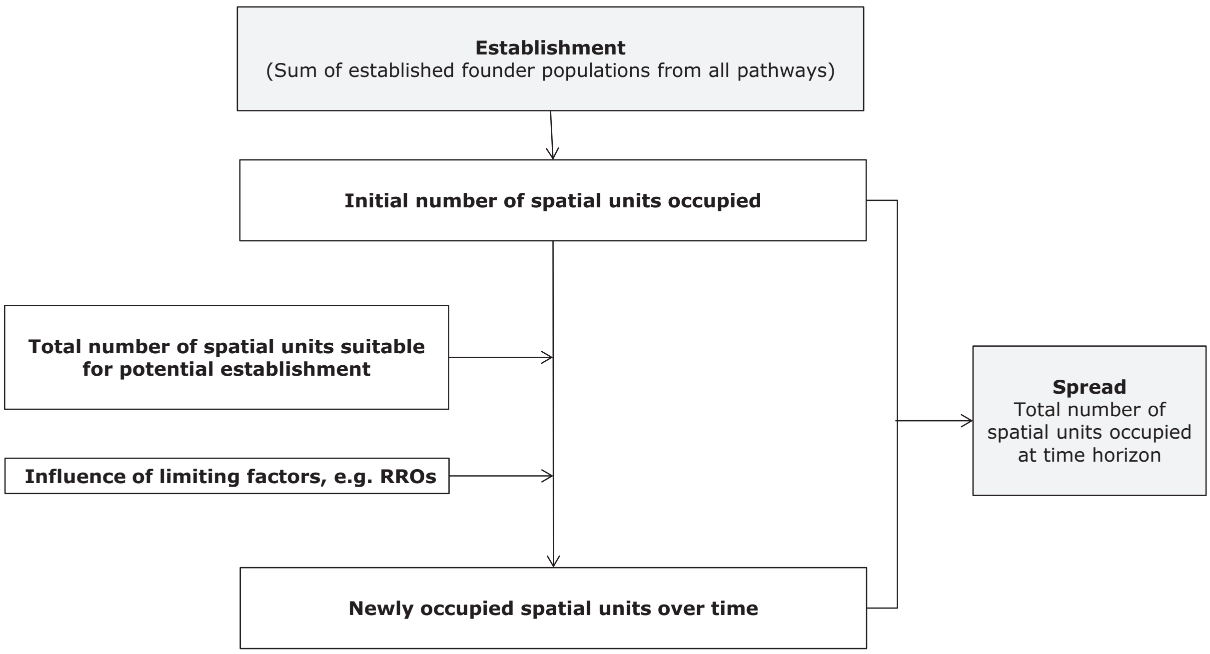

Figure 16: Conceptual model for spread of *Eotetranychus lewisi* in the EU

3.4.2. Formal model for spread

A logistic equation was used to model potential spread of *E. lewisi* over a period of 10 years.

$$u = e^{r+\frac{\epsilon}{K}=\lambda\times e^{\epsilon/K}} \quad \text{and} \quad r = \ln(\lambda)$$

The spread equation has two meta-parameters μ and r that are automatically calculated from previously defined parameters:

λ is the yearly multiplication factor that describes the increase of the number of spatial units occupied by the pest:

$\lambda = 1.13$

λ was estimated by considering the rate that three other mites recently spread following introduction into the EU. The mites were *Tetranychus evansi,* detected in the late 1990s, *Eutetranychus orientalis* and *Eutetranychus banksi*, both detected in the early 2000s (Navajas et al., 2014).

ϵ is the rate at which new populations establish expressed in NUTS regions per year and is derived from the establishment model.

K is the carrying capacity, expressed as the maximum number of NUTS regions that can be colonised (due to presence of hosts or host habitat and suitability of climate).

K = 276

3.4.3. Results of the assessment of the spread of *E. lewisi*

Three of the four pathways considered (citrus fruits, raspberry plants for planting and strawberry plants for planting) are highly unlikely to lead to the introduction of a population of *E. lewisi* in the next 10 years. The pathway most likely to introduce *E. lewisi* into the EU is poinsettia plants for planting.

The logistic growth spread model suggests that at the time horizon o the assessment one *E. lewisi* founder population has established in a NUTS 2 region of the EU and there is a 15% chance that it has spread to occupy more than one NUTS 2 region; hence, there is also a 85% likelihood that one NUTS 2 region is occupied. There is a 5% likelihood that *E. lewisi* would have spread to more than six NUTS 2 regions after 10 years (Figure 17). It is extremely unlikely that *E. lewisi* would establish and spread within 10 years in scenario A2.

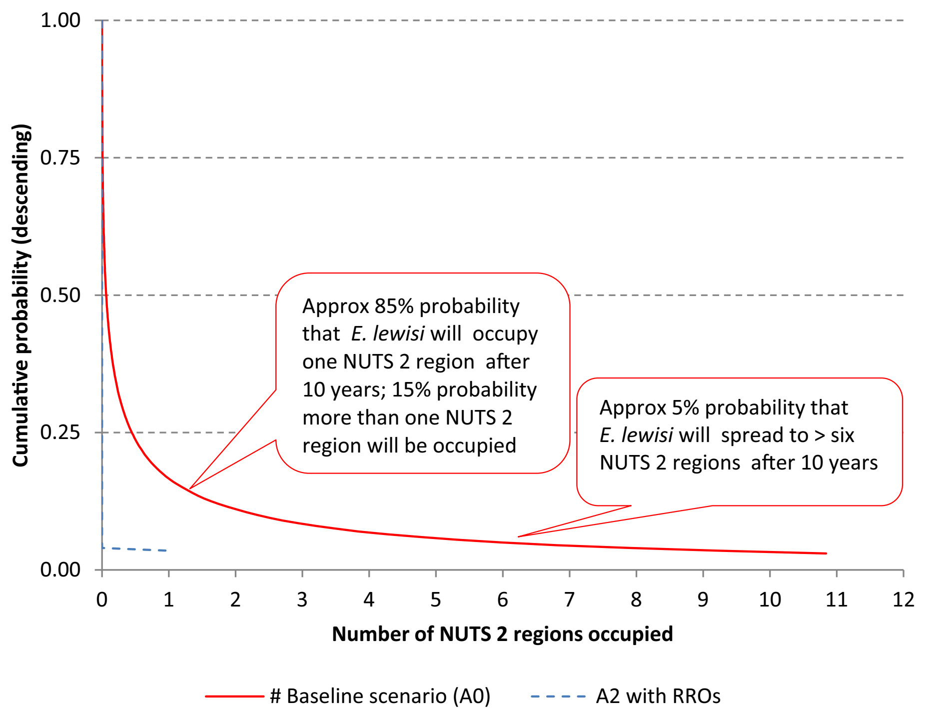

Figure 17: Panel's expectation in terms of the descending cumulative likelihood of the number of NUTS 2 regions occupied by *E. lewisi* after 10 years

3.4.4. Potential spread of *E. lewisi* from Madeira to the rest of the EU territory

One of the aspects that the Panel was asked to specifically focus further work on was the reason for the absence of *E. lewisi* in the continental EU. Given that *E. lewisi* was reported in Madeira in 1992 from samples collected on *Euphorbia pulcherrima* in 1988 and *Vitis* sp. in 1990 (Carmona, 1992), it raises the question as to why the mite has not spread from Madeira to mainland Portugal and/or the wider EU. The terms of reference of the request specifically indicate to investigate the reasons of absence of *E. lewisi* in the EU.

To investigate this, the Portuguese National Plant Protection Organisation was contacted to determine if there is currently specific Portuguese phytosanitary legislation on the movement of agricultural commodities between Madeira and mainland Portugal other than the requirements that are laid down in Council Directive 2000/29/EC[3]. The Portuguese Authorities confirmed that from the time that Portugal accessed to the EU in 1986, the autonomous region of Madeira has been considered EU territory as regards the application of EU plant health legislation and that there is no specific domestic legislation on the movement of agricultural commodities between Madeira and mainland Portugal.

Having determined that there was no local specific risk reduction options in place to hinder the movement of potentially infested hosts from Madeira, the Panel sought data reporting agricultural production and trade from Madeira, in particular data on plants for planting of poinsettia, strawberry, citrus, grapevine or other hosts, such as peaches, as well as data for citrus fruits moving from Madeira to mainland Portugal or other EU countries. The information received is summarised in Table 5.

Table 5: Information on the key *E. lewisi* host plants grown in Madeira in 2016

Host	Detail	Data	Trade from Madeira to EU
Poinsettia	One grower receives rooted cuttings from another EU MS to grow on and sell to the final consumer within Madeira for the Christmas period	46,400 cuttings into Madeira in 2016	No
Strawberry	One operator receives strawberry plants for planting from another EU MS	83,000 plants into Madeira in 2016	No
Grapevine	One operator produces *Vitis* plants in Madeira. They are sold exclusively to the local market	22,337 *Vitis* plants sold in Madeira in 2016	No
Prunus persica	Two producers grow and sell *P. persica* plants in Madeira. Plants are sold exclusively in the local market	An estimated 618 plants sold in Madeira in 2016	No
Citrus	Council Directive 2000/29/EC[3] prohibits the production of citrus plants in Madeira due to the presence of *Trioza erytreae*	Madeira has a citrus fruit producing area of 117 ha mainly small orchards for self-consumption	No

Source: Portuguese NPPO (Data kindly provided to EFSA by the Portuguese National Plant Protection Organisation).

In conclusion, the information obtained from the Portuguese authorities indicates that Madeira does not trade key *E. lewisi* hosts with mainland Portugal or other EU Member States; indeed, Madeira actually sources plants for planting of poinsettia and strawberry from outside of Madeira. Recognising that movement of plants for planting is a major pathway for the spread of plant pests (Liebhold et al., 2012), the lack of trade of *E. lewisi* hosts from Madeira to other parts of the EU is a factor in explaining why *E. lewisi* has not spread to other EU Member States.

3.4.5. Conclusions on the assessment of spread within the EU

The Panel's assessment focused on pest spread at the NUTS 2 spatial scale. Spread is most likely to result from *E. lewisi* escaping from poinsettia and transferring to hosts outdoors. While a population of *E. lewisi* established outdoors in the EU would grow, it is anticipated that spread would be quite slow; equal to or slower than what was seen for *T. evansi, E. orientalis* and *E. banksi*, which each spread to three NUTS 2 regions over a period of 5–10 years (Navajas et al., 2010, 2014).

3.4.5.1. Unquantified uncertainties in the assessment of spread

i) As the logistic growth equation was used to estimate spread, a limited number of parameters are relied upon.
ii) Potential long-distance dispersal via wind currents was not quantified. Likewise, human-assisted dispersal was not considered.
iii) Movement of host plants within the EU, e.g. via trade, was not explicitly quantified.
iv) Phoresy is known to contribute to the dispersal of mites (Macchioni, 2007) but was not quantified.

3.4.5.2. Conclusions on spread

If *E. lewisi* were to establish outdoors in the EU it would spread locally. In California, *E. lewisi* spread from citrus orchards to strawberry fields close by when the orchards were grubbed up (Howell, 2017 personal communications). Non-quarantine pest mites that were introduced into the EU in recent years have spread to three NUTS 2 regions over 5–10 years, mostly via movement of plants for planting. *E. lewisi* being a quarantine pest, its movement on plants for planting would be inhibited when detected and its spread is consequently anticipated to be slower. Spread to more than one NUTS 2 region is unlikely within 10 years. The Panel would be extremely surprised if spread to six NUTS 2 regions occurred within 10 years.

3.5. Impact

In this section, the Panel did not quantify the magnitude of impact but addressed in a narrative approach the additional information that was found as compared to the pest categorisation (EFSA PLH Panel, 2014a). In this context, a systematic literature search was performed and experts were consulted, on the potential consequences that could be posed by *E. lewisi* in the risk assessment area on cultivated crops for which some information was gathered. The Panel did not address the impacts posed by the mite on ecosystem services and biodiversity as no information on this topic could be found.

When found, measures taken by some countries to prevent the entrance of *E. lewisi* are also reported.

3.5.1. Host range

E. lewisi has been reported from 71 herbaceous and woody plant species belonging to 26 different families (Migeon and Dorkeld, 2006–2017). The list of potential hosts includes cultivated species, in addition to the commodities investigated in this opinion (i.e. poinsettia, strawberry, raspberry, lemon and orange fruits); castor oil plant (*Ricinus communis*), cotton (*Gossypium hirsutum*), fig (*Ficus carica*), pawpaw (*Carica papaya*), olive (*Olea europaea*), peach (*Prunus persica*) and vine (*Vitis vinifera*) are reported as hosts of *E. lewisi*. Wild hosts include weeds, such as nightshade (*Solanum elaeagnifolium*), and several tree species including acacias (*Acacia* spp.), pines (*Pinus ponderosa*) and aspens (*Populus tremuloides*). In *R. communis*, high infestations of *E. lewisi* were observed causing chlorosis on mature leaves (Guanilo et al., 2012). It should be noted, however, that the report of a species as a host of *E. lewisi* does not necessarily mean that the mite can complete its life cycle on the species or that it can cause economic damage. Therefore, there is uncertainty regarding the exact host status of some of species on the list.

In EFSA PLH Panel (2014a), the impact of the mite was reported for the four potential pathways addressed in the present opinion. Two additional commodities were identified for the strong impact caused by the Lewis mite i.e. peaches and for the relevance in the EU, i.e. vineyards. Here, the Panel provides an update on the level of impact caused by *E. lewisi* in the six commodities with the additional information that could be retrieved.

3.5.2. Potential impact of *E. lewisi* in the risk assessment area

<u>On poinsettias</u>, Doucette (1962) reported that the Lewis mites feeds on the lower side of leaves, causing a speckled or peppered appearance, and produces profuse webbing, especially around the flowers. Extensive feeding by the spider mite causes leaf chlorosis of poinsettias and eventually leaf loss (Doucette, 1962). Similarly, Ho (2007) reported that poinsettias heavily infested with *E. lewisi* and the whitefly *Aleurodicus dispersus* suffered severe defoliation. If populations of *E. lewisi* are not controlled, the resulting loss of colour and leaves ruin the sale value of poinsettias (Doucette, 1962). Mites tend to be more of a problem during hot and dry weather conditions.

In Canada, the Lewis mite is most often found on poinsettias, where it may have been introduced on poinsettia cuttings (OMAFRA, 2014). While usually considered as an occasional pest and the mite is often missed by growers, Jandricic (2016) has recently reported *E. lewisi* as causing the most widespread mite problem in 2016. The Lewis mite has been considered as an insidious pest, because it is difficult to detect and usually appears late in production and the damage does not disappear (Gilrein, 2006). Early detection is difficult since the symptoms are rather subtile at first (e.g. chlorosis), which can be confused with a nitrogen deficiency. Although pesticides have been effective at controlling the mite (Pérez-Santiago et al., 2002), failure to detect the mites early can lead to crop damage and economic losses (CAB International, online).

On citrus, *E. lewisi* has been mentioned as present in California for many years, it has first been reported at Corona in California in 1942 on fruits of the navel orange (Reuther et al., 1989). Found primarily along the Californian coast, it was noted primarily on citrus fruits (Pritchard and Baker, 1955). The mite feeds mostly on the citrus fruit and produces web profusely (Jeppson et al., 1975). No notable injury occurs on citrus leaves were reported but the large quantities of webbing produced by the mite collect dust and makes infestations highly visible. Heavy infestations cause silvering on lemons and silvering or russeting on oranges (Jeppson et al., 1975). Although the mite is considered, as a minor pest of citrus by Vacante (2010), as a pest of very minor importance by Doucette (1962) and as an occasional host of citrus in southern California by Jeppson et al. (1975), *E. lewisi* continues to be cited as a pest in the southern citrus districts except in desert areas (Meagher, 2008).

On strawberry, the *E. lewisi* feeding results in chlorosis and bronzing of the leaves, and a reduction in fruit production at high mite densities. The mite has been seen on strawberries and raspberries in California for some time, where infestations appear to increase (Dara, 2011). Outbreaks have caused significant damage to strawberry production, particularly in organic fields, becoming a problem in commercially cultivated strawberries and raspberries in recent years (Howell and Daugovish, 2013). Some varieties attract spider mites more than others, e.g. Ventana variety supports higher populations of *E. lewisi* (Howell, 2017). *E. lewisi* is considered as an emerging pest in California commercial strawberries and has also been found on raspberries with an increasing frequency (Howell and Daugovish, 2013).

On peach, Mena Covarrubias and Zegbe Domínguez (2007) report that *E. lewisi* is the mite pest with major economic importance in deciduous fruit trees in north-central Mexico, where it is present mostly in peaches and sometime on apple trees. Densities can be high on leaves and can limit peach production. Infestation by *E. lewisi* was found to reduce yield by 62% and average fruit weight by 54%; heavily defoliated trees by mite infestations would need several years to recover.

On grapevine, Sazo Rodríguez et al. (2003) indicates that in some regions of Chile outbreaks of *E. lewisi* have been reported in vineyards.

3.5.3. Evaluation of the endangered area in EU

An 'endangered area' is defined in the ISPM 5 (FAO, 2016), as 'an area where ecological factors favor the establishment of a pest whose presence in the area will result in economically important loss'. However, 'economically important loss' is not clearly defined and the Panel, therefore, interprets endangered area as 'the area where ecological factors favor the establishment of a pest whose presence in the area will result in harmful consequences to cultivated and managed plants and the environment' (EFSA PLH Panel, 2010). For this, the area has to be specified, where host plants are present and the environment is suitable.

Besides host availability, the Panel explored the suitability of climatic conditions, mainly temperatures, as a key factor determining the potential for *E. lewisi* to develop and cause impact after establishment in the EU. The results are presented in Appendix E where climate suitability maps and also host availability maps (main cultivated hosts in the EU) are presented.

With regard to climate suitability, Annual Accumulated Temperature (AAT) in Europe was employed as an indicator of thermal conditions to determine whether there is sufficient Temperature above the *E. lewisi* minimum threshold (estimated at 8.3 ± 2.11 for an egg-to-adult cycle (Lai and Lin, 2005) to complete its development. The resulting maps indicate that the most suitable areas for the mite development cover Mediterranean countries and secondarily parts of the Atlantic coast. Also based on the thermal constant described by the same authors (159 degree days from egg-to-adult), the potential number of complete generations by *E. lewisi* in southern EU could reach over 10 per year. With the number of *E. lewisi* adults emerged per generation estimated as 30 based in an average ambient temperature (Lai and Lin, 2005), the climatic conditions would favour the establishment of founding populations in large parts of southern EU, although other factors mitigate the establishment of the mite.

With regard to the host availability in the EU, the regions with favourable climatic conditions encompass EU growing areas of citrus, vineyards, fruit and berry, with the last category also being extensively produced in north-east EU, mainly Poland. Both, the distribution of the main cultivated host crops and the percentage land occupied at NUTS 2 level in the EU were mapped and presented in Appendix E. Seen together the maps show that in general the more intensively cropped growing regions (largest crop areas) are also the most densely occupied (highest % of host relative to NUTS 2 area), which should tend to favour outbreaks occurring after mite establishment.

Besides Madeira, where *E. lewisi* occurs, two other reports of mite occurrences are from the UK and Poland (reported as eradicated) on poinsettia grown in greenhouse conditions.

The Panel concludes that *E. lewisi* has the potential to established in large part of the risk assessment area, highlighting the Mediterranean countries as the most endangered area in the EU, where the production of host crops is mostly concentrated and where climatic conditions are favourable for the mite to develop.

3.5.4. Regulatory status and actions taken against *E. lewisi* in third countries

Outside the EU, among the EPPO countries, Israel and Jordan have classed *E. lewisi as a* quarantine pest (EPPO, 2017). In the past, *E. lewisi* was mentioned as being a pest in Israel (Reuther et al., 1989), but a recent survey of the spider mites in the country does not mention the presence of *E. lewisi* (Ben-David et al., 2013). For some citrus importing countries, *E. lewisi* is considered a quarantine pest, which requires the implementation of phytosanitary inspections and delivery of certificates, as for example citrus exports from Chile to Brazil (SAG, 2014).[10] Since 2015, exports of citrus (*Citrus latifolia* Tanaka) from Mexico to South Korea, takes place under strict phytosanitary measures with field inspections, risk reduction options during packaging, storage and shipment conditions to be implemented in order to guarantee citrus to be free of *E. lewisi* among other citrus quarantine pests (SENASICA, 2014).[11]

3.5.5. Conclusions on the host range and potential impact

Several of the plants species reported as hosts of *E. lewisi* are economically important crops and some are particularly widely cultivated in EU in either protected agricultural systems and/or in open fields (e.g. poinsettia, strawberry, peach). Also, weeds and wild species are widely available in EU (e.g. *Ipomea*). It is recognised that wild/uncultivated hosts neighbouring commercial host crops play a role in *E. lewisi* outbreaks. For example in California, *E. lewisi* was found in castor bean near strawberry fields and the mite may have made a host jump due to the destruction of citrus orchards adjacent to strawberry fields (Burrascano, 2000).

Quantitative data on the impact of *E. lewisi* in the different reported hosts is scarce. Studies often document yield losses due to spider mites in general and there are no impact reports on *E. lewisi* alone. However, E. *lewisi* causes different degrees of yield and/or quality losses in several crops in the area of its current world distribution, mainly in the Northern American continent. Incidentally, *E. lewisi* is reported to be one of the main pests of peaches, reducing yield by 62% in north-central Mexico. While impact is not quantified for poinsettia, failure to detect *E. lewisi* early can lead to economic losses. The Lewis mite is considered as an emerging pest in California commercial strawberries mainly in organic farming and has also been found on raspberries with an increasing frequency.

No observed impact is reported in the EU despite *E. lewisi* presence reported in Madeira since 1988.

Besides the host availability in EU, an extensive part of the EU has a favourable climate for *E. lewisi* to develop. Therefore, the Panel concludes that there is a potential for *E. lewisi* causing consequences in the risk assessment area.

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[10] SAG (2014). Directrices para la exportacion de cítricos (naranja, limón y mandarina) a Brasil. Available online: http://www.sag.gob.cl/sites/default/files/directrices_exportacion_citricos_brasil_2014_09_30_0.pdf

[11] SENASICA (Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria de Mexico), 2014. Plant Quarantine Import Requirements for Mexican Persian lime. Available online: https://www.gob.mx/cms/uploads/attachment/file/132537/Lim_n_persa_a_corea.pdf [Accessed: 28 July 2017]

3.6. Conclusions of the assessment

3.6.1. Unquantified uncertainties

The Panel identified several uncertainties that could not be quantified in the risk assessment as listed below:

- With regard to the current occurrence of *E. lewisi* in EU

  There is an uncertainty regarding the current situation in Madeira since there have been no reports of *E. lewisi* from there since 1990. However, Madeira does not trade key *E. lewisi* hosts with mainland Portugal or other EU Member States (Table 5) and the influence of this uncertainty is therefore assessed to be insignificant as to acting as a source for spread from Madeira to other parts of the EU.

- With regard to the impacts in the EU although the mite status in Madeira island is present, no impacts caused by *E. lewisi* have been reported from Madeira, and a reason for that could be that mite collecting events in Madeira are sporadic, according to specialists contacted by the Panel.
- With regard to the other potential pathways

  E. lewisi has a broad host range and other pathways than those included in this risk assessment may be relevant. However, since no damage (suggesting low occurrence of the mite) has been reported on other hosts than those which have been included, this uncertainty is assessed to be insignificant.

- With regard to trade data

  Plant propagating material might spend a part of their cycle in a different country, e.g. poinsettia mother plants from US may be used for producing cuttings in some other country (Colombia, Kenya) before ultimately being sent to the EU. However, no information about such potential procedures were found and their effect on the risk were assessed to be insignificant.

- With regard to entry and establishment

  Industry practices may change, e.g. the procedures for good agricultural practice. Within the time frame of the current assessment, i.e. 10 years, it is assessed that such potential changes will not change the conclusion of this risk assessment.

- To simplify, fixed numbers were used to convert pieces of poinsettia imported into packs of poinsettia imported. One fixed number was used for unrooted cuttings and another one for rooted cuttings and young plants. The use of fixed values instead of instead of distributions underestimates the calculated total uncertainty but since the conversion factors used represents 'worse case situations' the influence of this procedure is not assessed to influence the conclusion of this risk assessment (Appendix B).

  To simplify, a fixed conversion factor was used to convert strawberry plants for planting into packs as a pathway unit as well as for converting the number of infested ha at the plants for planting production area into runners for berry production (Appendix C). The use of fixed values instead of a distributions leads to an underestimation of the calculated total uncertainty. However, the likelihood that this pathway leads to established populations is assessed to be extremely low and the Panel does not expect this underestimation to change the conclusion of this risk assessment.

  To simplify, a fixed conversion factor was used to convert the imported volume of citrus fruits to individual fruits (Appendix D). The use of a fixed value instead of a distribution leads to an underestimation of the calculated total uncertainty. The likelihood that this pathway leads to established populations is assessed to be extremely low and the influence of this underestimation is not expected to change the conclusion of this risk assessment.

  The entry of *E. lewisi* associated with the 'citrus fruit with passenger traffic' was not assessed. The frequency of passengers carrying 'one' citrus fruit was estimated as 0.1% on average (EFSA PLH Panel, 2014b). The movement of *E. lewisi* on fruit carried by passengers cannot be excluded but it is assessed to be much lower than that of regular import of citrus fruits which was assessed to be close to zero (Appendix D).

- Other studies contrasting with the Panel's analyses: Recently, the French agency ANSES developed a multicriteria analysis to characterise and rank a list of plant pathogens in order to prioritise them based on the risk and impact of pests (Tayeh et al., 2016). Based on 24 criteria, in line with ISPM No 11 (FAO, 2013), and using pairwise comparisons among harmful organisms, six criteria ranked *E. lewisi* as having a high probability of entry (wide host range including different plant families; arrival via commodities trade; and probability of escaping inspections) and establishment (importance of the surface of crops grown in the EU being hosts for the pest; ecoclimatic conditions matching present geographical distribution of the pest and the risk assessment area).

3.6.2. Overall conclusions

Eotetranychus lewisi is a spider mite occurring in North, Central and South America, Africa and Asia. It is a plant pest reported from a wide range of hosts; *Citrus*, *Euphorbia*, *Fragaria, Prunus, Rubus* and *Vitis* are some of the most commercially important hosts threatened in the EU. The mite is currently regulated in the EU only for plants of *Citrus* L. *Fortunella* and *Poncirus*, and their hybrids. Based on the available information, *E. lewisi* is not known to occur in the risk assessment area except in Portugal, where *E. lewisi* has a restricted distribution, being limited to Madeira. Previous incursions elsewhere in the EU have been eradicated. The absence of trade of *E. lewisi* hosts from Madeira to other parts in the EU is likely to be the major reason in explaining why *E. lewisi* has not spread to other EU MS.

The Panel identified four potential pathways of entry of *E. lewisi* on hosts that are not regulated for this specific organism. Subsequently, the probability of entry, establishment, as well as further spread after possible establishment of *E. lewisi* in the EU were assessed.

The risk assessment was performed in accordance to the principles described in the EFSA PROMETHEUS (PROmoting METHods for Evidence Use in Scientific assessments) project. In this context, the Panel prepared a protocol for the systematic and reasoned search of the evidence to be used as evidence in the risk assessment.

Three of the four pathways considered (citrus fruits imported from third countries where the mite occurs, raspberry plants for planting imported from third countries where the mite occurs and strawberry plants for planting imported from the USA) while providing routes for possible pest entry to the EU, do not realistically provide opportunities for *E. lewisi* to establish within the EU in the next 10 years (the time horizon of the assessment). This is due to either the highly controlled conditions under which strawberry and raspberry propagating material and plants for planting are grown and managed, or due to the handling and shipping conditions used to import citrus fruit.

The pathway most likely to introduce *E. lewisi* into the EU is the imports of poinsettia plants for planting from third countries where the mite occurs. Model results indicate that it is likely that most years at least one infested pack of poinsettia arrives in the EU; on average between one pack and a few tens of packs are likely to enter infested with *E. lewisi*. To put this in context, the model assumes up to approximately 80,000 packs of poinsettia enter the EU each year from third countries of which several hundred to a few thousand packs come from countries where *E. lewisi* is known to occur. The factors contributing most to the uncertainty of the estimate of entry are related to a lack of detailed EU wide information for international poinsettia trade and a lack of knowledge about the level of infestation in the country of origin.

While outbreaks in glasshouses that arise from the entry of infested poinsettia, can be expected in future, establishment in EU glasshouses is not anticipated. In considering establishment outdoors, the Panel carefully considered abiotic and biotic factors influencing establishment. Establishment of *E. lewisi* outdoors in the EU is most likely to result from mites entering on poinsettia plants for planting, then escaping from such plants onto other hosts growing outdoors, particularly in southern Europe. The ability of *E. lewisi* to escape from glasshouses is a limiting factor constraining establishment outdoors. While establishment outdoors in the EU is not expected within 10 years, uncertainty in the model indicates that there is approximately a 10% chance that at least one *E. lewisi* population could establish outdoors in the EU during the next 10 years. Given the low number of populations likely to establish, it is assumed that *E. lewisi* establishment in the risk assessment area would be a rare event.

A logistic spread model to assess the extent of likely spread after establishment up to the time horizon, showed that spread is likely to be slow such that it is most likely that *E. lewisi* would be limited to occurring in one NUTS 2 region after 10 years although there is perhaps a 5% chance that spread to up to six NUTS 2 regions could occur within 10 years. However, such a spread would be very surprising.

The Panel recognises also that some uncertainties have not been quantified when assessing probabilities and the model outputs should be interpreted as being approximate estimates.

E. lewisi is reported as reducing yield and impacting on the quality on peaches and poinsettia and is regarded as a growing concern for strawberry and raspberry growers in the Americas. Although *E. lewisi* is not known to have caused any noticeable impacts in Madeira, should *E. lewisi* be introduced in other parts of the EU, impacts similar to those observed in countries where the pest is present are to be expected.

E. lewisi is currently regulated in Annex IIAI to Council Directive 2000/29/EC on plants of *Citrus*, *Fortunella*, *Poncirus* and their hybrids, other than fruit and seeds. However, this is not considered as a possible pathway of entry into the EU in consideration of the general prohibition of import of these plants from third countries (Annex IIIA, 16 to Council Directive 2000/29/EC). Of the four pathways considered (poinsettia, strawberry, raspberry and citrus fruits), the stochastic model indicates that the poinsettia pathway is the most likely to provide a route into the EU, much more likely than the route on which the pest is currently regulated. This assessment suggests that *E. lewisi* being a polyphagous pest, a wider range of host plants for planting of could also be considered in the future.

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Abbreviations

AAT	Annual Accumulated Temperature
DD	degree days
EFSA PROMETHEUS project	EFSA PROmoting METHods for Evidence Use in Scientific assessments project (Annex A[5] (EFSA, 2017a))
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
ISEFOR database	Database developed within the FP7 Project 'Increasing Sustainability of European Forests: Modelling for Security Against Invasive Pests and Pathogens under Climate Change'
ISPM(s)	International Standard(s) for Phytosanitary Measures adopted by the International Plant Protection Convention
JRC	Joint Research Center of the European Commission
MS(s)	Member State(s)
NPPO	National plant protection organization
NUTS area	Nomenclature of Territorial Units for Statistics, it is a hierarchical system for dividing up the economic territory of the EU. The current NUTS 2013 classification is valid from 1 January 2015 and lists 98 regions at NUTS 1, 276 regions at NUTS 2 and 1342 regions at NUTS 3 level.
PAFF Committee	Standing Committee on Plants, Animals, Food and Feed
PFA	Pest Free Area (ISPM 4: FAO (1995))
PFPP	Pest Free Place of Production (ISPM 10: FAO (1999))
PFPS	Pest Free Production Sites
PLH Panel	EFSA Panel on Plant Health
PRA	Pest risk assessment
RA	Risk assessment
RRO	Risk reduction option
ToR	Terms of Reference

Appendix A – Notations and units used in the risk assessment for *Eotetranychus lewisi*

A.1. Notations

For each risk assessment sub-step of each pathway of the different scenarios mentioned above, the parameters have been estimated by calculation or conversion when data was available or using a semi-formal expert knowledge elicitation technique described in EFSA Scientific Committee (2016) when data were not available. The Panel provides the evidence and the uncertainties that were considered for each elicited parameter where expert judgement was used to estimate five quantiles. The corresponding fitted distributions are presented in the Annex B (EFSA, 2017b). Annex B is the calculation file developed in @RISK that was used for running the Monte Carlo simulations and that provides the models run used by the Panel to perform the risk assessment.

In this scientific opinion, the Panel used the notations, in the conceptual models and in the @Risk files used to perform the Monte Carlo simulations, as summarised below:

- Regarding the scenarios, scenarios A0, A1 and A2 are specified below:

Scenario A0: Current regulation in place: specific requirements laid down in Annex IIAI of Council Directive 2000/29/EC[3] for the pest (only for plants of the genera *Citrus*, *Fortunella* and *Poncirus*, and their hybrids, other than fruit and seeds) and host prohibitions according to Annex IIIA to Council Directive 2000/29/EC[3].

Scenario A1: Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]) and in addition all imported host commodities should come from Pest Free Areas (PFA) in the country at origin (ISPM 4 (FAO, 1995)) and enforced measures on specific pathways.

Scenario A2: Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]) and in addition all imported host commodities should come from Pest Free Places of Production (PFPP)/Pest Free Production Sites (PFPS) in the country at origin (ISPM 10 (FAO, 1999)) enforced measures on specific pathways.

- Regarding the Pathways
  The numbering of the risk assessment step or sub-step will be preceded by:
  - P for poinsettia plants (cuttings and pots) imported from countries where the pest occurs;
  - S for strawberry plants for planting imported from the USA;
  - C for citrus fruits (oranges and lemons) imported from countries where the pest occurs;
  - For the raspberry pathway, no notation is needed as the analyses of the pathway is done narratively.
- Regarding the risk assessment steps
  E = entry; B = establishment; S = spread; I = Impact
  The step are linearly ordered in a sequence E → B → S → I.
- Regarding the risk assessment sub-steps
  Different sub-steps are defined by an integer following the letter of the step.
  E.g. E1 is the first sub-step of the entry step, B2 is the second sub-step of the establishment step.
- Regarding the variables of the models
  N0 = represents the initial number used as the starting point of the entry models for the different pathways. It is expressed in a number of infested pathway units that could be traded per year separately for each pathway.
  N1 = represents the number corresponding to the end point of the entry step and the starting point of the establishment models for the different pathways. It is expressed in a number of founder populations entering in the EU per pathway unit per year separately for each pathway.
  N2 = represents the number corresponding to the end point of the assessment of the establishment step and the starting point of the spread model. It is expressed in a number of spatial units with at least one established founder population per year separately for each pathway.
- List of notations used in the scientific opinion and respective supporting document.

Table A.1: Details of notations used in the scientific opinion and in Annex B (supporting publication (EFSA, 2017b))

Notation	Definition	Abbreviation used in @Risk file (EFSA, 2017b)
Poinsettia plants for planting Pathway		
P_N0a.	Poinsettia demand – Average number of poinsettia plants marketed per year in the EU	P_N0a_Consum_Poins
P_N0b.	Percentage of poinsettias imported from third countries into the EU	P_N0b_Prop_Import
P_N0c.	Percentage of poinsettia from third countries where *E. lewisi* occurs	P_N0b_Prop_Import
P_E1.	Conversion of pieces of poinsettia into packs as a pathway unit (including both rooted and unrooted plants)	P_E1_Conv_Packs2Pcs
P_E2a.	Percentage of packs that are infested prior to export	P_E2a_Prop_Inf
P_E2b.	Percentage of infested packs surviving (remaining infested) following export checks	P_E2b_SurvPreExport
P_E3.	Percentage of infested packs surviving (remaining infested) following transport, shipping and storage (assume transport and storage conditions are not affecting the number of packs infested by mites but could increase the density of mites within the packs) – fixed at 100%	P_E3_Surv_Transp
P_E4.	Percentage of infested packs that remain infested after EU Import checks – i.e. percentage of infested packs passing border inspection into the EU	P_E4_Surv_Insp
P_N1.	Entry result: Average number of infested packs of poinsettia entering EU (per year)	P_N1_Entry_Poin
P_B2.	Percentage of plants from infested packs that will remain infested after the preplanting measures (dipping, fumigation, spraying, etc.) in glasshouse destination	P_B2_Surv_RRPPrePlant
P_B3a.	Aggregation factor: no of infested packs into no of infested glasshouses	P_B3a_Conv_Packs2GH
P_B4.	Annual average percentage of infested glasshouses that will remain infested following the cultural practices in the glasshouses at the end of the production cycle	P_B4_Surv_Cultivation
P_N2a.	Establishment (a): Average number of founder populations established in glasshouses per year resulting from EU imports of poinsettia plants	P_N2_EstGH_Poins
P_B3b.	Multiplication factor – average number of potential founder populations 'escaping' from each infested glasshouse	P_B3b_Conv_GH2NPop
P_B5.	Average likelihood that a potential founder population will establish outdoors to become an actual founder population	P_B5_Prop_EstOut
P_N2b.	Establishment (b): Average number of founder populations established outdoors originating from the EU imports of poinsettia plants	P_N2b_EstOut_Poins
P_N2.	Establishment (c) Sum of established founder populations = Founder populations in glasshouses (a) + founder populations escaping from glasshouses to establish outdoors (b)	
Strawberry plants for planting Pathway		
S_N0.	Average kg of plants for planting of strawberry per year from the USA for the EU strawberry Plants for planting production	S_N0_Import_Straw
S_E1a.	Conversion of kg of strawberry P4P (runners) into strawberry plants (constant)	S_E1a_Conv_Pcs2kg
S_E1b.	Conversion of strawberry plants for planting into packs as a pathway unit (constant)	S_E1b_Conv_Packs2Pcs
S_E2.	Average proportion of infested packs from production places in the USA intended for export to the EU	S_E2_Prop_InfUS

Notation	Definition	Abbreviation used in @Risk file (EFSA, 2017b)
S_E3.	Average proportion of infested packs after storage in the country at origin (USA) and transport to destination in the EU	S_E3_Surv_Trans
S_E4.	Average proportion of infested packs where the pest remains undetected after border inspection	S_E4_Surv_Insp
S_N1.	Entry result: Average number of infested packs entering into the EU per year	N1_Entry straw=
S_B1.	Average proportion of infested packs after storage at destination	S_B1_Surv_Stor
S_B2a.	Average proportion of infested packs that remain infested after preplanting treatment	S_B2a_Surv_RROpreplantCyL
S_B3a.	Conversion of no of infested packs into no of infested ha in the runner production area	S_B3a_Conv_Packs2ha
S_B4.	Average proportion of infested ha that remain infested with at least one founder population after cultivation (in the runner production fields)	S_B4_Surv_RROpostPlant
S_B5a.	Suitability of the environment (in the runner production fields)	S_B5a_Suit_EnvironCyL
S_N2a.	Establishment (a): Average number of infested runner production ha with at least one established founder populations of *E. Lewisi* at the end of the cycle of vegetation per year	S_N2_EstCyL straw=
S_B3b.	Conversion of number of infested ha at the P4P production area into runners for berry production	S_B3b_Conv_Runner2ha
S_B2c.	Average proportion of infested runners transferred to berry production areas	S_B2b_Surv_RROprefruitH
S_B2b.	Average percentage of infested runners that remain infested after preplanting treatment	S_B2c_Prop_TransfRun
S_B3c.	Conversion of number of infested runners into number of infested ha in the berry production area	S_B3c_Conv_InfRun2ha
S_B5b.	Suitability of the environment (in the fruit production fields)	S_B5b_Suit_EnvironH
S_N2b.	Establishment (b): Average number of infested berry production ha with at least one established founder populations of *E. Lewisi* per year	S_N2_EstH_straw=
S_N2.	Establishment: Sum of established founder populations = Ha with established founder populations in runner production area (a) + Ha with established founder populations in berry production area outdoors (b)	
Citrus fruit Pathway		
C_N0.	Tonnes of imported citrus oranges and lemons imported into the EU from third countries where *Eotetranychus lewisi* occurs	C_N0_Import_Citrus
C_E1.	Conversion of tonnes to No of fruits as a pathway unit	C_E1_Conv_t2Pcs
C_E2a.	Percentage of fruits that are infested preharvest prior to export	C_E2a_Inf_PreHarv
C_E2b.	Percentage of infested fruits where the pest survives the post-harvest treatment	C_E2b_Surv_PostHarv
C_E2c.	Percentage of infested fruits escaping pre-export quality checks	C_E2c_Surv_Cert
C_E3.	Percentage of infested fruits where the pest survives transport, shipping and storage	C_E3_Surv_Transp
C_E4.	Percentage of infested fruits that remain infested after EU Import checks – i.e. percentage of infested fruits passing border inspection into the EU	C_E4_Surv_Insp
C_E5.	Likelihood (in percentage) of successful transfer from citrus fruits to other hosts grown outdoors, establishing and leading to a founder population, over the next 10 years	C_E5_Prop_Host
C_N1.	Average number of infested citrus fruits (oranges and lemons) from which the pest has successfully transferred to a suitable host and establishing outdoors in the EU per year, for the next 10 years	C_N1_Entry_Citrus

A.2. Units

Table A.2: Summary table of the specifications of the assessment

Pathways	**Poinsettia plants (unrooted cuttings and rooted cuttings and young plants) imported from third countries where the pest occurs**	**Strawberry plants for planting imported from the USA**	**Raspberry plants for planting imported from third countries where the pest occurs**	**Citrus (oranges and lemons) fruits imported from third countries where the pest occurs**
Units for entry	No infested packs imported per year			No of infested fruits per year
Units for establishment	No of infested glasshouses with at least 1 established population	No of infested ha with at least 1 established population		
Units for spread	No of newly infested NUTS 2 areas for 10 years			
Units for impact	Yield losses on host crops			
Production unit	No potted plants per ha	No plants per ha	No plants per ha	Tonnes per ha
Time Step	1 year			
Time horizon	10 years			
Spatial resolution	1 ha/NUTS 2 level			

A.3. Expert elicitation and fitted distributions

For the estimation of each parameter of the conceptual models presented, the evidence collected and the related uncertainties will be systematically listed. Two cases can be expected: (i) the data found through the extensive literature search is sufficient to explicit the parameter; (ii) the data are insufficient and the expert knowledge has to be captured to explicit the parameter.

In the case expert knowledge has to be gathered, an informal expert knowledge elicitation, as defined in the working draft of the uncertainty guidance (EFSA Scientific Committee, 2016) will be conducted. The phases that will be followed are:

(i) Parameter definition: framing the question
(ii) Listing relevant evidences and uncertainties
(iii) Individual expert judgement
(iv) Consensualised aggregation of the individual judgements
(v) Verification of the estimate in the broader risk assessment context
(vi) Documenting the process.

All the parameter of the conceptual models will be expressed in a quantile distribution by the estimation of 5 quantiles (lower 1%, 1st quartile 25%, median 50%, 3rd quartile 75%, Upper 99%) and by fitting the best distribution using the @Risk software.

The expression of the parameters in the form of distributions has the advantage integrate uncertainty in the estimation.

Appendix B – Introduction of *Eotetranychus lewisi* through plants for planting of poinsettia imported from countries where the pest occurs

The Panel developed a model for this pathway identifying the parameters that are relevant for the survival and development of the Lewis spider mite (Figure B.1).

Many of the model parameters have been estimated using a semi-formal expert knowledge elicitation technique described in EFSA Scientific Committee (2016). For each parameter, the Panel provides the evidence used for its estimation and the uncertainties that were considered.

B.1. Entry assessment

B.1.1. Conceptual model for entry through Poinsettia plants pathway

P_N0a. Poinsettia demand – Average number of poinsettia plants marketed per year in the EU

↓

P_N0b. Percentage of poinsettias imported from third countries into the EU

↓

P_N0c. Percentage of poinsettia from third countries where *E. lewisi* occurs

↓

P_E1. Conversion of pieces of poinsettia into packs as a pathway unit (including both rooted and unrooted plants)

↓

P_E2a. Percentage of packs that are infested prior to export

↓

P_E2b. Percentage of infested packs surviving (remaining infested) following export checks

↓

P_E3. Percentage of infested packs surviving (remaining infested) following transport, shipping and storage (Assume transport and storage conditions are not affecting the number of packs infested by mites but could increase the density of mites within the packs) – fixed at 100%

↓

P_E4. Percentage of infested packs that remain infested after EU import checks – i.e. percentage of infested packs passing border inspection into the EU

↓

P_N1: **Entry result**: Average number of infested packs of poinsettia entering EU (per year)

Figure B.1: *Eotetranychus lewisi* conceptual model for entry via poinsettia plants for planting imported from countries where the pest occurs

B.1.2. Assessment of entry

When considering the poinsettia pathway, the aim of the entry step is to estimate the average number of infested packs of poinsettia plants (unrooted cuttings, rooted cuttings and young plants) arriving in the EU each year over the next 10 years. The entry step is composed on eight sub-steps. As shown in the above Figure B.1, The assessment of the pathway begins by considering the demand for poinsettia in the EU over the next 10 years.

B.1.2.1. Entry sub-step P_N0a: poinsettia demand

Parameter definition: Average number of poinsettia plants required within the EU each year for the next 10 years. This figure is composed of poinsettia plants from third countries plus poinsettia plants produced within the EU.

Evidence:

- Poinsettia is one of Europe's top flowering indoor plants; in 2011, EU sales were reported to be approximately 115–120 million plants per annum (SFE, online).
- A marketing initiative to promote sales of poinsettia in the EU began in 2000 and between 2011 and 2014 it was supported by the EU. The programme (SFE, online) aims to develop sales of poinsettia throughout the EU with particular reference to markets with growth potential such as the UK. The programme is active in 16 European countries.

Although not specific to poinsettia, between 2000 and 2014 there was an annual increase in demand for live plants (CN category 06 (live plants, bulbs etc.) of approximately 3% per year (EUROSTAT, online). However, this is a broad category that includes many other ornamental plants.

The codes of the commodities are described in the Commission Implementing Regulation (EU) 1101/2014[12] amending the Annex I of Council Regulation (EEC) 2658/87[13].

Uncertainties:

- There is very limited information available on this parameter, e.g. information about annual sales was obtained from a website with an interest in promoting activity within the poinsettia sector (SFE, online). The figures used in the parameter estimation are taken from grey literature in 2011.
- More recent information concerns a much broader category of plants and is not specific to poinsettia.
- While a 3% annual increase of the market was identified for live plants in general, it is unlikely that such a growth rate is sustainable for poinsettia alone.
- There is no time series data for poinsettia imports for all EU countries.

Taking the above evidence and uncertainties into account, Table B.1 represents the Panels' expectation of the average number poinsettia plants required within the EU each year for the next 10 years, together with the associated uncertainty around the median estimate.

Table B.1: Average number poinsettia plants required within the EU each year for the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (Percentile)	**Average number of poinsettia plants required within the EU each year for the next 10 years (millions of poinsettia plants)**	
P_N0a	**A0**	**Comments**
Lower (1%)	80	The Panel would be extremely surprised if the average number of poinsettia plants was below this estimate
Q1 (25%)	120	Upper report of annual sales in 2011
Median (50%)	140	Estimate is based on sales information from 2011 and anticipates future growth due to effective marketing, and increasing demand for live plants in general
Q3 (75%)	155	Estimate closer to median than 99th percentile
Upper (99%)	180	The Panel would be extremely surprised if the average number of poinsettia plants was above this estimate

Having estimated the average amount of poinsettia plants required in the EU, the proportion that comes from third countries is considered next.

B.1.2.2. Entry sub-step P_N0b: proportion of poinsettias from third countries

Parameter definition: Proportion of poinsettia plants from third countries required to meet annual demand over the next 10 years.

Poinsettia plants from third countries are imported as unrooted cuttings, rooted cuttings and young plants. The International Association of Horticultural Producers produces a yearly statistical publications: the International Statistics of Flowers and Plants 2016 (AIPH, 2016). The publication

[12] Commission Implementing Regulation (EU) No 1101/2014 of 16 October 2014 amending Annex I to Council Regulation (EEC) No 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff.

[13] Council Regulation (EEC) No 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the Common Customs Tariff. OJ L 256, 7.9.1987, p. 1–675.

provides statistics regarding the value (€) and/or quantity (kg) of imports of horticultural products, such as pot plants and cut flowers into the EU. Such extra-EU statistics are based on customs declarations required by EU Member State customs authorities. Extra-EU data represent an official harmonised source of information. AIPH (2016) also provides figures showing intra-EU trade. In the absence of customs control in the Schengen area, such intra-EU trade data are collected from large trade operators. The International Flower Trade Association collects statistics from over 3,000 companies in 20 countries worldwide of which 1,500 traders and wholesalers are in the EU. Membership accounts for more than 80% of the total value of the worldwide trade of cut flowers and pot plants. Intra-EU data are not official but represent the best information available. Unfortunately no statistics are specifically available describing trade in poinsettia pot plants. However, poinsettia plants are captured within the CN code 0602 9070 (indoor plants, rooted cuttings and young plants) and captured by AIPH as 'other ornamental plants' (Table 6.2 p. 158 of the AIPH, 2016).

Evidence:

- AIPH (2016) indicate that while the value of all ornamental plants imported from outside the EU was around €1.68 billion in 2015, 'other ornamental plants' which includes poinsettia, accounted for around €0.3 billion (18%) of the trade. Most EU Member States obtain 'other ornamental plants' from within the EU. Only Spain and the Netherlands imported more than 10% of the value of such plants from outside the EU.
- AIPH data indicate that of all 'other ornamentals plants' (CN 0602 9070) imported into the EU from third countries, two-thirds are imported via the Netherlands (AIPH, 2016, Table 6.2) and one-third is imported by other EU MSs (primarily Germany, Belgium, Luxemburg and Italy, which together make up 28% of EU third country imports of 'other ornamental plants').
- Dutch import data for 3 years between January 2012 and December 2014 indicate that approximately 45.3 million 'pieces' of poinsettia are imported into the Netherlands annually (Table B.2).

Table B.2: Dutch imports of poinsettia (rooted plants and unrooted cuttings) 2012–2014 (millions of pieces imported)

Type of poinsettia import	2012	2013	2014	3 years mean
Rooted poinsettia plants	3.97	6.38	5.14	
Unrooted poinsettia cuttings	41.36	37.64	41.38	
Total	45.33	44.02	46.52	45.29

- Dutch imports of 'other ornamentals plants' (CN 0602 90 70) which includes poinsettia, accounts for approximately two-thirds of all EU imports of 'other ornamentals plants' (AIPH, 2016, Table 6.2).
- If the proportion of imports of poinsettia into the Netherlands follows the pattern for 'other ornamental plants', i.e. two-thirds by the Netherlands, one-third by other EU Member States, then given that approximately 45 million poinsettia are imported annually by the Netherlands, then other EU Member States can be assumed to import approximately 22.5 million poinsettia pieces.
- Overall EU imports of all 'small plants and rooted cuttings' (CN 0602 9070) has tended to decline in recent years although specific data on poinsettia imports into the Netherlands does not follow this trend (the Netherlands imports were 45.3 million pieces in 2012, 44.0 million pieces in 2013 and 46.5 million pieces in 2014).
- Total EU sales in 2011 were between 115 and 120 million pieces but are expected to have grown in recent years due to marketing initiatives. Average annual sales over the next 10 years could be approximately 140 million pieces per year.
- With the Netherlands imports of around 45 million and other EU MS imports of around 22.5 million, perhaps around 72.5 million pieces of poinsettia will be produced from within the EU on average per year for the next 10 years (Table B.3).

Table B.3: Percentage of poinsettia plants imported in the EU and in the Netherlands

	Millions of poinsettia	As %
NL imports	45.0	48
Other EU MS imports	22.5	
EU production	72.5	52
Annual sales	140.0	100

- Using detailed Dutch trade inspection data (NL-NPPO, 2017) on poinsettia and more general, EU wide data for 'other ornamental plants' (EUROSTAT, online) approximately 48% of poinsettia are currently obtained from third countries.

Uncertainties:

- There is very limited information available on this parameter, e.g. only detailed data for the Netherlands over a short time series; there is no time series for all EU Member States.
- There is a lack of poinsettia marketing knowledge and expertise within the Panel.
- Poinsettia plant breeders in the USA develop commercially successful and popular varieties which can only be sourced from the USA – as US growers develop new varieties, EU may be tied to obtain selected varieties from outside the EU, perhaps leading to a rise in poinsettia imports from third countries.
- The US plant breeders have patents on the commercial varieties and to avoid such costs EU producers may switch to alternative (domestic) sources perhaps leading to a decline in poinsettia imports from the USA and other third countries.
- The UK and other EU multiple retailers are encouraging suppliers to provide plants from material produced in Europe, perhaps leading to a decline in poinsettia from third countries.
- Changes to the EU plant health regime with the implementation of new EU Plant health law Regulation 2016/2031[14] may inhibit imports of plants for planting from third countries, hence leading to a decline in poinsettia from third countries.

Taking the above evidence and uncertainties into account, Table B.4 represents the Panels' estimate of the average percentage of poinsettia plants from third countries required to meet annual EU demand over the next 10 years, together with the associated uncertainty around the median estimate.

Table B.4: Average percentage of poinsettia plants from third countries required to meet annual EU demand over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of poinsettia plants from third countries required to meet annual EU demand over the next 10 years	
P_N0b	**A0**	**Comments**
Lower (1%)	30	The Panel would be extremely surprised if the average percentage of poinsettia plants from third countries was below this estimate
Q1 (25%)	40	Based on recent data and current estimate
Median (50%)	48	
Q3 (75%)	55	
Upper (99%)	65	The Panel would be extremely surprised if the average percentage of poinsettia plants from third countries was above this estimate

B.1.2.3. Entry sub-step P_N0c: percentage of poinsettias from countries where *Eotetranychus lewisi* occurs

Parameter definition: Average annual proportion of poinsettia plants arriving in the EU from countries where *E. lewisi* occurs, over the next 10 years.

A literature search identified countries where *E. lewisi* is known to occur (PROMETHEUS Protocol, Annex A[5] (EFSA, 2017a)). The proportion of 'rooted cuttings and young plants' (which includes

[14] Regulation (EU) No 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants, amending Regulations (EU) No 228/2013, (EU) No 652/2014 and (EU) No 1143/2014 of the European Parliament and of the Council and repealing Council Directives 69/464/EEC, 74/647/EEC, 93/85/EEC, 98/57/EC, 2000/29/EC, 2006/91/EC and 2007/33/EC. OJ L 317, 23.11.2016, p. 4–104.

poinsettia) could be determined following a data search on EUROSTAT of CN code 0602 90 70 (EUROSTAT, online).

Figure B.2 shows the amount of material of 'rooted cuttings and young plants' imported into the EU 2011–2015.

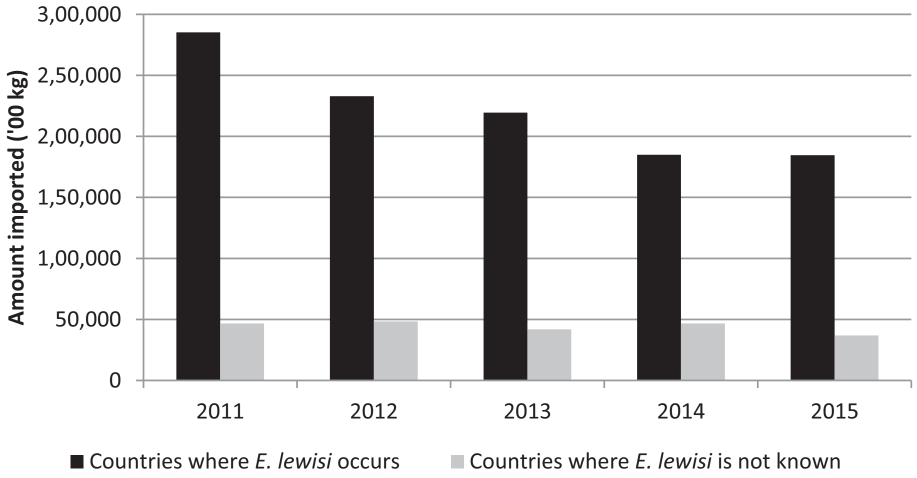


Figure B.2: EU imports of 'rooted cuttings and young plants (which includes poinsettia) CN0602 9070, 2011–2015 from countries where *E. lewisi* occurs and from countries where *E. lewisi* is not known to occur

Table B.5 expresses the data in Figure B.2 following conversion to annual proportions of material from countries where *E. lewisi* occurs and from countries where *E. lewisi* is not known to occur.

Table B.5: Percentage of EU imports of 'rooted cuttings and young plants' (which includes poinsettia) from countries where *E. lewisi* occurs and from countries where *E. lewisi* is not known to occur, 2011–2015

Year	2011	2012	2013	2014	2015	5 years mean
% from third countries where *E. lewisi* occurs	85.9	82.8	84.0	79.9	83.4	83.2
% from third countries where *E. lewisi* is not known to occur	14.1	17.2	16.0	20.1	16.6	16.8
Sum	100.0	100.0	100.0	100.0	100.0	100.0

While the amount of EU cuttings and young plants imported from countries where *E. lewisi* occurs has dropped in recent years from over 28.5 million kg in 2011 to 18.5 million kg in 2015, a drop of around 35%, the percentage of imports of cuttings and young plants from countries where *E. lewisi* occurs has varied much less, and ranges between approximately 80% and 86%. However, such data is not specific to poinsettia but covers very many species of ornamental plants. To better understand the proportion of poinsettia entering the EU from countries where *E. lewisi* is known to occur, we turn to more detailed import data collected by the Netherlands (NL-NPPO, 2017). Dutch trade inspection data for the years 2012–2014 indicate that approximately 5.4% of rooted poinsettia plants were sourced from countries where *E. lewisi* is known to occur and approximately 0.3% of unrooted poinsettia cuttings were sourced from countries where *E. lewisi* is known to occur (Table B.6).

Table B.6: The number of 'pieces' of poinsettia plants (rooted cuttings and young plants and unrooted cuttings) sourced from countries where *E. lewisi* is either not known or known to occur, 2012–2014

Type of poinsettia	Status of *E. lewisi* in third country	Year			3 years mean %
		2012	2013	2014	
Rooted cuttings and young plants	*E. lewisi* not known	3,354,596	6,355,735	5,138,870	
	E. lewisi known	618,745	25,643	4,441	
	Sum	3,973,341	6,381,378	5,143,311	
	% from not known	84.4	99.6	99.9	94.6
	% from known	15.6	0.4	0.1	5.4
Unrooted cuttings	*E. lewisi* not known	41,136,865	37,555,792	41,055,210	
	E. lewisi known	225,655	87,656	105,704	
	Sum	41,362,520	37,643,448	41,160,914	
	% from not known	99.5	99.8	99.7	99.7
	% from known	0.5	0.2	0.3	0.3

Table B.7 shows the combination of rooted cuttings and young plants with unrooted cuttings.

Table B.7: Combination of rooted cuttings and young plants with unrooted cuttings

	2012	2013	2014	3 years mean
NL imports of poinsettia from countries where mite occurs	1.9%	0.3%	0.2%	0.8%
NL imports of poinsettia from countries where mite is not known	98.1%	99.7%	99.8%	99.2%

Evidence:

- Most EU Member States obtain the majority of ornamental plants from other EU Member States.
- The Netherlands is a major importer of ornamental plants from outside the EU.
- Detailed data from the Netherlands over three years provides precise figures on the amount of poinsettia imported and where it comes from.
- Over the 3-year period 2012–2014, there was been a decline in the proportion of rooted poinsettia cuttings and young plants coming from countries where *E. lewisi* is known to occur.
- Between 2012 and 2014, on average NL imported less than 1% of all poinsettia material from countries where *E. lewisi* occurs (unrooted cuttings, rooted cuttings and young plants combined).

Uncertainties:

- There is very limited information available on this parameter, e.g. only detailed data for the Netherlands over a short time series is available; there is no time series for all EU Member States describing the sources of imports of poinsettia.
- For all EU Member States, broad import data indicate that around 80% or more of the category 'rooted cuttings and young plants' (CN 0602 9070), not just poinsettia, come from countries where *E. lewisi* is known to occur. However, what proportion of such data refers to poinsettia alone is not known.
- *E. lewisi* is difficult to detect and might have spread internationally to more countries than the ones where the pest has been reported, thus poinsettia plants may already have been imported from those countries where the mite occurs, but where it has not been detected.
- *E. lewisi* may spread during the next 10 years and imports could come from newly infested countries.

Taking the above evidence and uncertainties into account, Table B.8 represents the Panels' expectation of the average percentage of poinsettia plants arriving in the EU from third countries where *E. lewisi* occurs, over the next 10 years.

Table B.8: Average percentage of poinsettia plants arriving in the EU from countries where *Eotetranychus lewisi* occurs, over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	**Average percentage of poinsettia plants arriving in the EU over the next 10 years, from countries where *E. lewisi* occurs**	
P_N0c	**A0**	
Lower (1%)	0	The Panel would be extremely surprised if the average percentage of poinsettia plants sourced from countries where *E. lewisi* occurs was zero
Q1 (25%)	0.8	Between 2012 and 2014, on average NL imported less than 1% of all poinsettia material from countries where *E. lewisi* occurs; however, other EU MSs also import poinsettia, probably from the USA where the mite is known to occur
Median (50%)	1.5	
Q3 (75%)	3	
Upper (99%)	6	The Panel would be extremely surprised if the average percentage of poinsettia plants from countries where *E. lewisi* occurs was above this estimate

B.1.2.4. Entry sub-step P_E1: conversion into packs as a pathway unit

Parameter definition: The average number of 'pieces' of poinsettia plants that constitute a 'pack'; traded and shipped together as a unit for the next 10 years. A pack is a sealed unit within which a mite could spread to other individual pieces of poinsettia in the same pack.

For very many species of ornamental plants traded, Dutch trade inspection data (NL-NPPO, 2017) detail the number of 'pieces' of plants in each consignment and the number of packs in each consignment. It is known that poinsettia plants from third countries are imported as unrooted cuttings, and as rooted cuttings and young plants. Dutch trade inspection data Dutch import data (2012–2014) for pieces of poinsettia imported as unrooted cuttings, and as rooted cuttings and young plants are shown in Table B.9. Plotting the number of pieces of poinsettia imported against the number of packs imported reveals the typical number of pieces per pack.

Table B.9: Dutch imports of poinsettia plants, unrooted or rooted cuttings, 2012–2014

Type of plants	**Pieces imported by NL (millions)**				**% imported as unrooted and rooted**			
	2012	**2013**	**2014**	**3-year mean**	**2012**	**2013**	**2014**	**3-year mean**
Unrooted cuttings	41.36	37.64	41.38	40.13	91.2	85.5	89.0	88.6
Rooted cuttings and young plants	3.97	6.38	5.14	5.16	8.8	14.5	11.0	11.4
Sum	45.33	44.02	46.52	45.29	100.0	100.0	100.0	100.0

Taking into account that between 2012 and 2014, over 88% of poinsettia plants were imported into the Netherlands as unrooted cuttings, the Panel distinguishes between packs of unrooted cuttings and packs of rooted cuttings and young plants. Figure B.3 shows a plot for unrooted poinsettia cuttings, and Figure B.4 shows such a plot for rooted cuttings and young plants.

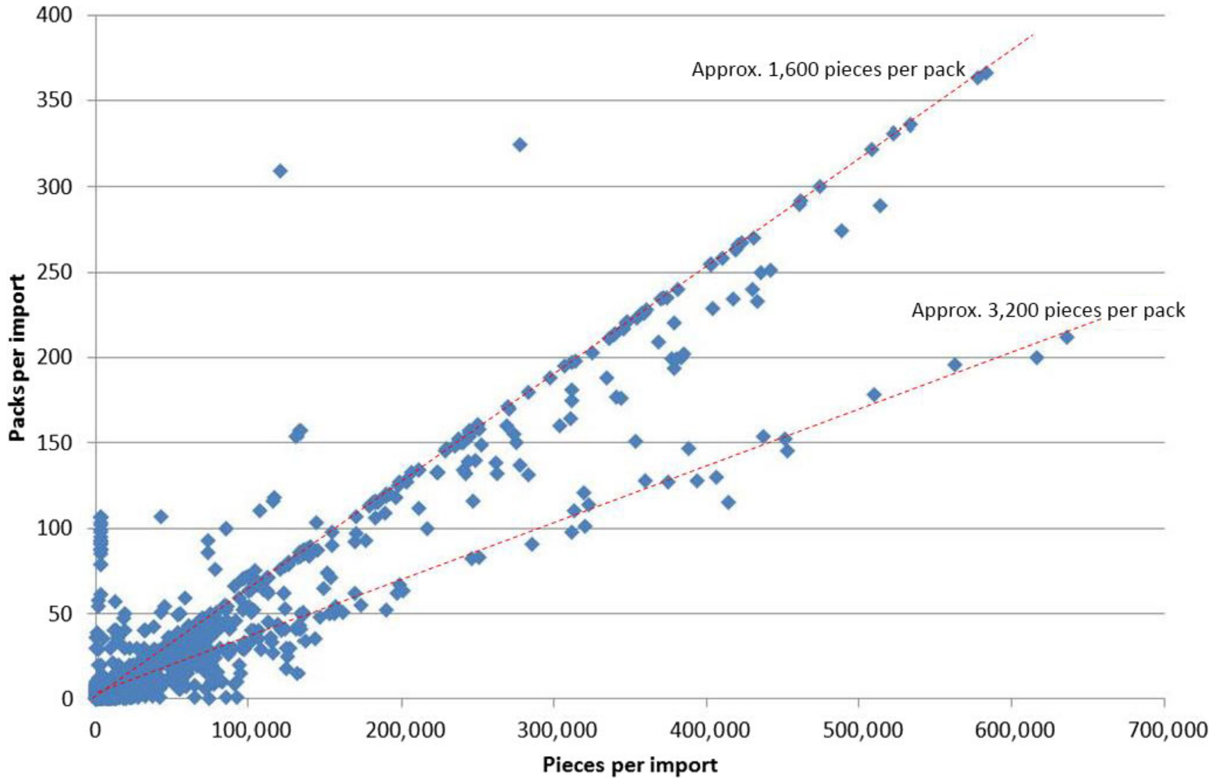


Figure B.3: Number of pieces of imported unrooted poinsettia cuttings per consignment vs number of packs per consignment, 2012–2014

The red lines in Figure B.3 suggest typical pack sizes of around 1,600 pieces per pack and 3,200 pieces per pack. There are more packs that contain 1,600 pieces per pack than 3,200 pieces per pack, indicating 1,600 pieces per pack is more common.

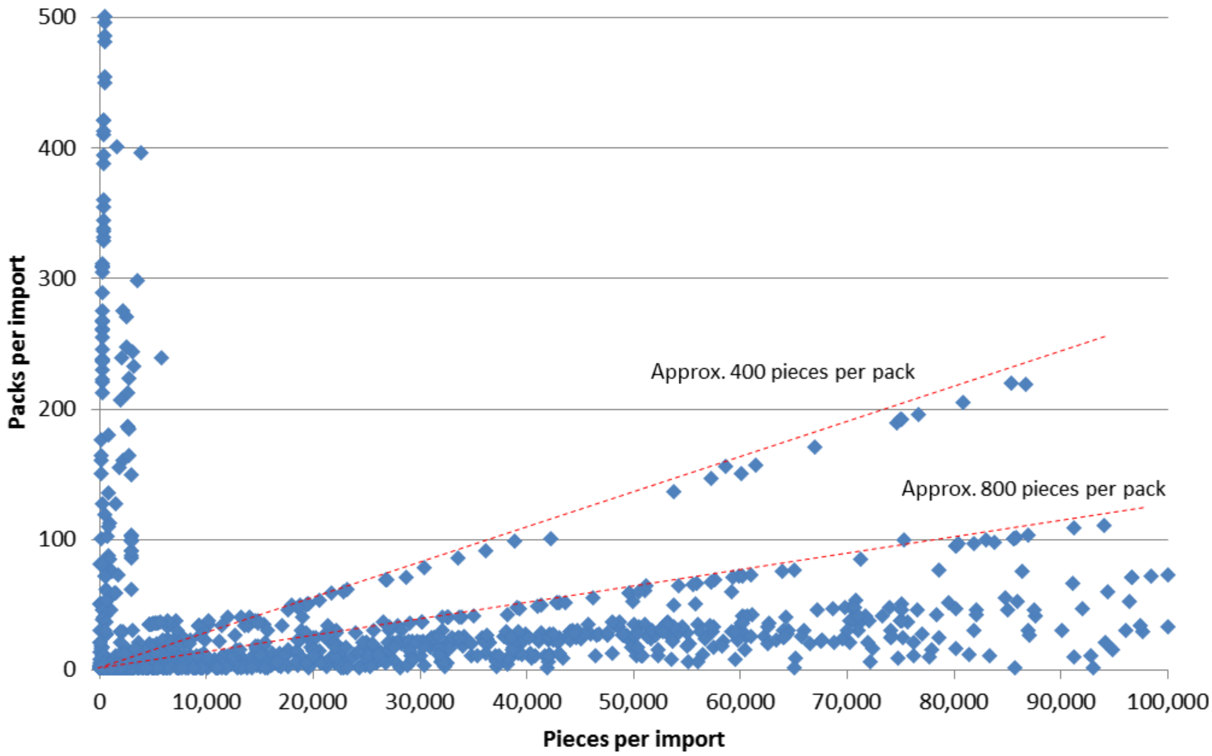


Figure B.4: Number of pieces of imported rooted poinsettia cuttings and poinsettia young plants per consignment vs number of packs per consignment, 2012–2014

The red lines in Figure B.4 suggest typical pack sizes of around 400 and 800 pieces per pack.

Evidence:

- The Netherlands is a major importer of ornamental plants from outside the EU.
- Detailed data from the Netherlands over three years provides precise figures on the number of pieces of poinsettia imported and pack size.
- Examining poinsettia imports by the Netherlands, one can distinguish between rooted and unrooted plant material.
- Although there is variation in pack size, there does appear to be a typical pack sizes for unrooted cuttings and for rooted cuttings and young plants.
- Unrooted cuttings of poinsettia are typically shipped in packs of 1,600 pieces.
- Rooted cuttings and young plants are typically shipped in packs of 400 pieces.

Uncertainties:

- There is very limited information available on this parameter, e.g. only detailed data for the Netherlands over a short time series is available; there is no time series for all EU Member States describing the number of pieces of poinsettia per consignment, or packs per consignment.
- The typical pack sizes imported into the Netherlands might not be the same as typical pack sizes imported into other EU Member States.
- Over time typical pack size may change.

Rather than describe the number of pieces of poinsettia per pack as a variable, then elicit judgements to estimate a distribution for the variable, the Panel opted to use a fixed number to convert pieces of poinsettia imported into packs of poinsettia imported. This is because the pack can be considered for the handling and transport of the poinsettia plants, to be an homogeneous unit of infection for the pathway in terms of exposure of the plant material to the pest.

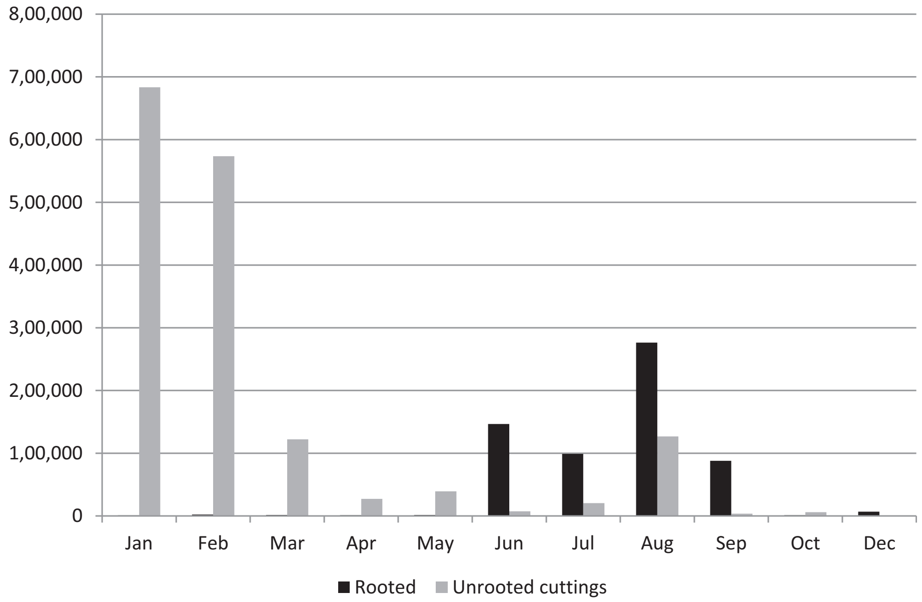
For unrooted cuttings, the Panel assumes 1,600 pieces of poinsettia per pack. For rooted cuttings and young plants, the Panel assumes 400 pieces of poinsettia per pack. Taking the lower number of pieces per pack for both unrooted cuttings and rooted cuttings, provides a scenario that leads to more packs being imported into the EU and hence a worse case as the higher number of packs could be distributed more widely on arrival into the EU.

Recognising that the majority of packs imported contain unrooted cuttings, the panel assumed that each year 88% of packs would be unrooted cuttings (based on Dutch trade inspection data Dutch data (NL-NPPO, 2017)) in sub-step P_E1, Table B.9 above).

B.1.2.5. Entry sub-step P_E2a: percentage of packs that are infested prior to export

Parameter definition: In countries where the mite is known to occur, what will be the average percentage of poinsettia grown for export that is infested by *E. lewisi* prior to export, over the next 10 years?

In plant nurseries, *E. lewisi* is only occasionally observed on poinsettias (Pilon, 2010). When it does occur, damage is often sporadic and may only occur on a few plants or cultivars (Njue, 2013). This suggests that the mite does not spread much within a nursery and some poinsettia cultivars are resistant to the mite.



Data source: (NL-NPPO, 2017)

Figure B.5: Seasonality of imports – mean monthly imports of poinsettia (unrooted cuttings, and rooted cuttings and young plants) into the Netherlands from countries where *E. lewisi* occurs (2012–2014)

Whilst poinsettias are imported every month of the year, the majority of imports of unrooted cuttings occur in the winter and spring. Rooted cuttings and young plants are mainly imported in the summer and autumn.

For this parameter, two different scenarios are considered, the scenario A0 with the current measures in place and scenario A2 where in the country at origin the poinsettia plants can only be imported from Pest Free Production Places.

B.1.2.5.1. Entry sub-step A0-P_E2a: percentage of packs that are infested prior to export under the current regulatory requirements

Evidence:

- Although reported on poinsettia in the USA in 1958 (Gilrein, 2006), lack of scientific publications over the years indicates that *E. lewisi* it is not a significant or regular pest in poinsettia production.
- Poinsettia plants are fairly high value ornamentals (Gill et al., 2011) and a wide range of insecticides and acaricides can be applied (Njue, 2013), limiting the opportunity for *E. lewisi* to establish in a production nursery.
- High value mother plants, from which cuttings are taken, are well cared for and carefully managed. Mite infestations are likely to be detected and treated, inhibiting the likelihood of infestations occurring.
- Quality of the cuttings is ensured by visual elimination of atypical plant material, and pesticide treatment, although not targeted at *E. lewisi,* it could still be controlling it.
- Only fairly recently has *E. lewisi* re-emerged as an occasional pest problem in poinsettia (Gilrein, 2006).
- Industry factsheets and publicity material has been developed (e.g. Gilrein, 2006; Pilon, 2010) to raise awareness of *E. lewisi* amongst poinsettia growers in North America.
- *E. lewisi* has been found in the UK on poinsettia plants from Guatemala, strongly suggesting that there can be some *E. lewisi* at sites growing and exporting poinsettia plants. However, over the many years that poinsettia has been traded, only one outbreak in the UK is known.
- In the USA, damage symptoms in poinsettia appear in the autumn (Gilrein, 2006) but the majority of imports into the Netherlands occurs during January, February and March.

- There have been no confirmed interceptions of *E. lewisi* on poinsettia during import inspections, although outbreaks (detections post import) have been linked to poinsettia imports.

Uncertainties:

- There is very limited information available on this parameter, e.g. text and comments describing the occurrence of *E. lewisi* in poinsettia nurseries come largely from the grey literature; there is no survey data indicating the *E. lewisi* incidence in ornamental nurseries in countries where the mite is known to occur.
- The mite is difficult to detect, especially when the population is low, so it could occur more often, yet go undetected. However, as populations can grow rapidly, if present they should be detected eventually (damage is usually detected in the autumn – see above, but the mite could have been there for months beforehand).

B.1.2.5.2. Entry sub-step A2-P_E2a: percentage of packs that are infested prior to export in third countries in pest free places of production

Evidence:

- As *E. lewisi* is often found late in the season just prior to marketing of finished pot plants, surveillance earlier in the season, when the mite population is lower, is unreliable unless webbing is visible (Gilrein, 2006).
- Production systems and conditions for poinsettia production are well described, e.g. (UF IFAS, 2011). The controlled environment implies good pest management.
- There are industry standards and protocols describing product quality and plant health status, e.g. (ECKE ranch, online).
- The international standard for phytosanitary measures (ISPM 4: FAO, 1995) describes the requirements for the establishment of Pest Free Areas (PFA). However, maintaining a PFA for the related mite *Eutetranychus orientalis* was not considered realistic (EFSA PLH Panel, 2013).
- The international standard for phytosanitary measures (ISPM 10: FAO, 1999) describes the requirements for the establishment of pest free places of production (FAO, 1999).
- The production sites are usually located at altitudes that reduce the likelihood of mite occurrence (expert assumption).

Uncertainties:

- Due to their small size, mites are difficult to detect (Navia et al., 2010; Navajas et al., 2014) and although it is possible for them to be detected, their identification to species level requires specialist expertise, so can be unreliable without expert knowledge.
- There is no evidence and we have no knowledge of PFAs being used to control mites (expert knowledge)
- In the EU regulation, no pest free places of production (PFPPs) have been established to protect the EU territories against the entry and or spread of any mite in the EU.

Taking the above evidence and uncertainties into account, Table B.10 represents the Panels' estimate of the average percentage of poinsettia packs grown for export in countries where the mite is known to occur, that will be infested by *E. lewisi* prior to export, over the next 10 years.

Table B.10: Average percentage of poinsettia packs infested with *Eotetranychus lewisi* prior to export, over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of poinsettia packs infested by *E. lewisi* prior to export, over the next 10 years (%)		
P_E2a	**A0**	**A2**	**Comments**
Lower (1%)	0.1	0	For A0, the Panel would be extremely surprised if the average percentage of infested poinsettia packs was below 1 in 1,000 (i.e. 0.1%) For A0, the Panel would be extremely surprised if the average percentage of infested poinsettia packs, in countries where *E. lewisi* occurs, was equal to or above 1 in 20 plants (i.e. 5%) For A2, unlikely but possible to have ineffective measures (1 infested pack out of 100 is rendering the PFPP ineffective)
Q1 (25%)	0.5	0.02	
Median (50%)	1.0	0.05	
Q3 (75%)	3.0	0.2	
Upper (99%)	5.0	0.5	

B.1.2.6. Entry sub-step P_E2b: percentage of infested packs passing export checks

Parameter definition: Average percentage of infested packs passing industry quality checks and export checks at origin and remaining infested, then shipped to the EU, over the next 10 years.

Evidence:

- Mites, in general, are very difficult to detect, especially when they occur at low population densities.
- Based on the Dutch trade inspection data (NL-NPPO, 2017) and assuming that other EU Member States imports follow a similar pattern, most exports occur in January, February and March when, if present, the mite is likely to be at a low population level if coming from a northern temperate country such as the USA.

Uncertainties:

- There is no specific data for this parameter.
- There is no survey information measuring the performance of export inspections. However, the Panel assumes that such inspections are performed at the same level of effectiveness as import inspections.
- Liebhold et al. (2012) estimated that approximately 72% of infested plants for planting remain undetected following import inspections. Thus, around 28% of infested plants for planting are detected at import. The analysis by the authors considered plants infested by any pest taxa. Detecting mites is much harder so the 28% success rate is expected to be much lower if only considering mites.
- It is not excluded that over the next 10 years new technology develops to aid the detection of mites. However, the Panel assumes that it is not expected to greatly improve detection of mites on ornamental plants.

Taking the above evidence and uncertainties into account, Table B.11 represents the Panels' estimate of the average percentage of infested packs of poinsettia that remain infested after export checks, over the next 10 years.

Table B.11: Average percentage of infested packs of poinsettia that remain infested after export checks, over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	**Average percentage of infested packs passing quality checks at origin and remaining infested, then shipped to the EU, over the next 10 years**	
P_E2b	**A0**	**Comments**
Lower (1%)	98.5	The Panel would be extremely surprised if the average percentage of infested poinsettia packs that remained infested was below 98.5% The Panel would be extremely surprised if none of the infested packs were detected prior to export, i.e. the average percentage of infested poinsettia packs that remained infested was 100%
Q1 (25%)	99.2	
Median (50%)	99.4	
Q3 (75%)	99.6	
Upper (99%)	100.0	

B.1.2.7. Entry sub-step P_E3: percentage of infested packs surviving transport, shipping and storage

Parameter definition: Average percentage of infested packs which remain infested during transport/shipping and storage to the EU over the next 10 years.

Evidence:

- Unrooted poinsettia cuttings and rooted poinsettia cuttings and young plants are transported at 10–12°C. Warmer temperatures can result in severe epinasty (leaves bend down). Shipping at temperatures below 10°C can result in chilling injury to poinsettia (Kessler and Hesselein, 2003).
- Advice within the poinsettia industry suggests that shipping should not exceed 4 days (Kessler and Hesselein, 2003) hence poinsettia are assumed to arrive in the EU as airfreight.

- *E. lewisi* has a threshold temperature for development from egg to adult of between 8.3°C and 9.0°C (Lai and Lin, 2005); therefore, shipping temperatures of 10–12°C will not cause any mortality.

Uncertainties:

- There is very limited data on transport and shipping conditions of poinsettia.
- The thermal biology of *E. lewisi* is not well studied and similarities have to be made with related mites.
- Although some natural mite mortality may occur during shipping, all mites in an infested pack would have to die before an infested pack became an uninfested pack.
- While there are recommended conditions for transport (10–12°C) (BMT Surveys©, online a), it is possible that some poinsettia are transported at warmer or cooler temperatures. Warmer temperatures could facilitate mite survival; cooler temperatures could lessen likelihood of survival. Nevertheless, unless all individuals in an infested pack died, an infested pack would remain infested.

Taking the above information and uncertainties into account, the Panel assumes that all infested packs travelling to the EU will remain infested during shipping, and while some mortality may occur, an infested pack will remain infested for the duration of transport.

P_E3: Average percentage of infested packs that remain infested during transport and shipping to the EU = 100%.

B.1.2.8. Entry sub-step P_E4: percentage of infested packs surviving EU border import checks

Parameter definition: Average percentage of infested packs which remain infested following EU import/border inspection checks over the next 10 years.

Evidence:

- Mites, in general, are very difficult to detect, especially when they occur at low population densities.
- Based on Dutch import data (NL-NPPO, 2017), and assuming other EU Member States imports follow a similar pattern, most exports occur in January, February and March when, if present, the mite is likely to be at a low population level at origin.
- EUROPHYT interception records of non-compliance indicate that mites are seldom intercepted. Since 1995, when EUROPHYT records of non-compliance began to be collected, there have been 38 reports of mite interceptions. None of them were *E. lewisi*.
- The Council Directive 2000/29/EC[3] does not regulate *E. lewisi* on poinsettia, so EU import inspections will not have been looking specifically for *E. lewisi*.
- One confirmed outbreak has been reported in the EU in the UK in a poinsettia greenhouse (EPPO, 2014). The outbreak was eradicated.
- Surveys in Polish glasshouses between 1982 and 2005 identified possibly *E. lewisi* on ornamentals (Labanowski, 2009) but no information is provided as the frequency of findings or how widespread across Poland the mite was or whether any damage occurred and the species of the pest has not been confirmed. The Polish NPPO report the mite was successfully controlled (EFSA PLH Panel, 2014a).

Uncertainties:

- There is no specific data for this parameter.
- There is no survey information measuring the performance of EU import inspections. However, if we assume that EU inspections are as effective as US inspections, then we can be informed by the analysis of Liebhold et al. (2012) who estimated that approximately 72% of infested plants for planting remain undetected following import inspections. Thus, around 28% of infested plants for planting are detected at import. The analysis by Liebhold et al. (2012) considered plants infested by any pest taxa. Detecting mites is much harder so the 28% success rate is expected to be much lower if only considering mites.

- Populations of mite are not expected to change much during transport, so the population density in an undetected infested pack prior to export remains at approximately the same population density on arrival into the EU
- It is not excluded that over the next 10 years new technology develops to aid the detection of mites. However, the Panel assumes that it is not expected to greatly improve detection of mites on ornamental plants.

Taking the above evidence and uncertainties into account, Table B.12 represents the Panels' estimate of the average percentage of infested packs of poinsettia that remain infested after EU import checks, over the next 10 years.

Table B.12: Average percentage of infested packs passing EU import checks over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of infested packs passing EU import checks over the next 10 years	
P_E4	**A0**	**Comments**
Lower (1%)	98.5	The Panel would be extremely surprised if the average percentage of infested poinsettia packs that remained infested was below 98.5% The Panel would be extremely surprised if none of the infested packs were detected during import checks, i.e. the average percentage of infested poinsettia packs that remained infested was 100%
Q1 (25%)	99.2	
Median (50%)	99.4	
Q3 (75%)	99.6	
Upper (99%)	100.0	

B.1.2.9. Entry result P_N1: average number of infested packs of poinsettia entering the EU per year for the next 10 years

Figure B.6 shows the descending cumulative probability distribution for the number of infested packs arriving each year in the EU. The red (solid) line indicates scenario A0 (baseline). The blue (broken) line indicates scenario A2 (with additional RROs). Annotation is provided to aid interpretation of the chart.

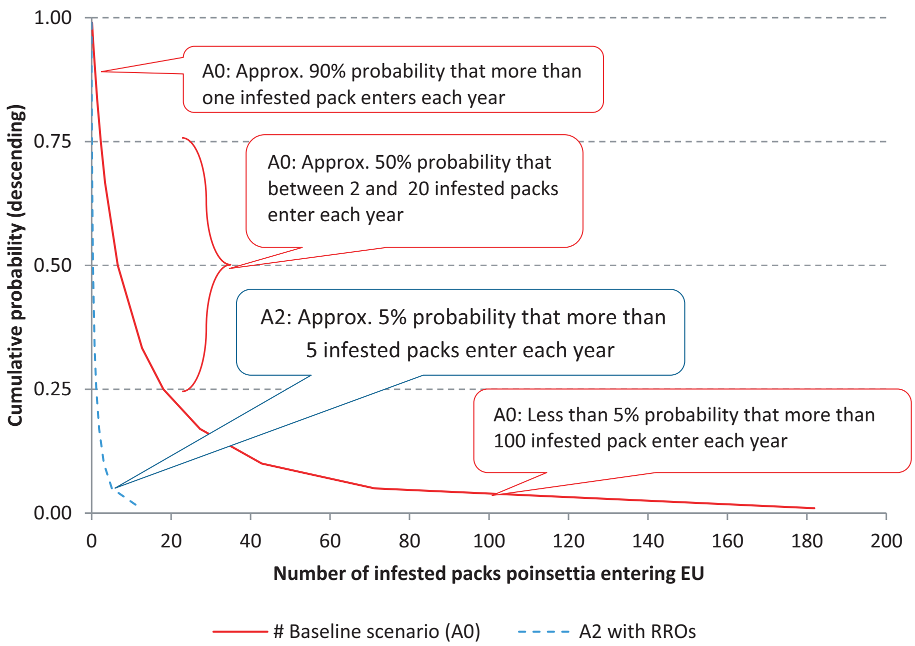


Figure B.6: Descending cumulative probability distribution of the mean number of packs of poinsettia entering the EU each year infested with *E. lewisi* (baseline scenario, A0; scenario A2 with additional risk reducing options)

Scenario A2 considered additional risk reduction options (RROs) whereby poinsettia plants are sourced from sites purporting to be pest free places of production or pest free production sites. There is a residual likelihood that a place of production, or a production site, certified as free from *E. lewisi* is not actually free of the pest. The results of including these RROs are indicated in Figure B.6 by the blue broken line. The results from Panel estimates suggest that whilst it is unlikely that an infested pack of poinsettia will arrive in the EU from sites certified as pest free, there is approximately a 25% chance that over the time horizon, a mean of 1 or more infested packs could enter the EU each year from such sites. There is approximately a 5% likelihood that five or more infested packs enter from infested sites (Figure B.6).

Comparing A0 and A2: In scenario A0, on average between 2 and 20 infested packs enter each year while in scenario A2 from 0 to 1 infested packs enter each year into the EU.

A benefit of the quantitative model is the promulgation of uncertainty through the model. Within the model for entry via poinsettia, there are four major sub-steps that contribute the most to uncertainty (Figure B.7). Three of the four sub-steps are not related to the biology of *E. lewisi* but concern the international trade in poinsettia. The uncertainties are about the average amount of poinsettia marketed each year in the EU, the amount that is imported, and the amount that is imported from countries where *E. lewisi* occurs. Improved knowledge about (i) the future trends of where poinsettia could be sourced from, and (ii) the amount imported into the EU would narrow uncertainty in the estimate of the number of packs arriving each year in the EU infested with *E. lewisi*. As seen in other recent quantitative assessments, e.g. EFSA PLH panel (2016) the single greatest uncertainty regarding entry is the level of infestation of the commodity at pathway origin.

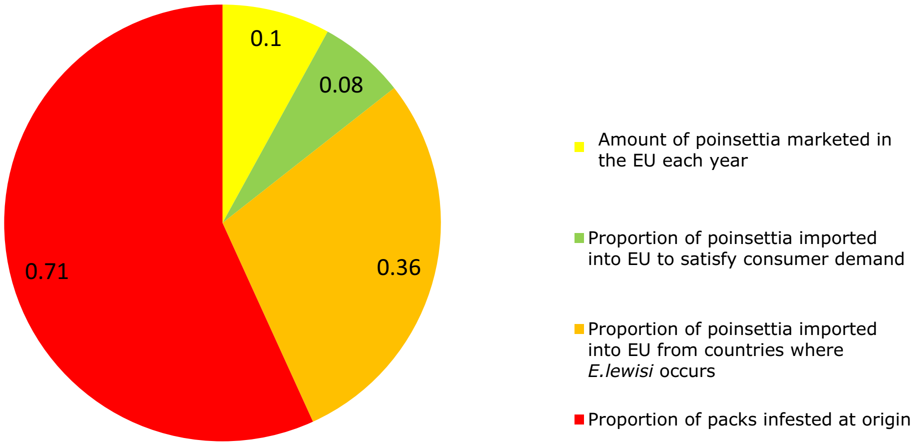


Figure B.7: Entry sub-steps estimates contributing most to the overall uncertainty regarding the number of packs of poinsettia entering the EU each year infested with *E. lewisi*

The following uncertainty factors have not been quantified in the entry step:

i) Potential for import of infested poinsettia from countries where *E. lewisi* is not currently known to occur although it is actually present.
ii) Variation in pack size, a fixed number is used for rooted and a different fixed number used for unrooted poinsettia.

B.1.3. Conclusions regarding entry via poinsettia

Given the uncertainties noted for each sub-step of the assessment of entry, and recognising that some uncertainties have not been quantified, the model output results should be interpreted in a more approximate manner than indicated in Figure B.6. Hence, the Panel thinks that it is very unlikely that on average, over the next 10 years, all packs of poinsettia entering the EU from countries where *E. lewisi* is known to occur could enter free from *E. lewisi*. On the other hand it is also very unlikely that the average number of packs that enter and are infested will be 100 or more. It is more likely that between one pack and a few tens of packs of poinsettia would, on average, enter the EU each year infested with *E. lewisi*. To put this in context, the model assumes up to approximately 80,000 packs of poinsettia enter the EU each year from third countries of which several hundred to a few thousand packs come from countries where *E. lewisi* is known to occur.

Sourcing poinsettia plants for planting from pest free places of production or pest free production sites in countries where *E. lewisi* is known to occur is likely to prevent infested packs entering the EU altogether. However, there is a chance that *E. lewisi* is undetected at such sites allowing a small number of infested packs to enter the EU each year. The number of infested packs that could enter is estimated to be less than 10, and if not nil, is most likely to be one.

B.2. Establishment assessment

B.2.1. Conceptual model for establishment through poinsettia plants

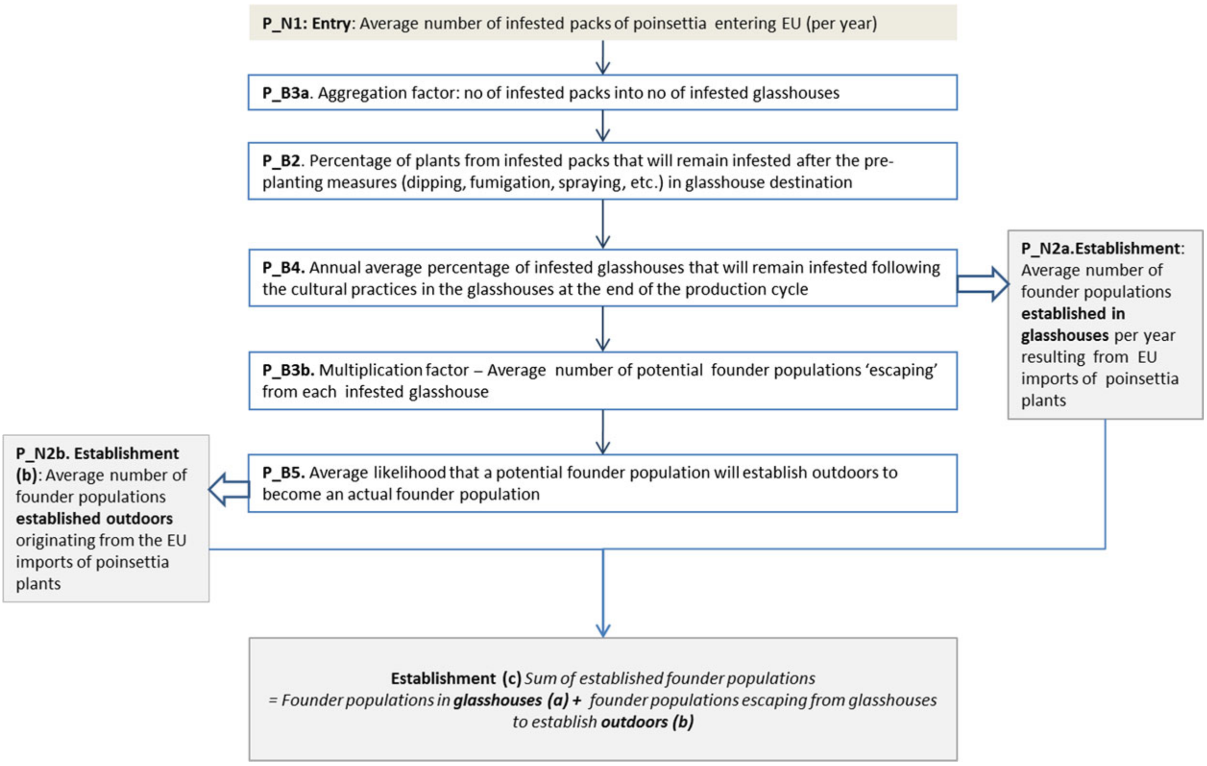


Figure B.8: Conceptual model for establishment considering the intended use of poinsettia

B.2.2. Assessment of establishment

Establishment is assessed by considering the proportion of potential founder populations that enter the EU and successfully transfer to hosts and are able to survive for the foreseeable future taking abiotic and biotic factors into account. Establishment includes assessing the potential founder populations that remain on a host within a glasshouse environment wherein they survive for the foreseeable future, and those populations that transfer to hosts outside of glasshouse and survive for the foreseeable future.

The assessment of establishment first considers establishment in EU glasshouses over the next 10 years, and uses potentially infested glasshouses, i.e. the number of glasshouses that receives a pack of poinsettia which is infested, as a starting point before considering establishment outdoors in the wider environment. Having estimated the number of infested poinsettia packs that arrive in the EU in the entry step, we now consider what happens to such packs so as to estimate the average number of founder populations that could potentially establish each year in glasshouses, or having 'escaped' from infested glasshouses, establish outdoors. When considering establishment and the intended use of poinsettia plants, the establishment step is composed of five sub-steps.

When considering the poinsettia pathway, the aim of the establishment step is to estimate the average number of actual founder populations that establish each year in the EU for the next 10 years. In addition to a quantitative estimate of establishment, a narrative description of where such establishment could take place is also provided.

B.2.2.1. Establishment sub-step P_B3a: aggregation factor describing the distribution of infested packs amongst ornamental/poinsettia growing glasshouses within the EU

Parameter definition: The average annual proportion of infested packs that are aggregated (or disaggregated) and are delivered to the same glasshouse facility. An aggregation factor of 1 means that each infested pack is not associated with another infested pack and each infested pack would go to a different glasshouse. Hence, one infested pack leads to one glasshouse potentially becoming infested. An aggregation factor of less than one indicates the degree to which an infested pack is split to create 'sub-packs' that go to different glasshouses. An aggregation factor of 0.5 means that each infested pack is split into two (1/0.5 = 2) and each part would go to a different glasshouse. Hence with an aggregation factor of 0.5, six infested packs arriving in the EU leads to 12 glasshouses potentially becoming infested (Table B.13). An aggregation factor of more than one indicates the degree to which infested packs are grouped together (aggregated) leading to individual glasshouses receiving multiple infested packs. An aggregation factor of 3 means that infested packs are likely to be grouped, and consequently for every three infested packs that arrive in the EU, potentially one glasshouse could become infested.

Table B.13: Examples of how changes to the aggregation factor increase or reduce the number of glasshouses potentially infested by *E. lewisi*

Number of infested packs	6	6	6
Aggregation factor	0.5	1	3
Calculation	6/0.5	6/1	6/3
Potentially infested glasshouses	12	6	2

Evidence:

- The results from the entry step indicate that relatively small numbers of infested packs of poinsettia arrive in the EU each year.
- The arrival of an infested pack can be considered a rare event.
- In consideration of the evidence above, P_B3a is estimate equal to one meaning that each infested pack goes to a different glasshouse.

B.2.2.2. Establishment sub-step P_B2: percentage of infested poinsettia packs that remain infested after management practices applied shortly after arrival

Parameter definition: The average annual percentage of infested poinsettias packs that remain infested after management practices applied shortly after receipt of the poinsettia are taken into account, e.g. dipping of cuttings preplanting, roguing.

Evidence:

- Advice to poinsettia growers highlight the need for good phytosanitation and identify spider mites as a potential problem to look for (e.g. Kessler and Hesselein, 2003; British Columbia Ministry of Agriculture, 2009).
- Chemical dips and drenches are used at planting to protect cuttings and young plants (British Columbia Ministry of Agriculture, 2009).

Uncertainties

- Poinsettia growers importing cuttings and young plants require a high capital investment in glasshouse structures, watering/misting and lighting equipment to produce good quality plants and are assumed to implement high standards to protect their businesses. However, there is no specific data to support this assumption.
- It is anticipated that low numbers of mites would infest a pack and whilst the number of mites may decline, the pack would remain infested to some degree.

Taking the above evidence and uncertainties into account, Table B.14 represents the Panels' estimate of the annual percentage of infested poinsettias packs that remain infested after management practices applied shortly after receipt of the poinsettia are taken into account, e.g. dipping of cuttings preplanting.

Table B.14: Average percentage of infested packs that remain infested after initial treatments (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of infested packs that remain infested after initial treatments	
P_B2	**A0**	**Comments**
Lower (1%)	0%	The Panel would be extremely surprised if none of the infested poinsettia packs remained infested after arrival
Q1 (25%)	80%	
Median (50%)	90%	
Q3 (75%)	95%	
Upper (99%)	100%	The Panel would be extremely surprised if all infested packs remained infested following initial treatments

B.2.2.3. Establishment sub-step P_B 4: average annual percentage of infested glasshouse sites that remain infested year round for the foreseeable future

Parameter definition: Percentage of infested glasshouse that will remain infested following the cultural practices in the glasshouses at the end of the production cycle where establishment could occur.

Evidence:

- Poinsettias can remain in a glasshouse for several months; unrooted cuttings are planted in the spring and can be grown on until winter before marketing. Alternatively older, rooted cuttings and young plants can be imported in the summer and grown on until marketed just before Christmas time (UF IFAS, 2011; Barne et al., 2014; CAB International, 2014).
- Poinsettia are grown in temperatures suitable for the development of *E. lewisi*.
- Mites, in general, are very difficult to detect when they occur at low population densities.
- Development from egg to adult on leaves of poinsettia takes from 19 days at 16°C to 8 days at 26°C (Lai and Lin, 2005). Multiple generations could develop during the poinsettia growing season. For example, while poinsettia are imported year round, most unrooted cuttings are imported between January and March and most rooted cuttings and young plants are imported between June and September. Unrooted cuttings arriving in mid-February and grown on until mid-November at 16°C would allow approximately 14 generations to develop; around six generations could develop on rooted cuttings arriving in mid-August and grown on until mid-November at 20°C.
- As populations grow, symptoms are more easily detected, e.g. webbing around the growing points of hosts, yellowing of leaves and feeding spots or a stippled appearance on damaged leaves (Doucette, 1962; Gilrein, 2006).
- As a quarantine pest in the EU, once detected action is very likely to be taken to eradicate the mite.
- In the UK and Poland, outbreaks of *E. lewisi* in poinsettia were detected and eradicated (Labanowski, 2009).
- In the USA, *E. lewisi* is not a quarantine pest, and outbreaks on poinsettia were easily controlled with no apparent carryover onto other crops (Njue, 2013).
- If detected early and only one or two plants are affected, it is possible to rogue the affected plants and closely watch the surrounding plants to see if treatment is needed.
- The vast majority of poinsettia is sold during the peak marketing season six weeks before Christmas; any remaining unsold are destroyed leaving the glasshouse free from poinsettia hosts.
- Good horticultural practice encourages thorough cleaning/disinfestation of glasshouse facilities perhaps with a crop break before planting/growing the next crop.
- Compared to fruit and vegetable crops, more diverse agrochemicals can be applied to ornamentals and applications can occur more frequently. Several pesticides are effective against mites.
- *E. lewisi* is a polyphagous mite and alternative hosts may be available elsewhere in a glasshouse that grows poinsettia. Crawling is a means of dispersal used by mites and allows individuals to spread to different parts of a host plant or between host plants if hosts, such as crops, grow closely together with the canopy in contact (Margoles and Kennedy, 1985).

- Studying dispersal of the mite *Tetranychus urticae* between plants within a glasshouse, Hussey and Parr (1963) concluded that spread resulted from crawling. As dispersal in air currents requires air speeds of 1.5 m/s, dispersal within glasshouses can be discounted and mites are therefore likely to remain localised, as reported by the authors.
- As dispersal from a host is driven by population density and deterioration of the host, e.g. by mite feeding (Smitley and Kennedy, 1985), operators of well managed glasshouses could be expected to be able to detect symptoms and mite populations then take action to remove or treat infested plants and prevent spread within a glasshouse.
- Good practice would ensure isolation practices/screens to inhibit spread of pests between alternative hosts.

Uncertainties

- The number of generations that develop will depend on temperatures, while several generations are possible the precise number is unknown.
- Whether EU growers are as aware of *E. lewisi* as US poinsettia growers. If growers in the EU are not so aware of the mite, it could go unnoticed for longer, or be misidentified.
- Whether potentially infested sites also grow other *E. lewisi* hosts that could allow populations to carry over is unknown.
- The proportion of potentially infested sites that conduct deep cleaning or implement crop breaks to inhibit pest carryover and allow establishment is unknown.

Taking the above evidence and uncertainties into account, Table B.15 represents the Panels' estimate of the annual percentage of infested glasshouse sites where establishment could occur, i.e. allowing carryover of mite populations year after year.

Table B.15: Average percentage of infested glasshouse sites where *E. lewisi* could establish (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Percentage of infested glasshouse that will remain infested following the cultural practices in the glasshouses at the end of the production cycle where establishment could occur	
P_B4	**A0**	**Comments**
Lower (1%)	0	The Panel would be extremely surprised if none of the infested poinsettia sites remained infested
Q1 (25%)	2.5	
Median (50%)	5	
Q3 (75%)	7.5	
Upper (99%)	10	The Panel would be extremely surprised if 1 in 10 of all infested sites remained infested

It is possible that populations 'escape' from an infested glasshouse, e.g. on infested plants unwittingly traded by a grower that had not detected the infestation. The next sub-step for establishment therefore considers this in terms of a multiplication factor representing the average number of potential founder populations that are generated from each infested glasshouse site. As for previous assessment sub-steps, the evidence and uncertainties are summarised in bullet points.

B.2.2.4. Establishment sub-step P_B3b: multiplication factor –average number of potential founder populations 'escaping' from each infested glasshouse

Parameter definition: The average annual number of potential founder populations that are generated from an infested glasshouse. Potential founder populations could be generated by the 'escape' of *E. lewisi* on hosts shipped from an infested glasshouse before the infestation is detected and contained/treated.

Evidence:

- Good horticultural practice is employed to minimise presence of all pests.
- High quality standards for relatively high value poinsettia plants increases likelihood that infestations are detected before infested plants are marketed.

- *E. lewisi* does not spread far within a glasshouse and when present affects only a proportion of plants. A fraction of plants could be infested (Njue, 2013).
- Temperatures in protected glasshouses are suitable for the development of *E. lewisi* and several generations could develop increasing likelihood of detection.
- Previous occurrences of *E. lewisi* in Poland and the UK were detected and eradicated before the mite was able to spread outdoors.
- The vast majority of poinsettia is marketed in a 6-week period prior to Christmas when outdoor temperatures over much of Europe are not suitable for *E. lewisi* population growth.
- Despite many years of importing poinsettia from countries where *E. lewisi* occurs, there is no evidence that the mite has escaped from glasshouses and established in continental Europe.

Uncertainties

- *E. lewisi* could spread to non-poinsettia hosts within a glasshouse before those plants are marketed.
- Host plants other than poinsettia could be marketed at different times of the year.

Taking the above evidence and uncertainties into account, Table B.16 represents the Panels' estimate of a multiplication factor representing the average number of potential founder populations generated from each infested glasshouse.

Table B.16: Multiplication factor representing the average number of potential founder populations generated from an infested glasshouse per year (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Multiplication factor representing the average number of potential founder populations generated from an infested glasshouse per time step	
P_B3b	**A0**	**Comments**
Lower (1%)	0	The Panel would be extremely surprised if none of the infested glasshouses were ever able to generate a potential founder population
Q1 (25%)	0.01	
Median (50%)	0.05	
Q3 (75%)	0.1	
Upper (99%)	2	The Panel would be extremely surprised if an average of two or more potential founder populations were generated from each infested glasshouse

B.2.2.5. Establishment sub-step P_B5: average likelihood that a potential founder population escaping from a glasshouse will establish outdoors to become an actual founder population

Parameter definition: Average likelihood that a potential founder population escaping from a glasshouse will establish outdoors to become an actual founder population.

Evidence

- Climate zones in countries where the mite is present also occur in the EU (see Appendix E).
- Across large parts of the EU, daily minimum temperatures exceed 8.3°C, a threshold for development on poinsettia (see Appendix E).
- Temperature data suggest that at least six generations per year are possible in southern EU regions (see Appendix E).
- Commercial hosts are widely grown across the EU (see Appendix E).
- Successful transfer requires large numbers of adult mites to become 'colonisers' but large numbers of mites are more easily detected and hence liable to be managed to prevent escape from a glasshouse and therefore inhibit transfer.
- *E. lewisi* has been detected in EU glasshouses, action has always been taken against it.
- No occurrence of transfer from glasshouse to outdoor hosts is known within continental EU.

Taking the above evidence and uncertainties into account, Table B.17 represents the Panels' estimate of the percentage of potential founder populations able to establish outdoors.

Table B.17: Average likelihood that a potential founder population escaping from a glasshouse will establish outdoors to become an actual founder population (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of potential founder populations that successfully transfer and establish outdoors	
P_B5	**A0 (%)**	**Comments**
Lower (1%)	0	Based on the above listed evidence
Q1 (25%)	5	
Median (50%)	10	
Q3 (75%)	40	
Upper (99%)	80	

B.2.3. Conclusions regarding establishment via poinsettia plants pathway

B.2.3.1. Establishment results P_N2: number of establish founder populations of *E. lewisi* in the EU per year for the next 10 years

P_N2 is the sum of the number of established founder populations in glasshouses (P_N2a) and the number of established founder populations outdoors in the EU (P_N2b) resulting from the EU poinsettia plants for planting imports per year for the next 10 years.

B.2.3.1.1. P_N2a: establishment in glasshouses

This baseline scenario A0 assumes that *E. lewisi* remains a regulated quarantine pest and that if detected in EU glasshouses action will be taken to eradicate it, as occurred in the UK and Poland. Multiplying the establishment sub-steps together in the stochastic (Monte Carlo) simulation, results show that, in the opinion of the Panel, it is unlikely that *E. lewisi* will establish in EU glasshouses and remain undetected over the next 10 years, the time horizon of this risk assessment. However, occasional incursions can be expected and it is not to say that the outbreaks will not occur; indeed the results from the assessment of entry suggests that a few infested packs are likely to arrive each year, but treatments, detection of symptoms and eradication measures applied to the quarantine pest is very likely to prevent the pest from establishing under glass in the EU. Nevertheless, a few infested plants could be marketed mistakenly from infested premises before eradication measures are applied.

The Panel's expectation is shown in Figure B.9 in the form of a descending cumulative probability distribution for the number of glasshouses in which *E. lewisi* establishes. The red (solid) line indicates results for scenario A0 (baseline). The blue (broken) line indicates scenario A2 (with additional RROs).

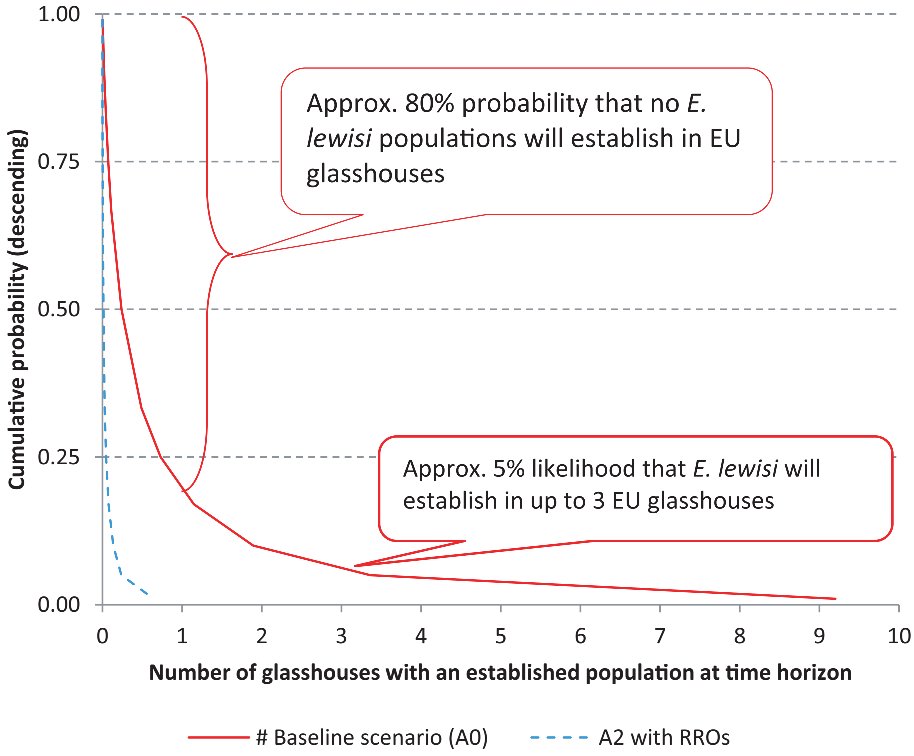


Figure B.9: Panel's expectation in terms of descending cumulative probability distribution for number of glasshouses in which *E. lewisi* establishes in the EU each year (baseline scenario A0; scenario A2: poinsettia plants imported from pest free places and sites of production)

Figure B.9 shows that under scenario A0, the establishment of *E. lewisi* within an EU glasshouse is not expected within the next 10 years, i.e. there is less than 20% chance that *E. lewisi* will establish in an EU glasshouse within 10 years. Figure B.9 also shows that under scenario A2 where poinsettia plants are imported from pest free places and sites of production, the Panel does not expect *E. lewisi* to establish in an EU glasshouse in the next 10 years.

B.2.3.1.2. P_N2b: establishment outdoors

Before the presence of *E. lewisi* in an EU glasshouse is detected, infested plants could be transferred outdoors from where the mite could transfer to other plants and potentially establish. Model results suggest that this is unlikely to happen in scenario A0 and very unlikely to happen in scenario A2. Figure B.10 shows the descending cumulative probability distribution for the number of founder populations establishing each year in the EU.

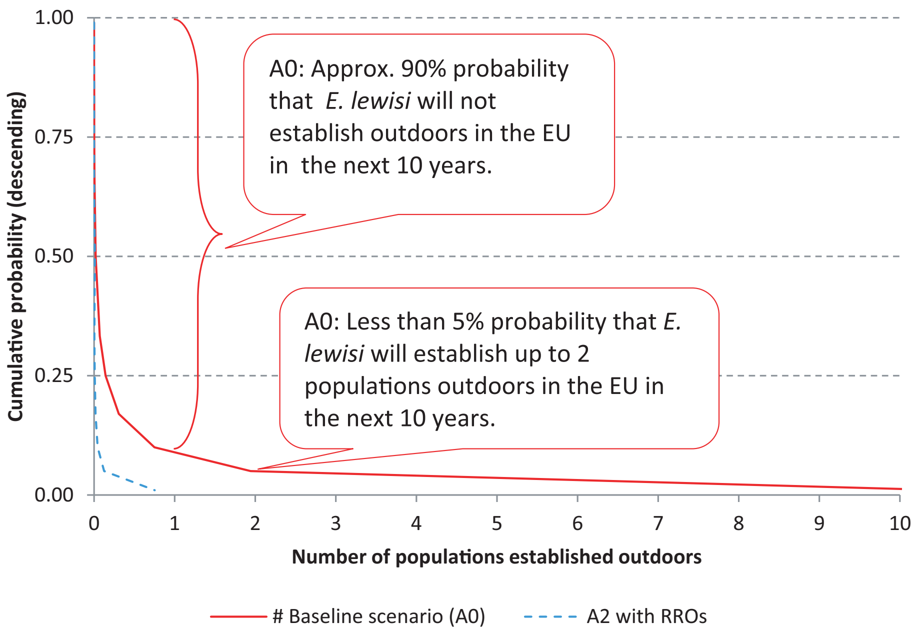


Figure B.10: Panel's expectation in terms of descending cumulative probability distribution for number of founder populations of *E. lewisi* establishing outdoors in the EU each year (baseline scenario A0; scenario A2: poinsettia plants imported from pest free places and sites of production)

B.2.3.2. Uncertainties

B.2.3.2.1. Establishment in glasshouses

Two factors contribute to the uncertainty around establishment in EU glasshouses; the confidence in the efficacy of initial treatment and checking conducted on recently arrived cuttings and young plants, but more significantly, the Panels estimate of the ability of *E. lewisi* to survive cultivation practices in EU glasshouses. 96% of the uncertainty around the likelihood of establishment in EU glasshouses comes from this sub-step.

B.2.3.2.2. Establishment outdoors

95% of the uncertainty in the estimate of the number of *E. lewisi* founder population establishing outdoors in the EU is related to the number of *E. lewisi* 'escapes' from infested glasshouses. The Panel recognises that *E. lewisi* has been found on poinsettia in EU glasshouses on a number of occasions (EFSA, 2014a; EPPO, 2014) but was eradicated on each occasion. *E. lewisi* is not known to occur outdoors within continental EU. Nevertheless, a number of mites have established outdoors in the EU in recent years (Navajas et al., 2014) although none of them were quarantine listed.

Appendix C – Introduction of *Eotetranychus lewisi* through strawberry plants for planting imported from the USA

C.1. Entry assessment

C.1.1. Conceptual model for entry through strawberry plants for planting pathway

S_N0. Average kg of plants for planting of strawberry per year from the USA for the EU strawberry plants for planting production

↓

S_E1a. Conversion of kg of strawberry P4P (runners) into strawberry plants (constant)

↓

S_E1b. Conversion of strawberry plants for planting into packs as a pathway unit (constant)

↓

S_E2. Average proportion of infested packs from production places in the USA intended for export to the EU

↓

S_E3. Average proportion of infested packs after storage in the country at origin (USA) and transport to destination in the EU

↓

S_E4. Average proportion of infested packs where the pest remains undetected after border inspection

↓

S_N1. Entry result: Average number of infested packs entering into the EU per year

Figure C.1: *Eotetranychus lewisi* conceptual model for entry via strawberry plants for planting imported from the USA

C.1.2. Assessment of entry

California is the largest producer of strawberries plants for planting in the USA: 1,600 out of 2,000 ha in the USA (García-Sinovas et al., 2012). As *E. lewisi* can reach the pest status in strawberries in California (Strand, 2008), the Panel focused on Californian nurseries as a potential pathway for the introduction of *E. lewisi* into the EU.

The assessment of the pathway begins by considering the imports of mother plants (runners) from the US into the EU over the next 10 years.

C.1.2.1. Entry sub-step S_N0: average kg of plants for planting of strawberry per year from the USA for the EU strawberry plants for planting production for the next 10 years

Parameter definition: Average kg of plants for planting of strawberry per year from the USA for the EU strawberry plants for planting production for the next 10 years.

Evidence:

- According to the EUROSTAT CN 0602 90 30 (EUROSTAT, online) on average over the last 5 years, more than 90% of the European strawberries and vegetable plants for planting imported from the USA into the EU correspond to imports to Spain. From this figure, an additional 10% (weight) of strawberry plants was accounted for to represent all European strawberries and vegetable plants for planting material imported from the USA.

- Spanish imports of strawberry plants for planting figures were kindly provided by from Spanish Ministry of Agriculture (MAPAMA, online) (Table C.1).
- The part of Spanish imports coming from the USA is 53.6% (2,618,292.2 + 18,735.2 kg) in average from 2012 to 2016 (source: Dirección General de Sanidad de la Producción Agraria Ministry of Agriculture, Spain).

Table C.1: Spanish imports of strawberry plants for planting (2012–2016)

Year	Spanish imports from US			Spanish imports coming from US (B = 53.6% of A)	Total EU imports (110% of B)
	Fragaria spp.	*Fragaria* × *ananassa*	Total (A)		
2012	203,027	16,481	219,508	117,656	129,422
2013	724,709	14,319	739,028	396,119	435,731
2014	1,076,063	207,367	1,283,430	687,918	756,710
2015	1,005,635	133,380	1,139,015	610,512	671,563
2016	709,479	489,378	1,198,857	642,587	706,846
Total	3,718,913	860,925	4,579,838	2,454,793	2,700,272
Mean	743,783	172,185	915,968	490,959	540,054

Source: Dirección General de Sanidad de la Producción Agraria, Ministry of Agriculture, Spain.

- The comparison of the Spanish imports of strawberries plants for planting to the imports of 'strawberries + vegetables' plants for planting (EUROSTAT CN 0602 90 30) from the USA shows the large proportion of the strawberry plants for planting belonging to this category. Therefore, the Panel assumes that this proportion is equivalent to the proportion of strawberries plant for planting.

Uncertainties:

- No detailed figures on yearly import of strawberry plants for planting from the USA into the EU are available; it is assumed that the average of these imports does not follow a clear trend over time.
- The reasons why import of vegetables from the USA to Spain is declining in the last years are unknown to the Panel. The Panel assumes that the Spanish share of the strawberry imports of strawberry plants for planting is representative of the EU imports (from 70.2% to 96% for Spanish imports of plants for planting and vegetables from the USA during the last 5 years according to EUROSTAT (online)). A correction factor of about 10% corresponding to imports into other EU countries than Spain should be introduced in the calculations of the strawberry plants for planting.

Based on these assumptions, the Panel estimated the distribution of the average kg of plants for planting of strawberry imported from the USA per year into the EU for strawberry plants for planting production (Table C.2).

Table C.2: Average weight of the strawberry plants for planting imported from the USA per year for the EU strawberry plants for planting production, for the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average kg of plants for planting of strawberry imported from the USA per year for the EU strawberry production, for the next 10 years	
S_N0	**A0**	**Comments**
Lower (1%)	300,000	Lowest value was chosen regarding the situation in 2012, 2013, missing older data and the long prediction period of 10 years
Q1 (25%)	600,000	Assuming a stabilisation of the market in the future results in more certain estimates
Median (50%)	700,000	
Q3 (75%)	800,000	
Upper (99%)	1,100,000	Upper using the existing trend as forecast Upper using total market share by US for strawberry plants

C.1.2.2. Entry sub-step S_E1a: conversion of kg of strawberry plants for planting (runners) into strawberry plants

Parameter definition: Average weight of a strawberry plants for planting (a leafless runner).

Evidence:

- According to EUROSTAT and to Junta de Castilla y León (2009), on average a strawberry plants for planting weighs 35 g (S_E1a).

Uncertainties:

- None to report.

C.1.2.3. Entry sub-step S_E1b: conversion of strawberry plants for planting into packs as a pathway unit

Parameter definition: Average number of pieces of strawberry plants for planting in a pack, which constitutes the pathway unit.

In order to consider the elementary unit of the consignment as a homogeneous infestation unit in terms of its handling, transporting, treatments, final destination and use of plants for planting, a conversion factor was calculated to transform the number of plants into packs.

Evidence:

- The conversion factor was estimated considering the typical condition on import mentioned in the technical hearing on the strawberry production held at EFSA in 2014 (EFSA, 2014b) including the type of material, its storage and transport conditions and its proportions.
- An average pack of strawberry plants for planting was estimated to 1,180 pieces (see Figure C.2 based on ISEFOR Data for the Netherlands).

NL imports of strawberry plants

COUNTRY_ISO	COUNTRY	Year	GN_CODE	Pieces PIECES	Pack COLLI_AANTAL	Pieces per pack	GENUS
KE	KENIA	2013	0602109000	12	1	12	FRAGARIA
EG	EGYPTE	2012	0602903000	15	1	15	FRAGARIA
EG	EGYPTE	2013	0602907000	35	1	35	FRAGARIA
US	VERENIGDE STATEN	2012	0602903000	100	1	100	FRAGARIA
PE	PERU	2014	0602909990	640	4	160	FRAGARIA
US	VERENIGDE STATEN	2013	0602903000	200	1	200	FRAGARIA
US	VERENIGDE STATEN	2012	0602903000	3688	8	461	FRAGARIA
US	VERENIGDE STATEN	2013	0602903000	1620	3	540	FRAGARIA
US	VERENIGDE STATEN	2013	0602903000	3300	5	660	FRAGARIA
US	VERENIGDE STATEN	2014	0602903000	6000	9	667	FRAGARIA
US	VERENIGDE STATEN	2014	0602903000	3196	4	799	FRAGARIA
US	VERENIGDE STATEN	2014	0602903000	3196	4	799	FRAGARIA
US	VERENIGDE STATEN	2014	0602907000	190000	186	1022	FRAGARIA
US	VERENIGDE STATEN	2013	0602903000	7500	7	1071	FRAGARIA
US	VERENIGDE STATEN	2012	0602903000	6600	6	1100	FRAGARIA
US	VERENIGDE STATEN	2012	0602903000	606000	505	1200	FRAGARIA
US	VERENIGDE STATEN	2013	0602903000	151200	126	1200	FRAGARIA
US	VERENIGDE STATEN	2013	0602903000	151200	126	1200	FRAGARIA
US	VERENIGDE STATEN	2014	0602903000	5500	4	1375	FRAGARIA
US	VERENIGDE STATEN	2013	0602907000	7839	2	3920	FRAGARIA
US	VERENIGDE STATEN	2012	0602907000	8133	1	8133	FRAGARIA
US	VERENIGDE STATEN	2014	0602907000	8575	1	8575	FRAGARIA

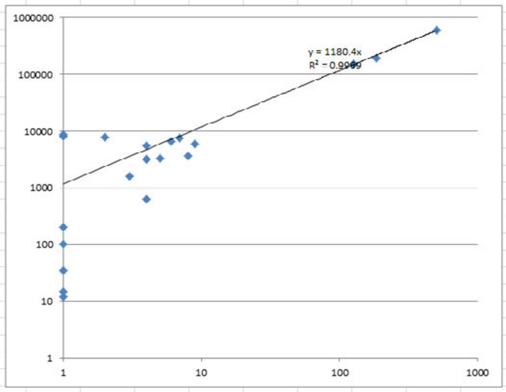


Figure C.2: Average pack size of strawberry plants for planting as an homogeneous pathway unit – 1,180 pieces (ISEFOR Data for the Netherlands)

- Individual package units typically contain around 1,200 'pieces' (rooted cuttings/young plants) per pack although the number of 'pieces' per pack varies much more amongst the smaller consignments, i.e. consignments with less than 10 packs or consignments of less than 10,000 'pieces' where the number of pieces per pack ranges from 12 to over 8,500.
- The main part of import (to NL) is delivered in packs of the size 1,200 pcs/pack. And, the size pack was confirmed for the packs sizes prepared in the nurseries in California (Howell, 2017).
- The strawberry plants for planting of are imported as cold stored or frigo plants. Frigo plants are dormant strawberry plants stored for several months (up to 7 months) at −1.5°C (Durner et al., 2002) from the USA.

Uncertainties:

- Possible trade could be naked, rooted plants, chilled plants without leaves, small plants with leaves. Transport conditions (e.g. temperature, time) are not known and can vary. Type of plants for planting, means and conditions of transport might result in different pack sizes.
- The representativeness of the Dutch data for the estimation of the pack size.
- The number of points to estimate the pack size is limited to four deliveries.

Based on this estimation in this model, the Panel used a pack size of 1,200 pcs/pack (S_E1b).

C.1.2.4. Entry sub-step S_E2: average proportion of infested packs intended for export to the EU leaving the production places in the USA

Parameter definition: Average proportion of infested packs intended for export to the EU leaving the production places in the USA.

Evidence:

- Plants for planting in the USA are produced under certification schemes (Howell, 2017).
- No outbreaks of *E. lewisi* have been reported on strawberry plants in the EU.
- No interceptions of *E. lewisi* have been reported in the EU (EUROPHYT interception database).
- Between 20,000 and 30,000 packs are imported in the EU annually.
- Only 40 notifications of mite interceptions (none of them *E. lewisi*) in different commodities (EUROPHYT) in the EU in the last 25 years.
- Spanish imports of Californian strawberry plants for planting are mainly 'Foundation' (mother plants) either white or purple labels corresponding to the top quality of plants for planting (Junta de Castilla y León, 2009).

Uncertainties:

- Mixed infestations *E. lewisi* and another tetranychid mite, *Tetranychus urticae*, a frequent pest of strawberries, occur in the USA (Howell, 2017).
- Misidentification of *E. lewisi* by visual inspection cannot be excluded.
- No EUROPHYT notifications of interceptions of any mites (Tetranychids and Eriophyds) on strawberry.

Based on these assumptions, the Panel estimated the distribution of the average percentage of infested strawberry packs leaving the USA per year into the EU for strawberry plants for planting production (Table C.3).

Table C.3: Average proportion of infested packs leaving the USA to Europe (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average proportion (%) of infested packs intended for export to the EU leaving the production places in the USA	
S_E2	**A0**	**Comments**
Lower (1%)	0	*E. lewisi* does not occur in the nurseries in California
Q1 (25%)	0.025	'Foundation' mother plants imported from California are top quality (purple and white labels)
Median (50%)	0.05	
Q3 (75%)	0.1	
Upper (99%)	0.5	High value crop that receives adequate treatments ensuring high quality plant material. Effective certification schemes are in place in the USA max = 1 infested plant out of 200 packs (estimated from the 40 interceptions of mites reported by EUROPHYT as a worse case scenario)

C.1.2.5. Entry sub-step S_E3: average proportion of infested packs after storage in the country at origin (US) and transport to destination in the EU

Parameter definition:

This parameter is a risk reduction option considering that during storage and transport of frigo plants to the EU, plants are exposed to a cold treatment performed under temperatures of −2°C to −1.5°C (Lieten et al., 2005). Moreover, plants are stored and transported in plastic bags and crates to keep the plant moisture and to avoid cross contamination between packs. The frigo plants are transported by air.

Evidence:

- Harvest of plants for planting in California extends from December to July (Aarons Creek Farms Inc, online)
  - −2°C to −1.5°C are the storage and transport conditions;
  - most packs are cold treated for around 10 days at −2°C to −1.5°C (January to March) (EFSA, 2014b).
- Imports from the USA occur in winter period (January–March) based on Dutch import data for 2012–2014.
- Usually transported by air (short duration of transport).
- Packs are isolated (in a plastic bag within a cardboard box (Howell, 2017), and no pest from one pack can therefore contaminate another pack.
- No spread from US nurseries in California to US sites of production in other states has been reported (Howell, 2017) suggesting no infestation or no survival during distribution.

Uncertainties:

- Continuity between storage and transport conditions?
- Is the pest present in the nurseries for plants for planting production?
- Can the mite survive the winter period in the areas of production of plants for planting in the USA?
- Are all plants for planting are transported by air (duration of transport)?

Based on these assumptions, the Panel estimated the distribution of the average percentage of infested strawberry packs after storage in the USA and transport to the EU per year for strawberry plants for planting production (Table C.4).

Table C.4: Average proportion of infested packs after storage in the USA and transport to Europe (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average proportion (%) of infested packs after storage in the country at origin and transport to destination	
S_E3.	**A0**	**Comments**
Lower (1%)	0	Cold treatment for more than 10 days could lead to 100% mite mortality
Q1 (25%)	1.5	A packs remains infested with at least one mite that survives Very uncertain
Median (50%)	2.5	
Q3 (75%)	5	
Upper (99%)	10	The number of mites is reduced but the number of infested packs remains unchanged Some adverse event in cold treatment facility/equipment cannot be excluded

C.1.2.6. Entry sub-step S_E4: average proportion of infested packs where the pest remains undetected after border inspection

Parameter definition: Plant material is subjected to border inspection before clearing at customs. This RRO would imply the destruction of any infested pack before entry.

Evidence:

- No interception notified.
- No outbreak reported on strawberry.
- In general, visual inspection is not effective for detecting mites specially at low infestation levels, which is what is expected (see above).
- The pest is not regulated on strawberry so no specific lab testing for the mite is foreseen.

Uncertainties:

- Are all interceptions of mites in Member States notified in EUROPHYT database?
- Misidentification of *E. lewisi* cannot be excluded with visual detection.

Based on these assumptions, the Panel estimated the distribution of the average percentage of infested strawberry packs which remain undetected and therefore not destroyed after border inspection at the EU point of entry per year for strawberry plants for planting production (Table C.5).

Table C.5: Average percentage of infested packs where the pest remains undetected after border inspection (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of infested packs where the pest remains undetected after border inspection	
S_E4.	**A0**	**Comments**
Lower (1%)	98.5	Based on EUROPHYT interception (40 mite interceptions on all plant types have been reported over 25 years) 25,000 packs are imported per year into the EU
Q1 (25%)	99.2	1% of 25,000 are infested, 250 packs, and 40 mites are detected in 25 years, less than 1 per year)
Median (50%)	99.4	
Q3 (75%)	99.6	
Upper (99%)	100	No detection could easily occur, especially for low infestation densities

C.1.2.7. Entry result S_N1: average number of infested packs of strawberry plants for planting entering the EU per year for the next 10 years

Table C.6: Average number of infested packs of strawberry plants for planting entering the EU per year for the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average number of infested packs of strawberry plants for planting entering the EU per year for the next 10 years	
S_N1	**A0**	**Comments**
Lower (1%)	0.00	
Q1 (25%)	0.08	
Median (50%)	0.20	
Q3 (75%)	0.50	
Upper (99%)	4.08	

The outcome of the model shown in Table C.6 indicates that at the median one infested pack of strawberry plants for planting (containing 1,200 plants) for the production of runners in the EU would enter the Union from the USA every 5 years.

C.1.3. Conclusions regarding entry via Strawberry plants for planting from the USA

Results from multiplying the inputs for each entry sub-steps in the stochastic (Monte Carlo) simulation, are provided in Figure C.3 for the baseline scenario (A0). Figure C.3 shows the descending cumulative probability distribution for the number of infested packs from the USA arriving each year in the EU suggesting that 1 infested pack could be expected to enter the EU every 4–5 years. Moreover, the Panel would be really surprised if more than four *E. lewisi*-infested packs arrive during one single year and also if infested pack would enter into the EU during more than 5 consecutive years.

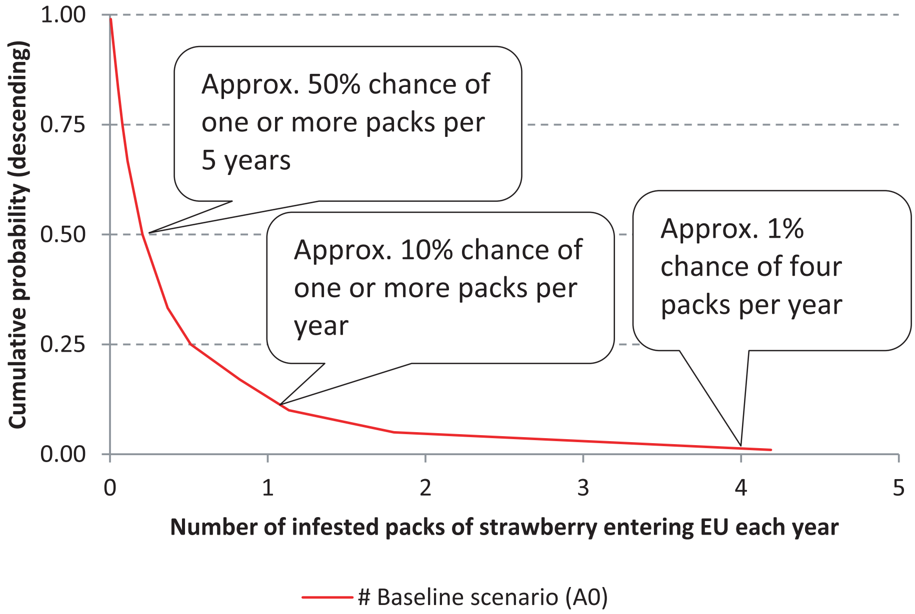


Figure C.3: Panel's expectation in terms of descending cumulative probability distribution for the number of infested strawberry plants for planting packs arriving in the EU from the USA per year (baseline scenario A0)

Within the entry step, there are three major sub-steps that contribute the most to uncertainty (Figure C.4). The main factor is the proportion of infested packs at origin (74%), followed by the survival of the mite during transport (24%), which takes place at chilling conditions (−2°C to −1.5°C). Although these conditions are quite detrimental for the Lewis spider mite, the fact that the pathway unit is a pack and not a plant should be kept in mind to interpret this uncertainty (survival of one single mite per pack means that the pack would remain infested; only with 100% mortality would an infested pack become uninfested). For the same reason, the uncertainty about the efficacy of border inspection is nil. Future trends in trade of strawberry plants for planting imported from the USA have a small contribution to overall uncertainty (2%). Similarly to the previous pathway (poinsettia plants for planting), the single greatest uncertainty regarding entry is the level of infestation of the commodity at pathway origin.

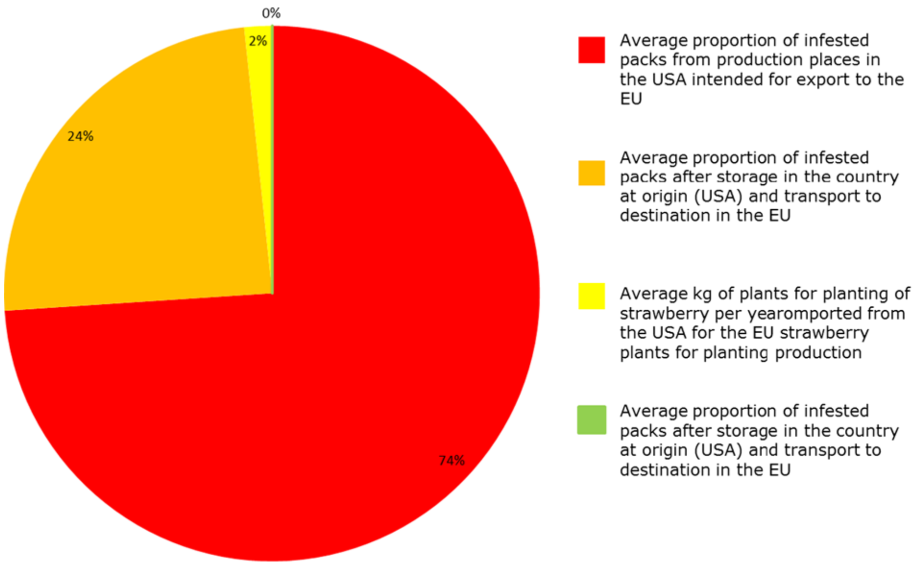


Figure C.4: Entry sub-steps contributing the most to overall uncertainty regarding the number of packs of strawberry plants for planting imported from the USA into the EU each year infested with *E. lewisi*

Uncertainty factors not being quantified in the entry step

i) Potential for import of infested strawberry plants for planting from countries where *E. lewisi* is not currently known to occur although it is actually present. Potential for import of infested strawberry plants for planting from states in the USA other that California where agricultural practices could lead to a different level of infestation of the commodity.
ii) Variation in pack size. An average size of 1,200 plants per pack has been assumed. The smallest the size of the pack, the easier to detect and eliminate infested plants.

Given the uncertainties for each sub-step in this step of the assessment and recognising that some uncertainties have not been quantified, model output results should be interpreted in a more approximate manner than indicated in Figure C.3. Hence, the Panel expects that it is very unlikely that on average, over the next 10 years, all packs of strawberry plants for planting entering the EU from the USA could enter free from *E. lewisi*. On the other hand, it is also very unlikely that the average number of packs that enter and are infested will be more than 4 per year. It is more likely that about one pack of strawberry plants (containing 1,200 plants) would, on average, enter the EU every 4 years infested with *E. lewisi*. Because the main factor affecting the uncertainty about these figures is the proportion of infested packs at origin, any action aimed at reducing this uncertainty (i.e. including *E. lewisi* in a certification scheme) would have an effect on the overall risk estimations.

C.2. Establishment assessment

The aim of the establishment step is to estimate the average number of hectares with at least one established founder population of *E. lewisi* per year, for the next 10 years. Spain is the largest importer of strawberry plants for planting in the EU (90% of the total). Therefore, we focused on this Member State. Imported plants are used to produce a second generation of plants for planting in the highlands of the Castilla y León Spanish community (around 1,200 m above sea level). From there, runners produced following certification schemes are transferred to the province of Huelva (South West of Spain), where 86% of Spanish strawberry production concentrates. The Panel, therefore, estimated establishment at both locations:

i) the place of production of plants for planting (Castilla y León highlands) and
ii) the berry production area where infested plants for planting place of production would eventually go (Huelva).

C.2.1. Conceptual model for establishment through strawberry plants for planting

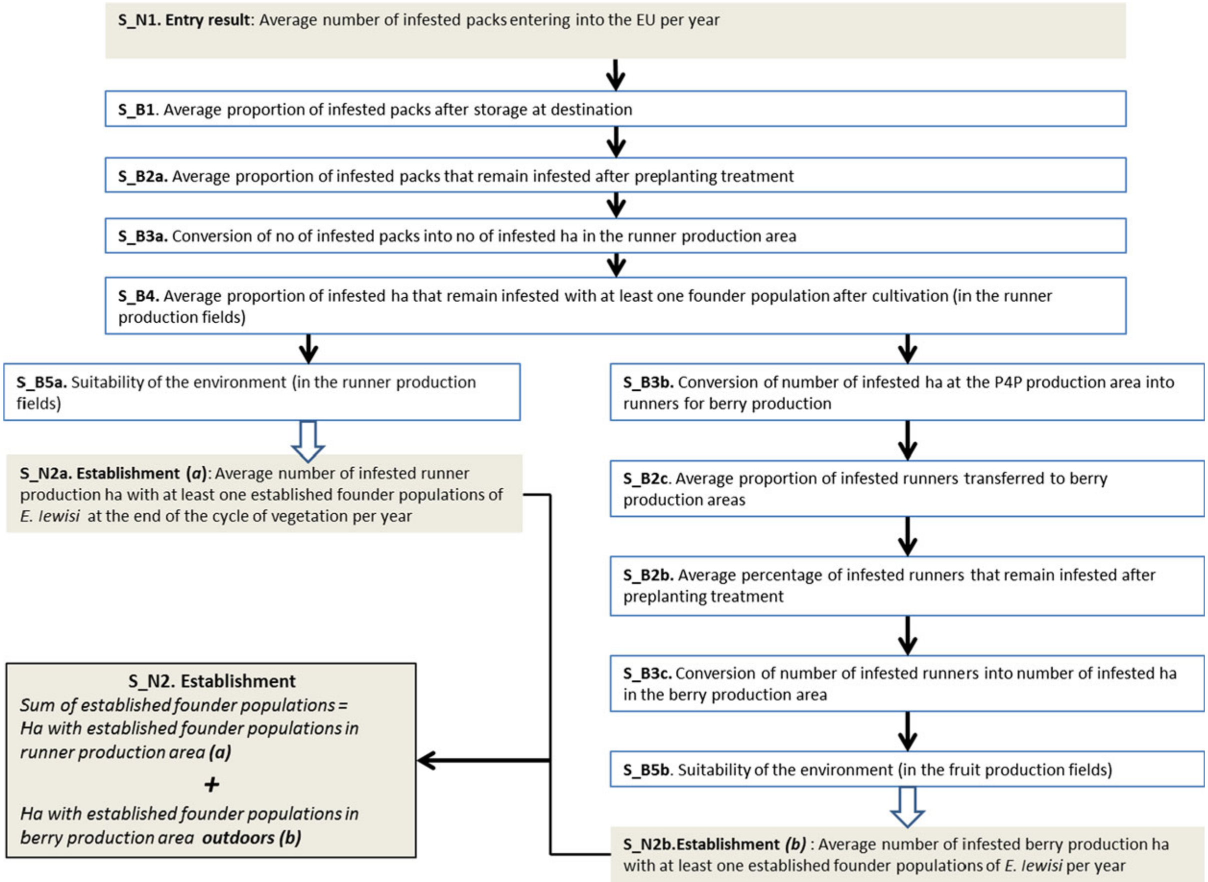


Figure C.5: Conceptual model for establishment of *Eotetranychus lewisi* considering the intended use of strawberry plants for planting

As shown in Figure C.5, this step is composed of three and one common sub-steps and conversion factor, respectively, plus one and five additional particular sub-steps for Castilla y León and Huelva, respectively.

C.2.2. Assessment of establishment

C.2.2.1. Common sub-steps and conversion factors (Castilla y León and Huelva)

C.2.2.1.1. Establishment sub-step S_B1: average proportion of infested packs after storage at destination

Parameter definition: Plants are imported from the US into Spain mostly from November through March and are usually planted in the highlands of Castilla y León in spring (García-Sinovas et al., 2012). Therefore, storage at chilling temperatures for up to 4 months at destination is a common practice.

Evidence: Same as in entry sub-step S_E3 (Average proportion of infested packs after storage in the country at origin (US) and transport to destination in the EU).

Uncertainties: Same as in entry sub-step S_E3 (Average proportion of infested packs after storage in the country at origin (US) and transport to destination in the EU).

Based on the mentioned assumptions, the Panel estimated the distribution of the average percentage of infested packs after storage at destination.

Table C.7: Average percentage of infested packs after storage at destination (Expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of infested packs after storage at destination (same as for entry sub-step S_E3)	
S_B1.	**A0**	**Comments**
Lower (1%)	0	Cold treatment for more than 10 days could lead to 100% mite mortality
Q1 (25%)	1.5	A pack remains infested with at least one mite that survives Very uncertain
Median (50%)	2.5	
Q3 (75%)	5	
Upper (99%)	10	The number of mites is reduced but the number of infested packs remains unchanged Some adverse event in cold treatment facility/equipment cannot be excluded

C.2.2.1.2. Establishment sub-step S_B2a: average proportion of infested packs that remain infested after preplanting treatment

Parameter definition: Strawberry plants for planting are subjected to preplanting treatments and must follow Spanish certification schemes. These should reduce mite prevalence in the packs.

Evidence:

- The Spanish certification schemes for strawberry plants for planting (Real Decreto 929/1995[15]).
- Dipping in insecticide/acaricide and fungicide (García-Sinovas et al., 2012) prior to planting.
- In California, *E. lewisi* is mostly a problem in organic farming less in conventional farming (Howell, 2017).
- There are no reports of resistance to acaricides for *E. lewisi* (MSU, online).

Uncertainties:

- *E. lewisi* is not specifically targeted by the Spanish certification schemes for strawberry plants for planting.
- The occurrence of resistant mite populations cannot be excluded.

Based on the assumptions above, the Panel estimated the distribution of the average infested packs at destination that would remain infested after preplanting treatments.

Table C.8: Preplanting plants for planting treatment: proportion of packs remaining infested after the treatment prior to planting (Expert judgement was used to estimate five quantiles)

Quantile (percentile)	Preplanting plants for planting treatment: percentage (%) of packs remaining infested after the treatment prior to planting	
S_B2a	**A0**	**Comments**
Lower (1%)	0	Very effective pesticide treatment against the mite
Q1 (25%)	10	Cost effectiveness of a treatment is expected
Median (50%)	15	
Q3 (75%)	20	
Upper (99%)	100	Organic nurseries and resistant mites to the pesticides used do not change the proportion of infested packs after the treatment

C.2.2.1.3. Establishment sub-step S_B3a: conversion of number of infested packs into number of infested hectares (runner production area) as a pathway unit

Parameter definition: Conversion of number of infested packs into number of infested hectares (runner production area) as a pathway unit.

[15] Real Decreto 929/1995, de 9 de junio, por el que se aprueba el Reglamento técnico de control y certificación de plantas de vivero de frutales. Ministerio de Agricultura, Pesca y Alimentación, «BOE» núm. 141, de 14 de junio de 1995, páginas 17713 a 17735 (23 págs.)

Evidence:

- Plant density for strawberry plants for planting production in Castilla y León (where Spanish imports of plants for planting are multiplied) is 12,000–24,000 plants per ha (García-Sinovas et al., 2012).
- 1 ha of strawberry plants for planting production in Castilla y León would require 24,000 plants for planting per ha/1,200 plants for planting packs = 20 packs.
- Max = 1 (each infested pack is planted in a different ha).
- Min = 0.05 = 1/20 (all infested packs are planted in the same ha).

Uncertainties:

- Planting densities (12,000–24,000 plants per ha).
- Field distribution of infested plants in a pack.

Based on the assumptions above, the Panel estimated the distribution of the infested packs necessary to infest one ha of strawberry plants for planting in Castilla y Leon area.

Table C.9: Conversion or aggregation factor: from infested packs to infested hectares (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Conversion or aggregation factor: from infested packs to infested hectares (%)	
S_ B3a.	**A0**	**Comments**
Lower (1%)	5	Min = 0.05 = 1/20
Q1 (25%)	12	
Median (50%)	20	
Q3 (75%)	33	
Upper (99%)	100	Max = 1 (each infested pack planted in a different ha)

C.2.2.1.4. Establishment sub-step S_B4: average proportion of infested ha that remain infested with at least one founder population after cultivation in the runner production area

Parameter definition: Average proportion of infested ha that remain infested with at least one founder population after cultivation in the runner production area.

Evidence:

- The Certification schemes for strawberry plants for planting, the Spanish Reglamento Técnico (Real Decreto 929/1995[15]) including two obligatory field inspections, Quality of nuclear stock crop rotation, isolation, etc.).
- Good agricultural practices, pesticide treatments, field preparation (soil sterilisation and weeding (alternative hosts are removed), 5-month production cycle.
- In California, *E. lewisi* is a problem in organic farming and not in conventional farming.

Uncertainties:

- *E. lewisi* is not specifically included in the Spanish certification schemes for strawberry plants for planting.

Based on the assumptions above, the Panel estimated the distribution of the initially infested ha would remain infested at the end of the season.

Table C.10: Average proportion of infested ha that remain infested with at least one founder population after cultivation in the runner production area (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of infested ha that remain infested with at least one founder population after cultivation in the runner production area	
S_B4.	**A0**	**Comments**
Lower (1%)	1	Eradication of low numbers of a tiny pest difficult to detect is unrealistic, moreover eradication
Q1 (25%)	5	Certification scheme is generally effective for detection and treatments are generally effective
Median (50%)	10	
Q3 (75%)	20	
Upper (99%)	95	Certification scheme is providing guarantee and mechanisms to detect the pest, however, eradication is not feasible as low pest prevalence is difficult to detect. Moreover, during the 5 months of cultivation the conditions are favourable for mite development and reproduction

C.2.2.2. Establishment sub-step for runner production area (Castilla y León) S_B5a. Suitability of the environment in the runner production area Castilla y León

Parameter definition: Suitability of the environment in the runner production area Castilla y León, for the mite to establish.

Evidence:

The Panel assumes that all stock material imported from the USA to the EU is for the nurseries to produce runners, which will subsequently go for berry production at production places. 90% of the imports from the USA go to Spain, and 10% to other EU countries.

With regard to Spain imports of plants for planting are imported for the production of runners, although hosts and alternate hosts are available in the planting area, the climate, and pest characteristics (T°C) are limiting the establishment of the pest in those areas, which are located at an altitude of 800–1,200 m above sea level in Spain in the Autonomous Community of Castilla y León, considering winter conditions and the production cycle of runners with disposal of old stock after harvest of runners.

Imported plants for planting are used for runner production in Spain in the highlands at about 500 km apart from the main berry production places (e.g. Huelva area) or in protected areas elsewhere in the EU. Although infested plants may remain infested after planting, establishment, which is the perpetuation of population for foreseeable future, does not occur as plants are destroyed after harvesting and the area where planted is rotated in the next cycle of vegetation. A pest population could be transient in production sites but would not establish.

- Climate: Plant material is arriving into the EU in the spring and climate is then suitable (Climatedata, online) for the pest to establish in large part of the risk assessment area.
- Host and alternate hosts: The pest arrives into the EU on a suitable host. In the EU, hosts are widely distributed and available, considering the pest is highly polyphagous, e.g. castor bean is a wild plant which is regarded as good reservoir for the mite in California. This host is widely distributed in the EU where it is even grown in some areas for oil production (e.g. France).
- Pest characteristic: If introduced in the EU, the pest would be at very low densities.
- *Neoseiulus californicus* is a predatory mite feeding on *E. lewisi* in California (Howell and Daugovish, 2013) and is indigenous and wide spread in southern EU.

Uncertainties:

- Low pest prevalence and Allee effects can take place.
- Winter conditions could be (or not?) lethal to the pest in all plants for planting growing areas in the EU.
- Low genetic diversity in the pest population considering the very low numbers introduced into the EU.

- In California, where *T. urticae* is also present, *E. lewisi* is regarded as a secondary pest which could be outcompeted by the former species. In organic farming when misidentification between the two mite species occurs, the inappropriate biological control agent *Phytoseiulus persimilis* is released, which releases *E. lewisi* from competition from *T. urticae*, resulting in outbreaks of the former (Howell, 2017).

Based on the assumptions above, the Panel estimated the distribution of the percentage of ha infested at the end of the season that would remain infested until the following season (overwintering of mite populations).

Table C.11: Suitability of environment: Hosts, climate, other ecological factors: proportion of hectares that are suitable for the pest to establish, for next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	**Percentage of hectares that are suitable for the pest to establish, for next 10 years**	
S_B5a.	**A0 (%)**	**Comments**
Lower (1%)	0	Not suitable for establishment only transient populations
Q1 (25%)	1	
Median (50%)	2	
Q3 (75%)	3	
Upper (99%)	5	5% of the USA imports into the EU might go to suitable areas in the EU

As indicated in the conceptual model (Figure C.1), the next parameter to estimate is the establishment end-point for the runner production area in Castilla y León (CyL), S_ N2a that corresponds to the Average number of ha infested with at least one established founder populations of *E. lewisi* per year (see Section C.2.3). S_N2a is a model output and is a calculated parameter.

C.2.2.3. Sub-steps for Huelva

C.2.2.3.1. Establishment sub-step S_B3b: conversion of number of infested ha at the plants for planting production area into runners for berry production in Huelva

S_B3b is a calculated conversion factor:

- 1 ha in Castilla y León area has 12,000–24,000 initial plants for planting (planting density);
- 1 initial plants for planting results in about 15–20 runners used for berry production.

Therefore, 1 ha plants for planting in Castilla y León produces (12,000–24,000) × (15–20) = 180,000–480,000 runners for berry production (García-Sinovas et al., 2012).

S_B3b = 290,000 runners for berry production in Huelva per ha of runners in Castilla y Leon.

C.2.2.3.2. Establishment sub-step S_B2c: average proportion of infested runners eventually transferred to berry production area (i.e. from Castilla y León to Huelva)

<u>**Evidence**</u>

- The Certification scheme for strawberries plants for planting provides for tolerance thresholds for *Steneotarsonemus pallidus*, and this is a tarsonemid mite that is smaller and more difficult to detect than *E. lewisi*.
- The production subjected to these certification schemes in Castilla y León is split into the following categories:
  - 82.5% of the production corresponds to certified fresh plants (Junta de Andalucía, 2008) with 0.5–1% tolerance for the *S. pallidus*.
  - 16% of the production corresponds to CAC material with a tolerance of 2–5% for *S. pallidus*. If more than 5% of the plants are infested, these plants are not marketed.
  - The remaining 1.6% of the production corresponds to mother plants (frigo) with 0 tolerance which do not go into the berry production market.
  - Based on the aforementioned evidences, a weighted average tolerance of 0.7–1.6% is assumed.

- The Spanish Real Decreto (Real Decreto 929/1995[5]) provisions include two obligatory field inspections, quality of nuclear stock, crop rotation, isolation etc.
- Good agricultural practices, pesticide treatments, field preparation (soil sterilisation (López-Aranda et al., 2009) and weeding (alternative hosts are removed), 5-month production cycle.
- In California, *E. lewisi* is a problem in organic farming and not in conventional farming (Howell, 2017).
- Leafless plants (runners) are produced and this makes mite detection easier.

Uncertainties:

- Symptoms of *S. pallidus* are really specific to the pest and certification may focus on symptoms rather than to pest detection.
- Mites are difficult to detect, especially at low densities.

Based on the assumptions above, the Panel estimated the distribution of the percentage of infested runners from initially infested ha that would be transferred to the berry production areas at the end of the season.

Table C.12: Average proportion of infested plants for planting runners eventually transferred to berry production areas (i.e., from Castilla y León to Huelva) (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Proportion of infested runners (%) transferred for fruit production in the EU (e.g. Castilla Leon to Huelva)	
S_B2c	**A0**	**Comments**
Lower (1%)	0	Certification schemes highly effective
Q1 (25%)	0.6	Controls not targeted *E. lewisi*
Median (50%)	0.8	
Q3 (75%)	1.5	
Upper (99%)	5.0	Only low mite densities could remain undetected at the end of the season

C.2.2.3.3. Establishment sub-step S_B2b: average proportion of infested runners that remain infested after preplanting treatment

Evidence:

- Dipping in insecticide/acaricide and fungicide prior to planting (Junta de Andalucía, 2008).
- Acaricidal effect (including a washing effect) of fungicides and other chemicals used before planting.
- In California, *E. lewisi* is mainly a problem in organic farming, less in conventional farming (see Howell, 2017).
- There are no reports of resistance of *E. lewisi* to pesticides (MSU, online).

Uncertainties:

- The occurrence of resistant mite populations cannot be excluded.
- Growers cannot easily identify *E. lewisi* and distinguish it from the indigenous spider mite *T. urticae*.

Based on the assumptions above, the Panel estimated the distribution of the average percentage of infested runners that remain infested after preplanting treatment.

Table C.13: Average percentage of infested runners that remains infested after preplanting treatment (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Preplanting plants for planting treatment: average percentage (%) of runners remaining infested after the treatment prior to planting	
S_B2b.	**A0**	**Comments**
Lower (1%)	0	
Q1 (25%)	5	
Median (50%)	10	
Q3 (75%)	20	
Upper (99%)	100	Low populations of mites could result extremely difficult to eradicate

C.2.2.3.4. Establishment sub-step S_B3c: conversion factor of number of infested runners into number of infested ha in the berry production area

The Panel distinguished two cases, in the best case all infested plants go to the same ha (conversion factor = 1) and in the worst case every single infested plant goes to a different ha (conversion factor = n).

For the estimate of this aggregation factor, the Panel assumed the worst case scenario where every infested plant goes to a different ha when more than one infested plant could go to the same ha.

S_B3c=100%, one infested runner would be enough to infest one ha of strawberry plants for berry production.

C.2.2.3.5. Establishment sub-step S_B5b: suitability of the environment for Huelva

Evidence:

Berry production in Spain is mostly located in the southwest, close to the border with Portugal (Junta de Andalucía, 2008). Infested plants may remain infested after planting for the following reasons:

- Climate: Plants are planted at the end of the summer through autumn. The Mediterranean climate in these areas is not a limiting factor for the establishment of the mite.
- Host and alternate hosts: The pest would arrive on a suitable host. Many hosts are available in the area because *E. lewisi* is a is highly polyphagous pest (e.g. castor bean, which is regarded as good reservoir for the mite in California, is widely distributed in the EU).
- If introduced in the EU, *E. lewisi* would be found at very low densities.
- *Neoseiulus californicus* is a predatory mite feeding on lewis the mite in California (Howell and Daugovish, 2013) which is indigenous and wide spread in southern EU.
- Even if *E. lewisi* is detected (and probably misidentified as *T. urticae*) by growers and treated (either chemically or biologically), the infested ha (which is the pathway unit) would most probably remain infested (although mite density would certainly be reduced). Therefore, the contribution of cultivation practices (as an RRO) on reducing the suitability of the environment for establishment is considered nil.

Uncertainties:

- Low pest prevalence and Allee effects can take place.
- Low genetic diversity in the pest population considering the very low numbers introduced into the EU.
- In California, where *T. urticae* is also present, *E. lewisi* is regarded as a secondary pest which could be outcompeted by the former species. In organic farming when misidentification between the two mite species occurs, the inappropriate biological control agent *Phytoseiulus persimilis* is released, which releases *E. lewisi* from competition from *T. urticae*, resulting in outbreaks of the former.

Based on these assumptions, the environment at the berry production areas fulfils all the environmental requirements for the pest to establish in terms of host availability, climate suitability and other ecological factors, and therefore, the Panel estimate the suitability of environment of the berry production area in Spain: S_B5b=100%.

As indicated in the conceptual model (Figure C.1), the next parameter to estimate is the establishment end-point for the strawberry production area in Huelva, S_ N2b that corresponds to the Average number of ha in Huelva area, outdoors, infested with at least one established founder populations of *E. lewisi* per year (see Section C.2.3). S_N2b is a model output and is a calculated parameter.

C.2.3. Establishment results S_N2

Two establishment end points were distinguished:

- Establishment (*a*): S_N2a. Average number of infested runner production ha with at least one established founder populations of *E. Lewisi* at the end of the cycle of vegetation per year (in Castilla y Leon).
- Establishment (*b*): S_N2b. Average number of infested berry production ha with at least one established founder populations of *E. Lewisi* per year (in Huelva).

The overall establishment potential through the strawberry plants for planting pathway is calculated as S_N2 = Sum of established founder populations = Ha with established founder populations in runner production area (a) + Ha with established founder populations in berry production area outdoors (b).

Table C.14: Calculated average number of infested runner production ha with at least one established founder populations of *E. Lewisi* at the end of the cycle of vegetation per year under scenario A0

Quantile (percentile)	**S_N2: average number of infested runner production ha with at least one established founder populations of *E. Lewisi* at the end of the cycle of vegetation per year under scenario A0**	
S_N2	**Castilla y Leon: S_N2a**	**Huelva: S_N2b**
Lower (1%)	0.00000000	0.00000350
Q1 (25%)	0.00000004	0.00047613
Median (50%)	**0.00000021**	**0.00280410**
Q3 (75%)	0.00000096	0.01469834
Upper (99%)	0.00002978	0.63978242

C.2.4. Conclusions

C.2.4.1. Establishment in Castilla y León (Spain)

Following the assessment, the Panel concludes that *E. lewisi* is very unlikely to establish in the runner production areas of the EU such as the Castilla y León area in Spain. This assessment was mainly driven by the following arguments:

i) Plant material used for producing strawberry plant propagation material must be certified material (Annex IV part A Section I point 24 to Council Directive 2000/29/EC[3]). Although the mite under scrutiny is not object of the certification, the cold storage (−2°C to −1.5°C) of the runners before planting (up to 4 months), the very strict cropping requirements such as the preplanting treatments of the runners (dipping of the plant material prior to planting), the crop monitoring (including at least two obligatory field inspections) and isolation requirements would negatively affect establishment.
ii) The plants for planting being produced following strict specifications, symptoms caused by the pest would have been detected early during cultivation and appropriate pest control measures implemented.
iii) At the end of the cycle of vegetation, the cropping practices and good agricultural practices would lead to the disposal of all type of contaminated material in the fields.
iv) The climate conditions are not suitable for the pest to overwinter even if it has successfully transferred to another suitable host in the vicinity of the crop.
v) As the A0 scenario assumes that *E. lewisi* remains a regulated quarantine pest, if detected, it would be subjected to eradication, as occurred in the past in poinsettias in the UK and Poland.

C.2.4.2. Establishment in Huelva (Spain)

Following the assessment, the Panel concludes that although environmental conditions (climate suitability and host availability) are conductive for the establishment of *E. lewisi* in the berry production areas of the EU, such as the province of Huelva in Spain, other factors act against establishment of the pest such that overall establishment is an unlikely event. Primarily this is because of the following reasons:

i) Strawberry plants produced in the Spanish highlands have been subjected to certification. Although *E. lewisi* is not object of the certification, the strict cropping requirements and crop monitoring (including at least two obligatory field inspections) for *Phytonemus pallidus*, a tarsonemid mite smaller and more difficult to detect than *E. lewisi*, would also negatively affect other mites populations in the propagation material (Real Decreto 929/1995[5]).
ii) Cropping practices, including chemical and/or biological control of other mite pests that may occur in the EU berry production areas (i.e. *T. urticae*) would have an effect on *E. lewisi* in case that it would be present.
iii) Cropping practices, including regular monitoring, would lead to early detection of any infested focus in the crop and would allow for action to be taken.
iv) As the A0 scenario assumes that *E. lewisi* remains a regulated quarantine pest, if detected, it would be subjected to eradication, as occurred in the past in poinsettias in the UK and Poland.

C.2.4.3. Overall conclusion on potential establishment through strawberry plants for planting pathway

- **Uncertainty factors not being quantified in the establishment step**

i) Potential for import of infested strawberry plants from the USA into different EU MS (10% of total imports from the USA) where both environmental and cropping conditions could have a different effect on the mite.
ii) Potential for climate change to provide better conditions (higher winter temperatures) for the mite to establish.

- **Conclusions on establishment**

Given the uncertainties listed and considered for assessing each sub-step of establishment and recognising that some uncertainties have not been quantified, the Panel expects that it is very unlikely that on average, over the next 10 years, *E. lewisi* will be able to establish in the EU via the strawberry plants for planting pathway. This is mostly due to a combination of two factors. On the one hand, due to the strict certification programs that strawberry plants for planting produced in the EU are subjected to. On the other hand, due to the low entry figures estimated in the previous step. Because climate conditions and host availability are highly conductive for establishment at the places where strawberry fruit production is located, it is important to maintain pest prevalence in the imported material as low as possible and keep the certification schemes in place.

- **Entry and establishment for the strawberry pathway under A1 (PFA) and A2 (PFPP) scenarios**

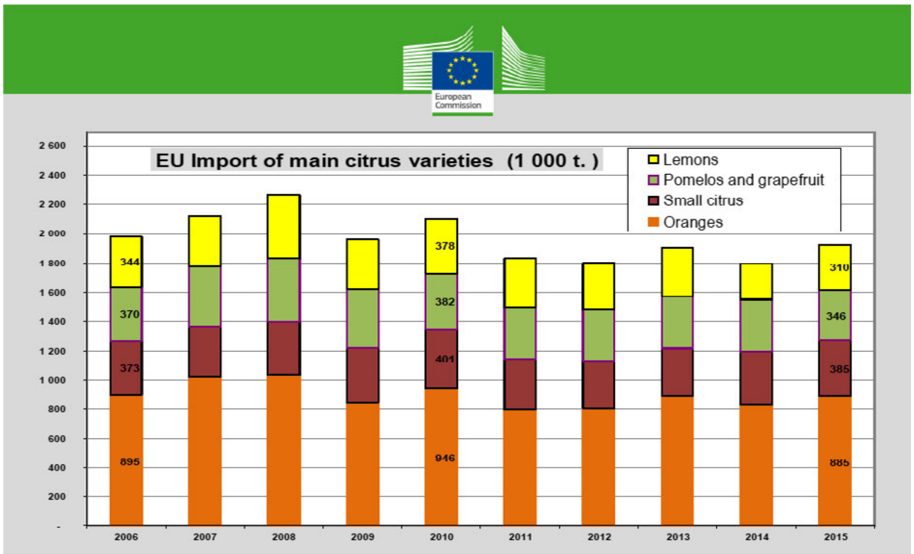
The current conditions (A0) for producing runners in the USA for export to the EU are very similar to a PFA situation (A1 scenario). The runners are produced in California in nurseries located in the highlands close to the border with Oregon, were conditions are unfavourable for the pest to establish. Furthermore, these mother plants are subjected to certification schemes (although *E. lewisi* is not specifically mentioned in the certification standards). Therefore, the Panel did not perform the assessment of the A1 scenario for strawberry plants for planting imported from the USA. For ensuring a control of the plant material originating from the USA specifically for freedom from *E. lewisi*, the Panel reflected on the possibility that the absence of the mite could be also ensured through the certification scheme of the plants for planting in California (this would reduce almost to zero the entry sub-step S_E2).

Regarding the A2 scenario, in view of the assessment of the A0 scenario, establishment of the pest seems very unlikely in the EU and therefore the Panel disregards also this scenario.

Appendix D – Introduction of *Eotetranychus lewisi* via citrus fruits (lemons and oranges) from third countries where *E. lewisi* occurs

D.1. Entry assessment

Every year big volumes of citrus fruits are imported into the EU (European Commission, 2016), with the main citrus varieties reported Figure D.1. *E. lewisi* has been reported on lemon (*Citrus lemon*) and oranges (*Citrus sinensis*) fruits (Jeppson et al., 1975) and it has been also reported on grapefruits leaves (Meagher, 2008; Doucette, 1962). However, no reports on the effect of the mite on grapefruits, pomelos and mandarins were found in the literature, and the Panel focussed in the analysis of this pathway on lemons and oranges, hereafter referred to as 'citrus fruits' It concerns the import of citrus fruit as a potential pathway for the introduction of *E. lewisi* in the EU.



Source: European Commission.

Figure D.1: EU import of main citrus varieties. From DG Agri Dashboard (updated 2016)

D.1.1. Conceptual model for entry through citrus fruits pathway

C_N0. Tonnes of imported citrus oranges and lemons to the EU from third countries where *Eotetranychus lewisi* occurs

C_E1. Conversion of Tonnes to No of fruits as a pathway unit

C_E2a. Percentage of fruits that are infested preharvest prior to export

C_E2b. Percentage of infested fruits where the pest survives the post-harvest treatment

C_E2c. Percentage of infested fruits escaping pre-export quality checks

C_E3. Percentage of infested fruits where the pest survives transport, shipping and storage

C_E4. Percentage of infested fruits that remain infested after EU Import checks – i.e. percentage of infested fruits passing border inspection into the EU

C_E5. Likelihood (in percentage) of successful transfer from citrus fruits to other hosts grown outdoors, establishing and leading to a founder population, over the next 10 years

C_N1. Average number of infested citrus fruits (oranges and lemons) from which the pest has successfully transferred to a suitable host and establishing outdoors in the EU per year, for the next 10 years.

Figure D.2: Model for entry and establishment of *Eotetranychus lewisi* into the EU through citrus fruits (lemons and oranges) imported from third countries where the pest occurs

D.1.2. Assessment of entry

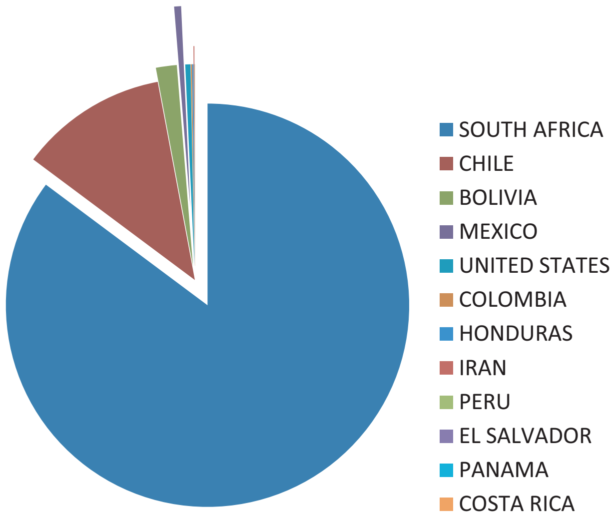
The aim of the entry step is to estimate the average number of infested citrus fruits (without leaves and peduncles) arriving in the EU each year over the next 10 years, that infests other hosts in the pest risk assessment area. The entry model is presented Figure D.2.

The assessment of the citrus pathway begins with the volumes (in tonnes) of imported lemons and oranges from third countries where *E. lewisi* occurs. Seven other sub-steps are considered. Entry assessment ends with the estimate of the average number of citrus fruits (oranges and lemons) that infests other hosts (mite transfer to a new host) in the EU.

D.1.2.1. Entry sub-step C_N0: tonnes of imported citrus oranges and lemons to the EU from third countries where *Eotetranychus lewisi* occurs

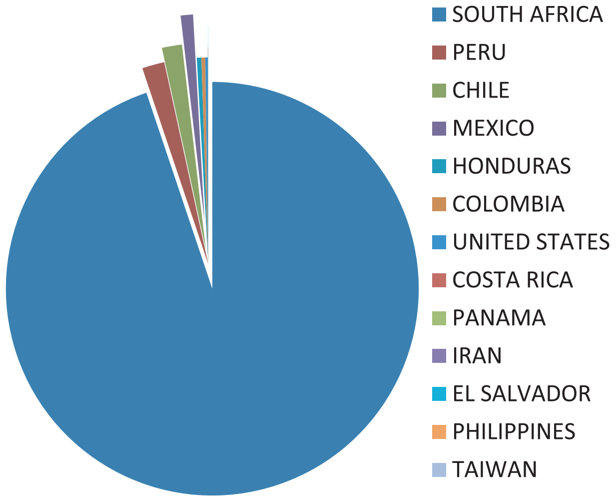
Parameter definition: Volumes (in tonnes) of citrus fruits imported from third countries where *E. lewisi* occurs.

Volumes of oranges and lemons imported from third countries for the period 2006–2016 are shown in Figures D.3 and D.4. Trade data correspond to the EUROSTAT category lemons (CN code 0805 50 00) and oranges (CN code 0805 1000) fruits, fresh or dried.



Source: EUROSTAT.

Figure D.3: Country of Origin of imports of lemon (fresh and dried fruits) *Citrus lemon* from countries where *E. lewisi* occurs in the last 10 years (2006–2016)



Source: EUROSTAT.

Figure D.4: Country of Origin of imports of oranges (fresh and dried fruits) from countries where *E. lewisi* occurs in the last 10 years (2006–2016)

Evidence:

- Import volumes from EUROSTAT.
- A literature search identified countries where *E. lewisi* is known to occur (EFSA, 2017a,b).
- The main exporters are South Africa (85% of total volume) and Chile (11%). *E. lewisi* occurs in both countries.
- Volumes of trade for the USA are stable during the period of time considered. Imports have steadily increasing for Chile for the same period of time.
- The trend over the next years is to maintain a stable volumes of imports into the EU.

Uncertainties:

- Citrus production in the EU might influence imports from third countries.
- Besides lemon and oranges, other citrus fruits could be hosts (e.g. pomelo and mandarins), which have not been considered here.
- New pests and diseases of lemons or oranges in citrus exporting countries might modify EU imports from these countries.

Table D.1: Volumes of fruits of oranges and lemons imported from third countries where *E. lewisi* occurs, for the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (Percentile)	Volumes of fruits of oranges and lemons imported from third countries where *E. lewisi* occurs, for the next 10 years	
C_N0 (in 1,000 tonnes)	**A0**	**Comments**
Lower (1%)	350	The Panel would be very surprised if the average would be lower than the lowest yearly imports occurred during the past 10 years
Q1 (25%)	500	While there is a trend for increasing trade, imported volumes per year are irregular. The Panel estimates that the present highest volume will last in the next 10 years
Median (50%)	550	
Q3 (75%)	600	
Upper (99%)	650	The Panel would be very surprised if the average would be more than 20% higher than the highest annual imports of the past 10 years

D.1.2.2. Entry sub-step C_E1: conversion of volume of import to number of citrus fruits

Parameter definition: In order to consider the elementary unit as an infestation unit, a conversion factor was calculated to transform volumes (in tonnes) of imports into the number of individual fruits as a pathway unit.

Evidence:

The average weight of US lemons is estimated at 100 g (85—113 g) and at 131 g (96–184 g) for oranges (USDA ARS, online). EU import in weight of lemons and oranges consists of 11% and 89%, respectively; therefore, the **combined weighted average per fruit is 128 g.** This conversation factor was used in the model.

Uncertainty:

Estimates are based on the average weight of fruits in the USA. The size and the weight might be different in other countries.

D.1.2.3. Entry sub-step C_E2a: percentage of fruits that are infested at preharvest (prior to export)

Parameter definition: This parameter estimates what will be the average percentage of fruits that are infested by *E. lewisi* prior to export, in countries where the mite is known to occur, over the next 10 years.

Evidence:

- The mite is widely distributed in several of the citrus producing countries, which export citrus fruit to the EU.
- The mite feeds mostly on the fruit (Jeppson et al., 1975).
- High quality standards as for the fresh market involve strict requirements for pest free fruits for export.
- In mandarins, *T. urticae*, an important spider mite pest of citrus, is not on the fruit at harvest time. Harvest occurs in winter when the conditions are not optimum for the pest to live on fruits, hence at harvest the symptoms are visible but the pest is not on the fruit (Pascual-Ruiz et al., 2014). Considering the similarities between *T. urticae* on mandarins and *E. lewisi* on lemons and oranges, the Lewis mite it is not expected to be on the fruits at harvest time.

- South Africa accounts for 63% of the total citrus planted area in the world in 2014/15 (GHI, 2016). Europe is South Africa's largest export market for oranges, accounting for approximately forty percent of the total export market (GHI, 2016).
- In South Africa, the main citrus exporting country to the EU, the citrus production occurs in several provinces. The Limpopo province has the largest area planted with citrus (44%) followed by Western Cape (27%) where *E. lewisi* has not been reported to occur. Among the provinces where the mite occurs (as reported in Smith Meyer and Creamer, 1999), Western Cape, Gauteng, Mpumalanga and Northern Province, the citrus production accounts for 17%, 8% and 2%, respectively (USDA GAIN, 2016).
- The mite seems to be well distributed in the above citrus producing provinces of South Africa where it has been reported on several host plants. In the Gauteng province, *E. lewisi* was reported besides on citrus, on *Euphorbia pulcherrima* near Pretoria (Smith Meyer, 1974). Other mite records from Pretoria are on *Ricinus communis*, in 1973; *Bauhinia* sp, in 1976; *E. pulcherrima*, in 1981; in Duiwelskloof, Limpopo Province on *E. pulcherrima,* in 1984, Nelspruit (new name Mbombela), Mpumalang Province (ARC PPRI, online).
- In the USA, the mite occurs in Arizona, California, Florida, Illinois, Maryland, Massachusetts, Michigan, Oregon, Washington and Hawaii (EPPO, 2017)
- The mite has been observed in citrus groves in California on unripe fruits where is reported as currently not being an issue (Howell, 2017).
- Citrus orchards involve a large complex of pests and diseases and methods to control/suppress them. Control programs are based on early pest detection through regular orchard inspections. Good agricultural practices on citrus are based on an array of tactics (e.g. PP2/27 standard (EPPO, 2004) describes the methods that contribute to keep arthropod pests at low prevalence, although the most common on is the use of synthetic pesticides). The use of pesticides to control other arthropod pests including spider mites, would be also efficient to control *E. lewisi*. Some physical methods such as oils have been used successfully for preharvest treatments. These may have direct or indirect effects on mites among other soft-bodied arthropods (Vincent et al., 2003). For example, Cowles et al. (2000) showed that trisiloxane, generally considered as an inert ingredient either suffocates or disrupts important physiological processes in the two-spotted spider mite, *T. urticae*.
- On citrus, *E. lewisi* is considered to be of minor importance in the EPPO region (EPPO, 2017).
- There are no interceptions of *E. lewisi* linked to trade in citrus fruits.

Uncertainties:

- There is no information on *E. lewisi* incidence on citrus in countries where the mite is known to occur.
- Available reports on *E. lewisi* distribution in South Africa might be outdated as from 1999 (Smith Meyer and Creamer, 1999).
- The mite is difficult to detect, especially when the population is low, so it could occur more often, yet go undetected. However, as populations can grow rapidly, if present they should be detected eventually.

Taking the above evidences and uncertainties into account, the Panel estimates the average percentage of citrus fruits infested with *E. lewisi* prior to export, over the next 10 years.

Table D.2: Average percentage of fruits infested by *E. lewisi* before harvest in the country at origin over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	**Average percentage of fruits infested by *E. lewisi* before harvest in the country at origin over the next 10 years**	
C_E2a.	**A0**	**Comments**
Lower (1%)	0.0001	The pest is present in the field During the harvest time in winter, the conditions are not optimum for the pest to live on the fruits At harvest time, the symptoms caused are visible but the pest is not really expected to be on the fruit (e.g. *Tetranychus urticae*) High quality standards as for export in fresh market
Q1 (25%)	0.001	
Median (50%)	0.01	
Q3 (75%)	0.03	
Upper (99%)	0.1	

D.1.2.4. Entry sub-step C_E2b: percentage of infested fruits remaining infested after post-harvest treatment

Parameter definition: This parameter estimates what will be the average percentage of citrus fruits for export in countries where the mite is known to occur, that will remain infested after post-harvest treatments, over the next 10 years.

Evidence:

- Standard post-harvest processing methods for commercial citrus fruits include washing and waxing procedures. Cleaning alone may be insufficient and often needs to be followed by another treatment. When cleaning is prescribed as a quarantine treatment, it is usually followed by inspection by the importing regulatory agencies to ensure that the cleaning was successful in removing undesired pests and debris (Vincent et al., 2003).
- Specific post-harvest chemicals include sodium hypochlorite, sodium *o*-phenylphenate, peroxyacetic acid, imazalil or thiabendazole (USDA APHIS, 2010). These molecules will probably be effective against mites.
- When physical post-harvest processing methods commonly used on citrus fruit were evaluated alone and in combination with the control of *Brevipalpus* flat mites on infested citrus fruits, a pest of citrus in South America, none of the treatments tested provided 100% reduction of all stages of mites. However, several combination of treatment were successful in achieving 90% reduction of mites (Peña et al., 2015). The most effective combination of treatments included soap and mechanical brushing followed by a wax coating.

Uncertainties:

- Information on post-harvest treatments is from practices in the USA and South America. No information from other exporting countries was identified.
- Most post-harvest methods are mainly designed to remove scale insects (Coccoidea), which are more attached to fruits than spider mites. It is expected, but not demonstrated, that applied methods should be well efficient to dislodge spider-mites.

Based on the uncertainties and the evidence detailed above, the Panel provides the estimates of the distribution of the average percentage of fruits infested by *E. lewisi* before harvest in the country at origin over the next 10 years.

Table D.3: Average percentage of fruits remaining infested after post-harvest treatments, for the next 10 years (EXPERT judgement was used to estimate five quantiles)

Quantile (percentile)	**Average percentage of fruits remaining infested after post-harvest treatments, for the next 10 years**	
C_E2b.	**A0**	**Comments**
Lower (1%)	0	The post-harvest treatment, i.e. brushing, drenching and waxing are quite effective in removing the insects from the surface of the fruit (scales are brushed and are usually more firmly attached to the fruits than mites)
Q1 (25%)	0.003	
Median (50%)	0.005	
Q3 (75%)	0.01	
Upper (99%)	0.05	

D.1.2.5. Entry sub-step C_E2c: percentage of infested fruits escaping pre-export quality checks

Parameter definition: This parameter estimates what will be the average percentage of infested fruits passing industry quality checks and export checks at origin and remaining infested, and are then shipped to the EU, over the next 10 years.

Evidence:

- Citrus imports must be accompanied by a phytosanitary certificate indicating freedom from quarantine pest.

Uncertainties:

- No specific data identified for this parameter.
- Mites, in general, are very difficult to detect, especially when they occur at low population densities.
- There is no survey information measuring the performance of export inspections. However, we assume that such inspections are performed at the same level of effectiveness as import inspections.

Taking the above evidence and uncertainties into account, and considering the similarities with parameters **P_E2b** (Average percentage of infested packs of Poinsettia plants passing quality checks at origin and remaining infested, then shipped to the EU, over the next 10 years) and **S_E4 (**Average percentage of infested packs of strawberry plants for planting where the pest remains undetected after border inspection), the Panel estimates the distribution of the average percentage of infested citrus fruits that remain infested after export checks, over the next 10 years.

Table D.4: Average percentage of infested fruits passing quality checks at origin and remaining infested, then shipped to the EU, over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	**Average percentage of infested fruits passing quality checks at origin and remaining infested, then shipped to the EU, over the next 10 years**	
C_E2c	**A0**	**Comments**
Lower (1%)	98.5	Same as P_E2b, S_E4
Q1 (25%)	99.2	
Median (50%)	99.4	
Q3 (75%)	99.6	
Upper (99%)	100	

D.1.2.6. Entry sub-step C_E3: percentage of infested citrus fruits remaining infested after transport, shipping and storage

Parameter definition: This parameter estimates the average percentage of citrus fruits for export which remain infested during transport/shipping and storage to the EU over the next 10 years.

Evidence:

- In general, the transport of commercial citrus fruit takes place under cool conditions (Wills et al., 1998). Oranges are typically shipped at 1°C and lemons are usually shipped at 10°C, because of their sensitivity to chilling injury. Cargos should be precooled prior to loading.
- According to citrus industry suggestions (BMT surveys©, Online b), lemons should not be stored for prolonged periods below 10°C, although 3–4 weeks storage at 3–5°C, which is typical for some receivers, is usually tolerated without harm.
- Yellow lemons harvested when dark-green have a much longer postharvest life than those picked yellow, which must be marketed more rapidly due to their shorter shelf-life. Lemons can be stored between 10°C and 14°C depending on the maturity-ripeness stage at harvest, season of harvest, storage time and production area. They can be stored for up to 6 months under the right conditions.
- Shipping temperatures (above) will not cause mite mortality of *E. lewisi*, however reproduction will stop.

Uncertainties:

- Shipping conditions of lemons and oranges are different.
- The thermal biology of *E. lewisi* at low T° is not well studied and similarities have to be made with related mites.

The Panel considers that the conditions of transport, shipping and storage of citrus fruits have no effect on *E. lewisi* mortality, and thus, the estimation of the parameter C_E3 is 100%.

D.1.2.7. Entry sub-step C_E4: percentage of infested fruits passing EU border import checks

Parameter definition: This parameter estimates the average percentage of infested fruits which remain infested following EU import/border inspection checks over the next 10 years.

Evidence:

- Mites, in general, are very difficult to detect, especially when they occur at low population densities.
- EUROPHYT records of non-compliance indicate that mites are seldom intercepted. Since 1995, when EUROPHYT records of non-compliance began to be collected, there have been 38 reports of mite interceptions. None of them were *E. lewisi*.
- The EU plant health Council Directive 2000/29/EC[3] does not regulate *E. lewisi* on citrus fruits; therefore, EU import inspections might not have been performed specifically on the association of citrus fruits and *E. lewisi*.

Uncertainties:

- There is no specific data for this parameter.
- There is no survey information measuring the performance of EU import inspections.
- Numbers of mites are not expected to change much during transport, so the population density in undetected infested fruits prior to export remains at approximately the same population density on arrival into the EU.

Table D.5: Percentage of infested fruits passing EU border import checks, over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of infested fruits passing EU import checks over the next 10 years	
C_E4	**A0**	**Comments**
Lower (1%)	98.5%	Same as P_E2b, S_E4 and C_E2c
Q1 (25%)	99.2%	
Median (50%)	99.4%	
Q3 (75%)	99.6%	
Upper (99%)	100%	

D.1.2.8. Entry sub-step C_E5: successful transfer of *E. lewisi* to other hosts over the next 10 years

Parameter definition: This parameter estimates the average percentage of successful transfer of *E. lewisi* from citrus fruits to other hosts grown outdoors, establishing and leading to a founder population over the next 10 years.

Evidence:

- In general, spider mites move to new resources when exploited plants are aged or exhausted (Kennedy and Smitley, 1985).
- Spider mites dispersion is limited. In non-crop systems, most species live on habitats that are discontinuous and transient (Mitchell, 1970).
- Mites use winds for dispersal. Studies on the spider mite *Brevipalpus phoenicis* demonstrated that winds lower than 30 km/h do not dislodge mites from citrus fruit surface (Alves et al., 2005). However, in the laboratory wind speeds of 16 and 26 km/h dislodged mites onto sticky traps (Peña et al., 2015).
- The importance of phoresy on mite dispersal estimated on *B. phoenicis* under field conditions showed that when infested lemons were placed in contact with fruit flies, 3 out of 60 fruit flies observed had mites attached to their seta or body.
- High numbers of mites are needed to have a successful transfer.
- The mites prefer green fruits and would not transfer to ripe fruits (Pascual-Ruiz et al., 2014).
- Previous mites that were introduced in the EU were associated with plants for planting and not with fruits (e.g. *Tetranychus evansi*) (Navajas et al., 2014).

- Not all host transfer occurring with mites are successful. Some mites that have adapted to their host might require several generations to adapt to a new host.
- In experimental field trails, when lemon fruits infested with the spider mite *Brevipalpus phoenicis* were placed next to a citrus plants no successful transfer observed (Peña, 2010).

Uncertainties:

- Because of the lack of data on *E. lewisi*, evidences are based on different spider mite species.
- No clear indications on the commodities on which other citrus spider mites have been introduced in the EU (e.g. *Eutetranychus banksi* and *E. orientalis*).

Table D.6: Average percentage of successful transfer of *E. lewisi* from citrus fruits to other hosts grown outdoors, establishing and leading to a founder population over the next 10 years (expert judgement was used to estimate five quantiles)

Quantile (percentile)	Average percentage of successful transfer of *E. lewisi* from citrus fruits to other hosts grown outdoors, establishing and leading to a founder population over the next 10 years
C_E5	**A0**
Lower (1%)	0
Q1 (25%)	0.005
Median (50%)	0.01
Q3 (75%)	0.015
Upper (99%)	0.02

D.1.3. Results for risk of introduction into the EU of *E. lewisi* through citrus fruit

The average number of infested citrus fruits (oranges and lemons) from which the pest has successfully transferred to a suitable host and establishing outdoors in the EU per year, for the next 10 years (C_N1) is computed based on the above described parameters distributions.

Table D.7: Computed average number of infested citrus fruits (oranges and lemons) from which the pest has successfully transferred to a suitable host and establishing outdoors in the EU per year, for the next 10 years (C_N1)

Quantile (percentile)	Computed average number of infested citrus fruits (oranges and lemons) from which the pest has successfully transferred to a suitable host and establishing outdoors in the EU per year, for the next 10 years
C_N1	**A0**
Lower (1%)	0
Q1 (25%)	0.00025
Median (50%)	**0.00152**
Q3 (75%)	0.00627
Upper (99%)	0.09218

D.1.4. Conclusions

Regarding the citrus fruits imported from countries where the pest occurs, the Panel provides for the estimation of each sub-step of the entry model, the supporting evidence and identifies uncertainties associated with model inputs. Results from multiplying the inputs for each entry sub-steps in the stochastic (Monte Carlo) simulation, are provided for the baseline scenario (A0). Figure D.5 shows the descending cumulative probability distribution for the number of infested fruits arriving each year in the EU. There is a probability of 1% that there will be 1 infested citrus fruit in 10 years. Accordingly, it is extremely unlikely that any infested citrus fruit will arrive in the EU from third countries where *E. lewisi* occurs, during the next 10 years.

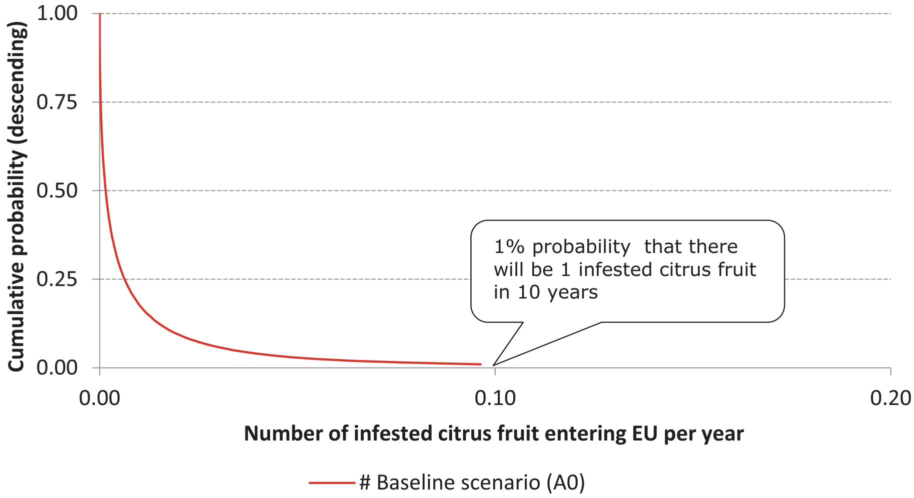


Figure D.5: Panel's expectation in terms of a descending cumulative probability distribution for the number of infested citrus fruits arriving in the EU from countries where *E. lewisi* occurs each year (scenario A0)

Within the model for entry via citrus fruits, there are three major sub-steps that contribute the most to uncertainty (Figure D.6). The main factor is the proportion of infested fruits before harvest in the country of origin (59%), followed by the survival of the mite after post-harvest treatments (31%). The proportion of infested fruits that will successfully operate a pest transfer to other hosts grown outdoors leading to a founder population contributes by 10% to the overall uncertainty. Uncertainties of estimates of the proportion of infested fruits, which remain infested following pre-export quality checks or transport, shipping and storage measures are close to 0.

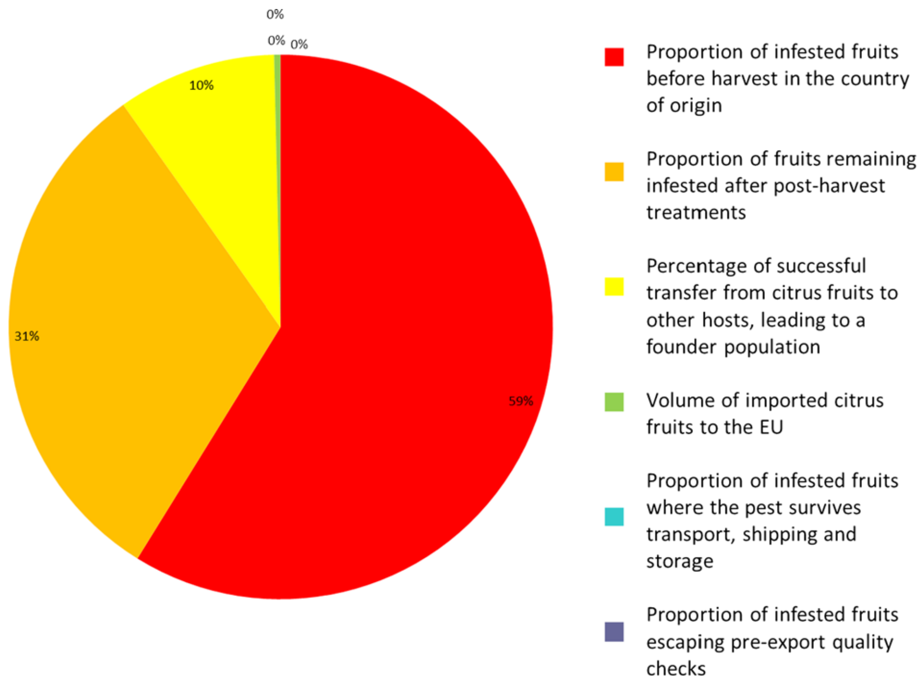


Figure D.6: Entry sub-steps contributing the most to overall uncertainty regarding the number of infested citrus fruits imported into the EU each year from third countries where *E. lewisi* occurs

- **Uncertainty factors not being quantified in the entry step**

With regard to the potential entry into the EU of the pest with citrus fruits carried by passenger traffic, the frequency of passengers carrying 'one' citrus fruit was estimated as 0.1% on average (EFSA

PLH Panel, 2014b). Thousands of passengers arriving daily in the EU, the frequency of passenger checks would have to be high to reduce the rate of entry of citrus fruit by passengers. The movement of *E. lewisi* on fruit carried by passengers cannot be excluded but has not been assessed here.

- **Conclusion on the entry assessment**

The Panel concludes on the assessment of entry for scenario A0 (current regulatory situation) that the risk that any infested citrus fruit enters into the EU and that a founding population of *E. lewisi* establishes in the EU is extremely unlikely during the time horizon for this risk assessment, despite the described uncertainties and that the Panel's estimates are based in several cases on evidences from other spider mite species than *E. lewisi*.

The current conditions (scenario A0) for citrus production in third countries where *E. lewisi* occurs and for exporting fresh fruit to the EU, result in an extremely low infestation rate when leaving the country of origin. Therefore, the Panel did not to perform the assessment of the A1 scenario for citrus fruit.

In the current situation (scenario A0), establishment of the pest seems extremely unlikely in the EU, and therefore, the more stringent scenario A2 was also disregarded.

Appendix E – Abiotic and Biotic factors for assessing establishment

The Panel assessed the abiotic and biotic factors influencing the establishment of *E. lewisi* in the EU.

A number of exotic tetranychids have established in Europe in recent years (Navajas et al., 2010), many of them from tropical or subtropical areas. However, none of the mites were recognised quarantine pests. The likelihood of a poikilothermic organism from warmer countries establishing in a temperate region such as the EU is influenced by low winter temperatures and has limited the distribution of mites that previously established in temperate regions (Migeon et al., 2009). The Panel therefore first consider climatic factors (temperature) and its influence on establishment.

E.1. Climate (minimum temperature)

Based on a comparison of the different Koppen Geiger climate zones between the EU and the areas where the pest is known to occur, the Panel concluded in EFSA (2014a) that climatic conditions would allow *E. lewisi* to potentially establish in large parts of the EU risk assessment area. Using data on the thermal biology of *E. lewisi,* efforts have been made to examine the number of generations possible each year across the EU so as to identify areas where climate (temperature) most favours establishment and to identify possible endangered areas.

Lai and Lin (2005) report a threshold temperature for development of 8.3°C (± 2.1°C) with 159 degree days (DD) required to complete a generation on poinsettia leaves. Moreover the authors indicate that at temperatures of 20, 24 and 28°C adult mites lived for approximately 12, 16 and 10 days, respectively, with a generation from egg to adult taking approximately 20, 17 and 13 days. Survival rates from egg to adults between 16°C and 20°C were approximately 73%.

Based on this information, the Panel generated maps indicating that, from the southern Mediterranean northwards into Sweden and Finland, large areas have minimum temperatures that are suitable for the completion of at least one generation of *E. lewisi* per year (Figure E.1). However, these maps are theoretical as in nature adults live for a few weeks at most and do not survive for many months. While a map may show that the thermal sum to complete a generation is accumulated, the time taken to accumulate such heat energy must be taken into consideration. Hence, it is in southern Europe where there are several multiple generations possible that establishment is most likely.

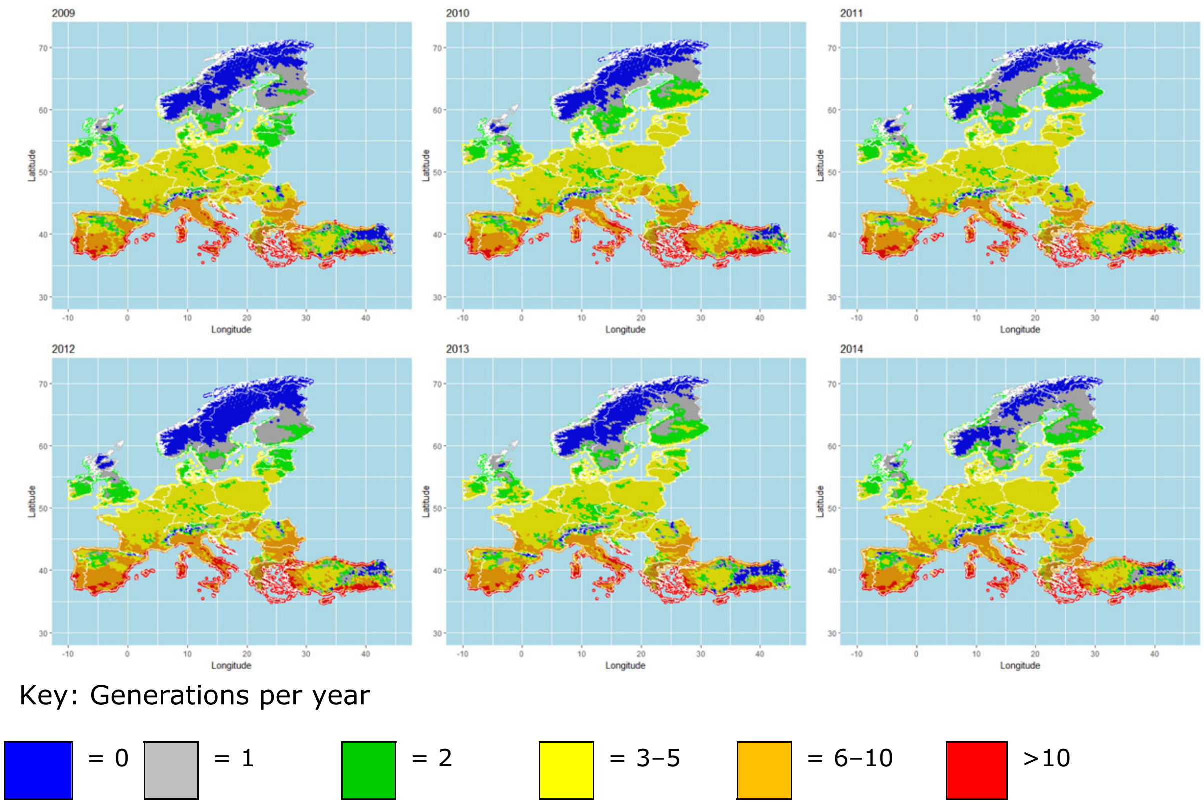


Figure E.1: Minimum number of *E. lewisi* generations per year possible across Europe, 2009–2014

Maps in Figures E.2 and E.3 indicate annual temperature data. Figure E.2 shows global accumulated temperature above a threshold of 10°C. Yellow circles indicate countries where *E. lewisi* occurs. Most of the countries where *E. lewisi* is present are tropical or subtropical with over 2,000 DD above 10°C (purple zones). However, *E. lewisi* is also known in the northeastern USA, the west coast of the USA and Chile, regions with large areas where accumulated temperature is above 1,000 DD (pink zones).

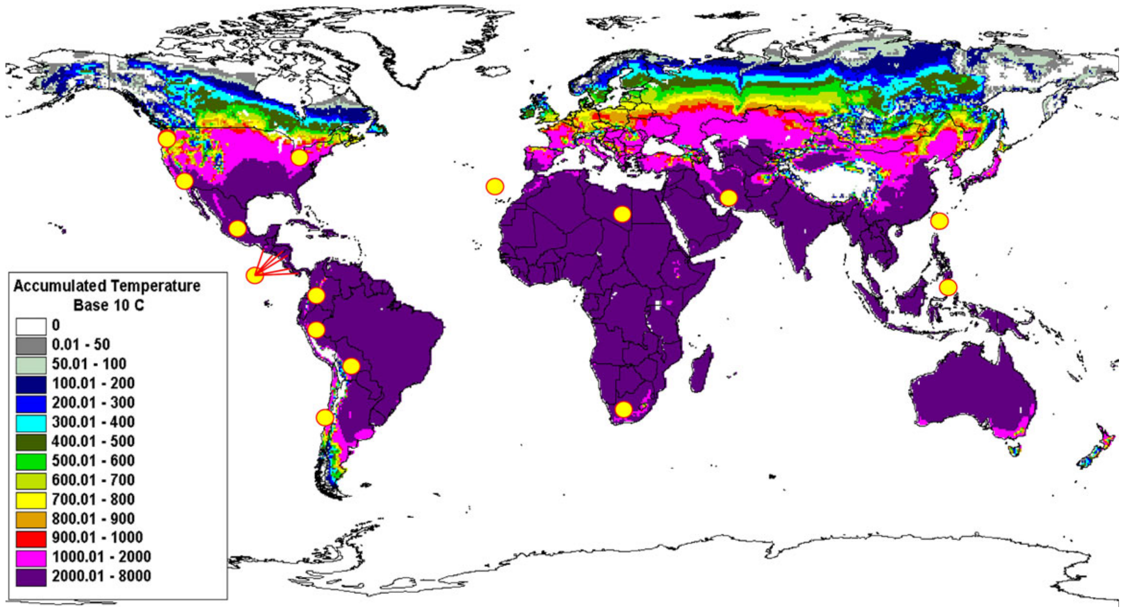


Figure E.2: Accumulated temperature above a threshold of 10°C using 1961–1990 monthly average maximum and minimum temperatures taken from the 10 minute latitude and longitude Climatic Research Unit database (IPCC, online; New et al., 2002). The map was kindly provided by R. Baker, FERA, and previously used in the EFSA-funded project Prima Phacie (MacLeod et al., 2012). Similar maps based on the same accumulated temperature, but expressed in Degree Days, were published in 2002 and 2012 (Baker, 2002; Eyre et al., 2012)

The same colour scale is used in Figures E.2 and E.3 for Europe, 2009–2014. Figure 3 shows that substantial parts of southern European countries, such as Portugal, Spain, Italy and Greece, as well as the Mediterranean coast of France are shown as pink zones. The Panel notes that in Southern Europe, 2014 was generally a much cooler year than the earlier years, as indicated by larger red areas and much less pink. In the absence of climatic data for Madeira Island, the Canary Islands are represented in the left down corner as a proxy of Madeira Island.

With regard to the climate data used for preparing Figure E.3, the daily maximum air temperatures (from 1 January 2009 to 31 December 2014) are available for Europe (Temperature data were provided by the European Commission Joint Research Center (JRC) Monitoring Agricultural Resources (MARS) unit Meteorological Data Base (EC/JRC) for about 10,000, 25 × 25 km grids.

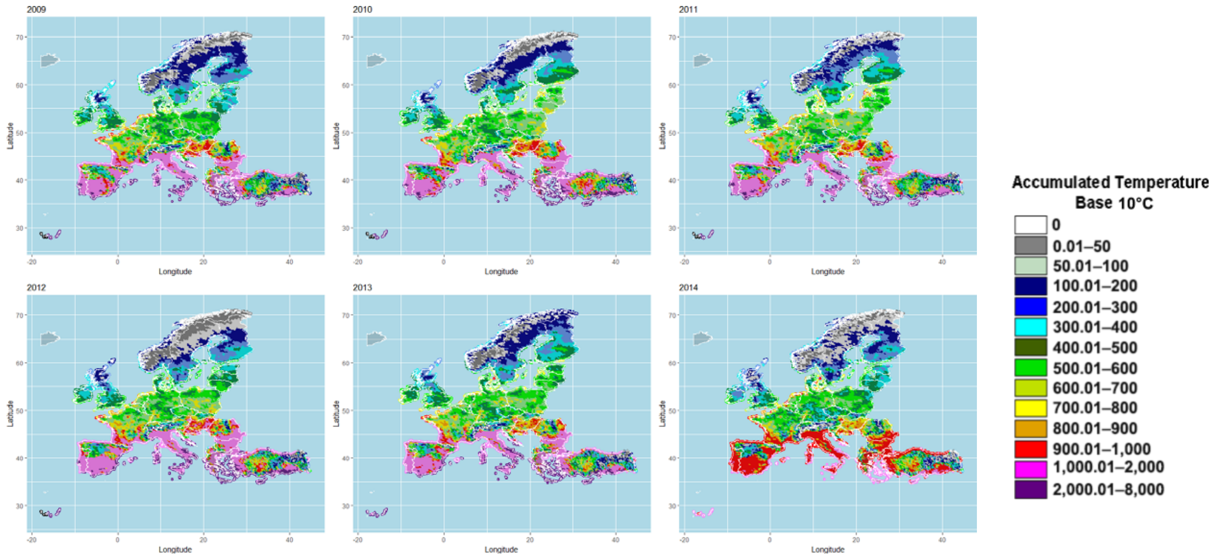


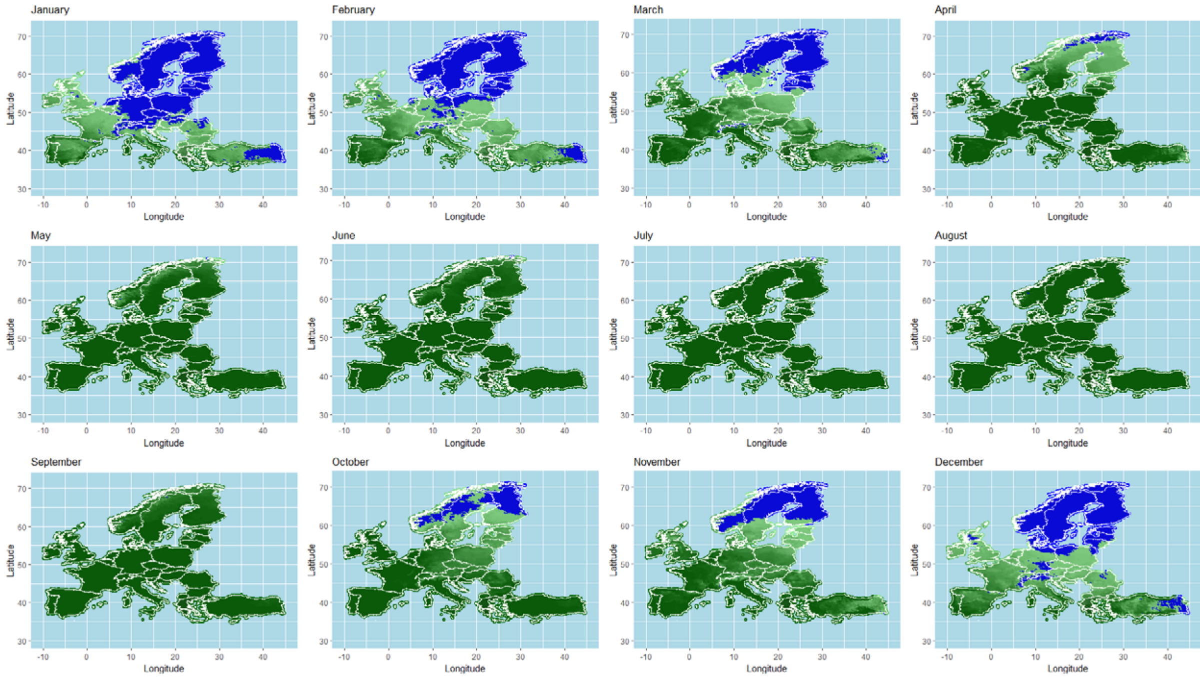
Figure E.3: Accumulated temperature in Europe above 10°C for years 2009–2014

Maps in Figure E.4 represent monthly temperature data for 2009. The daily maximum air temperature for the period considered was used to identify grids where temperatures were above 8.3°C, reported as the lower bound impeding life cycle development. For each month of the year, the number of days above the threshold were summed and indicated with different shadings of green (darker shades of green indicates more days above threshold), blue indicates areas in which cycle completion within the month would not be possible.

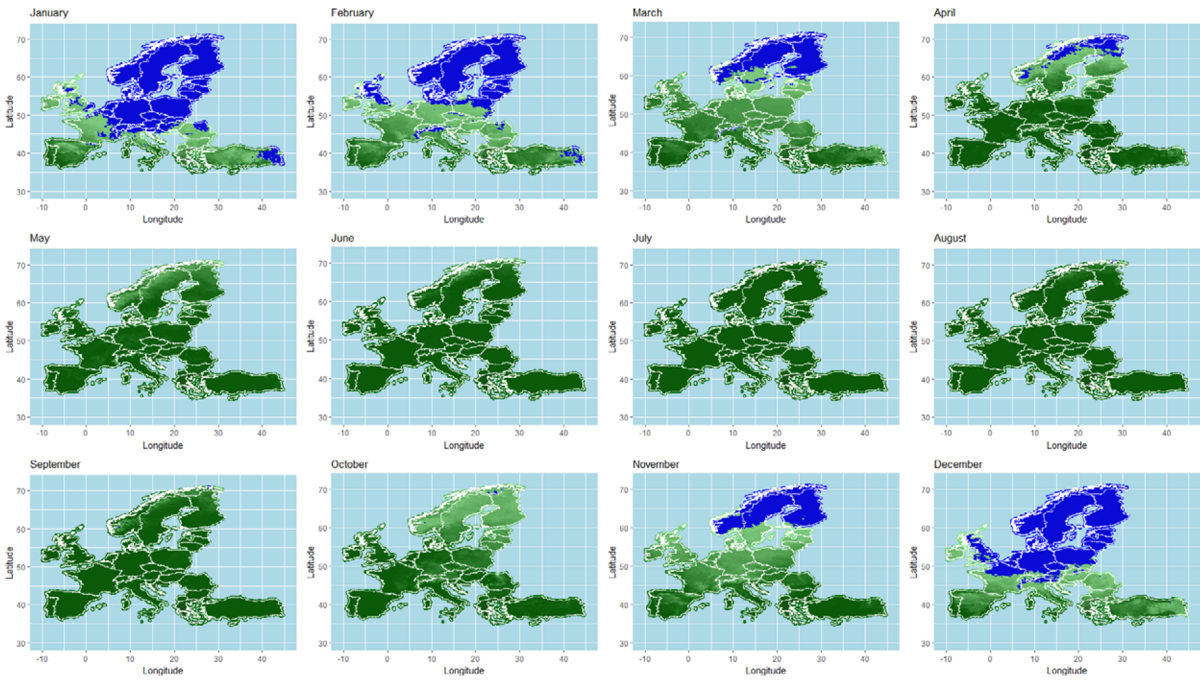
Figures E.4a–f show the temperature suitability in the EU per month for 2009–2014. These maps show the months of the year most likely to support development of *E. lewisi* within Europe.

With regard to Figure E.4a–f, the daily minimum air temperatures (from 1 January 2009 to 31 December 2014) are available for Europe (temperature data were provided by the JRC Monitoring Agricultural Resources (MARS) unit Meteorological Data Base (EC/JRC)) for about 10,000, 25 × 25 km grids. The daily minimum air temperature for the period considered was used to calculate for each day in the year the amount of degrees above the predefined threshold reported as impeding cycle completion, only days having minimum temperature above the threshold were considered to calculate the total amount of degrees accumulated in a year. The resulting amount was then divided by the total number of degrees needed to complete a generation and maps for each year were prepared depicting areas for which not a single generation would be completed in a specific year (blue colour), and different colours (5 classes) indicating the potential number of completed generations in different regions in Europe.

a

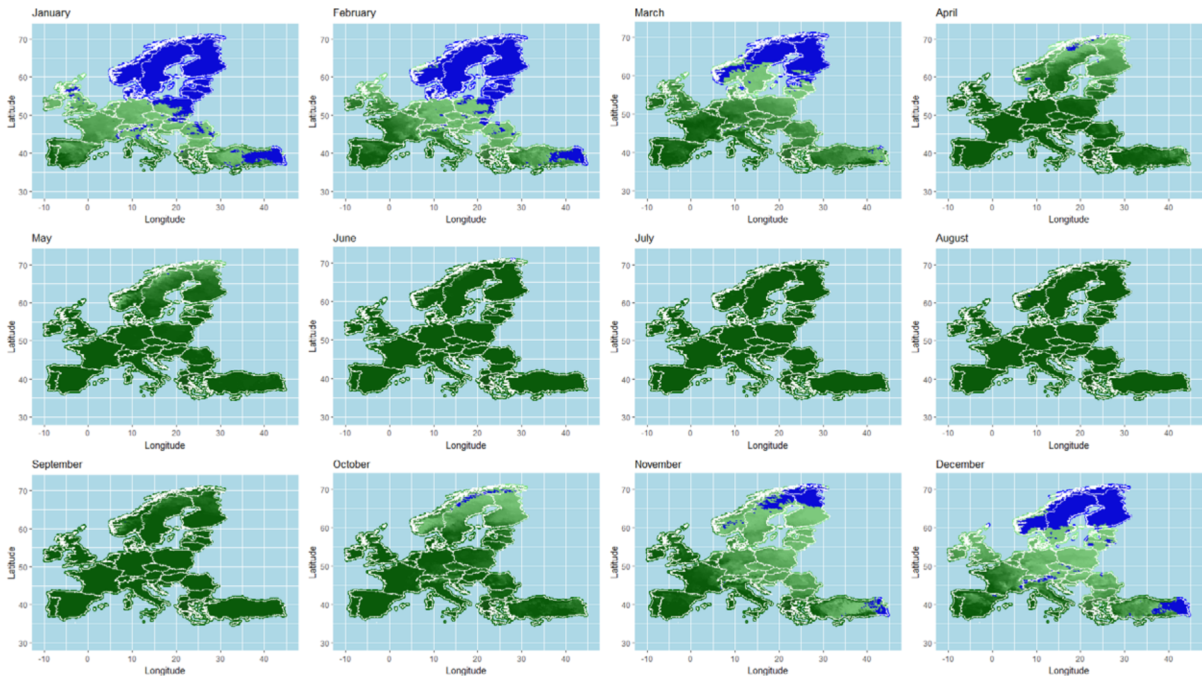


b



a: 2009; b: 2010; c: 2011; d: 2012; e: 2013; f: 2014.

Figure E.4: Temperature suitability in the EU per month for 2009–2014 c



d

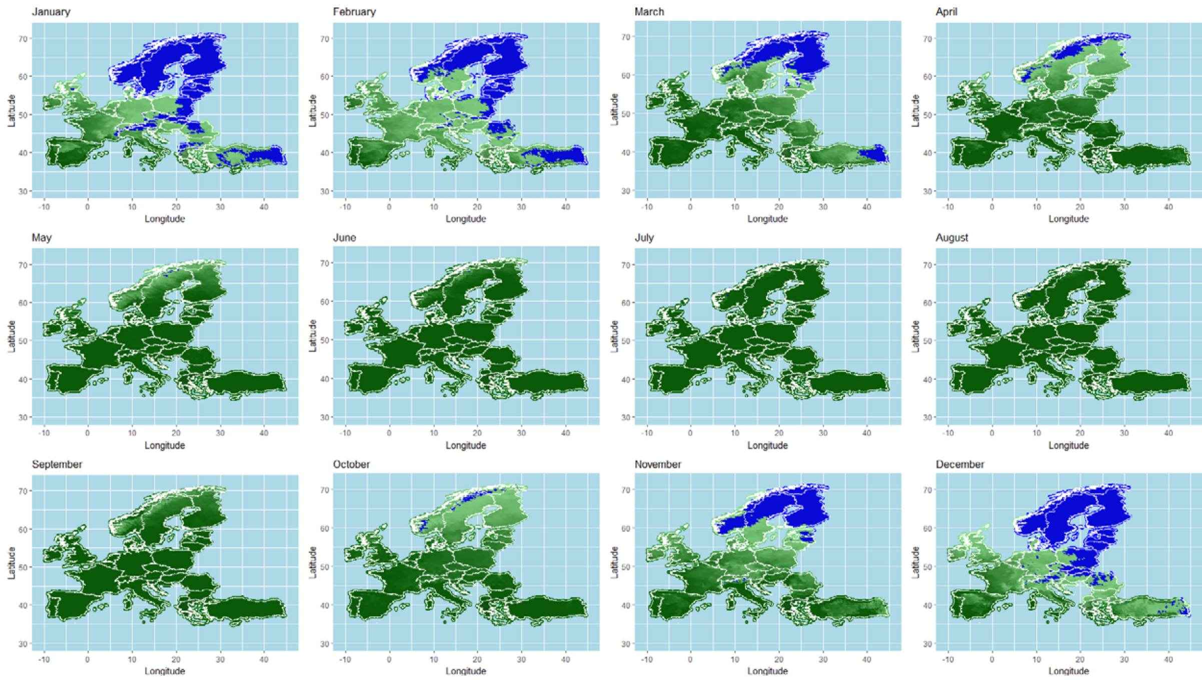
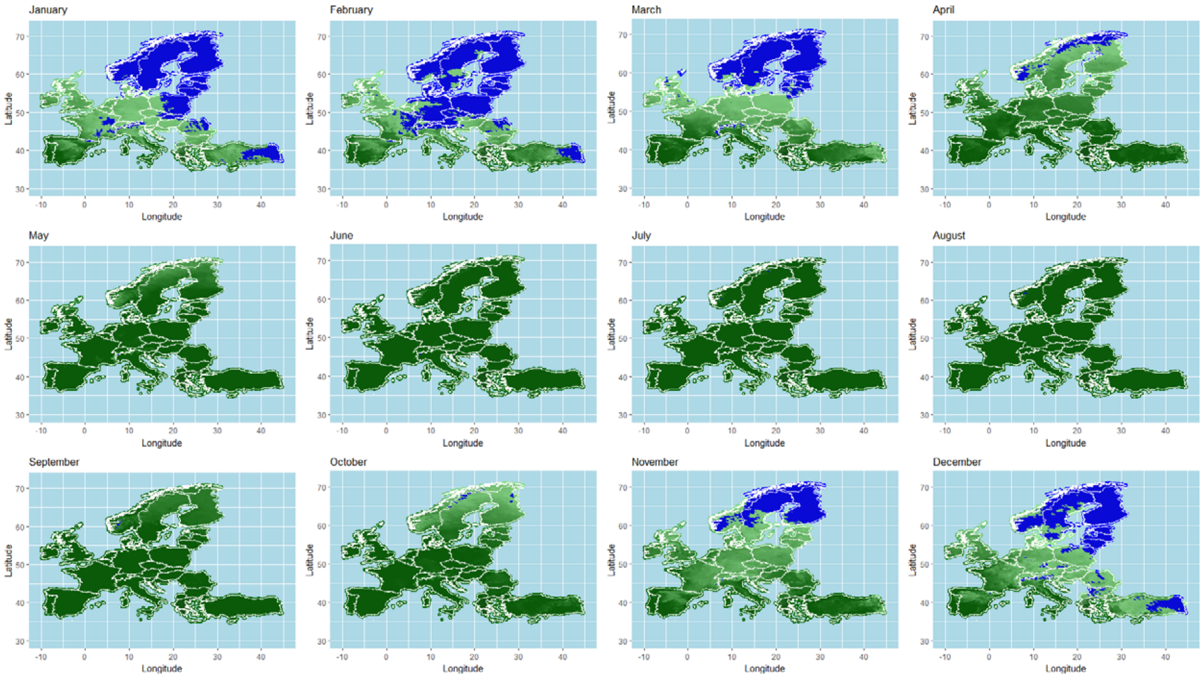


Figure E.4: Continued

e



f

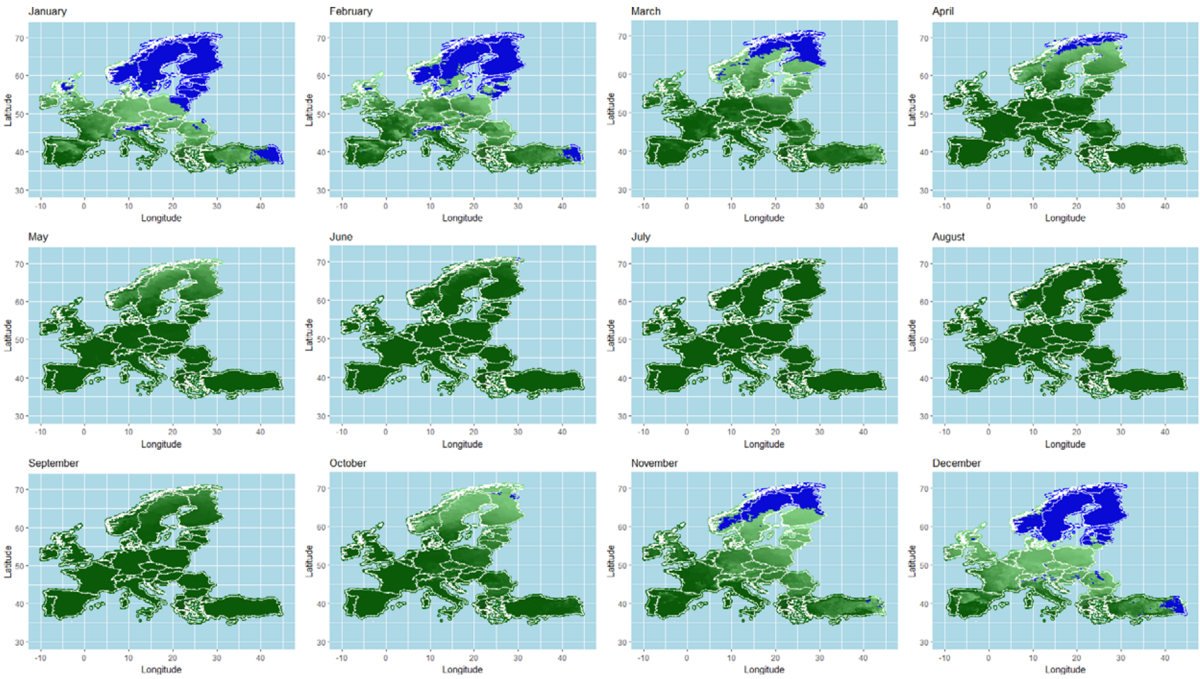


Figure E.4: Continued

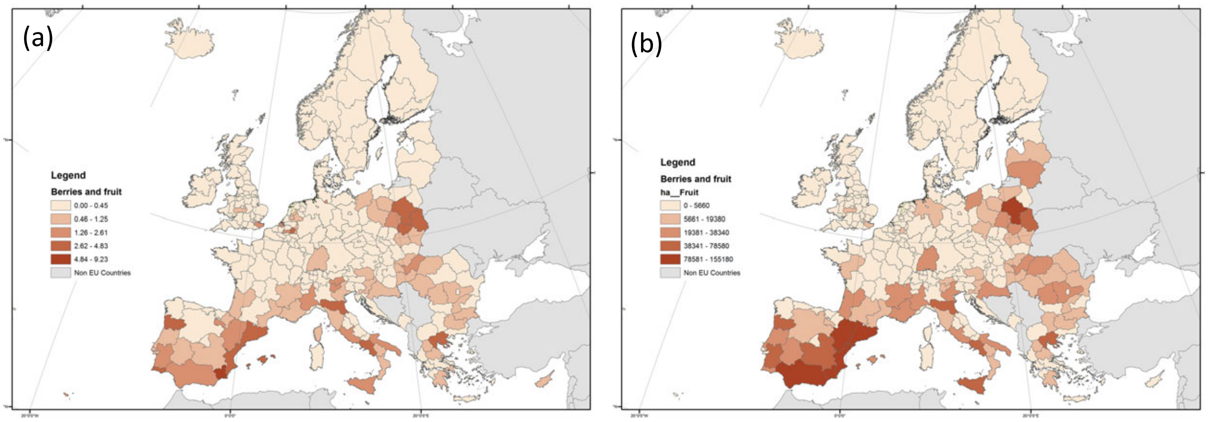
E.2. Host plants of *E. lewisi*

E.2.1. Commercial hosts

Commercial hosts on which *E. lewisi* has been reported causing damage in third countries are grown in a variety of managed systems across the EU, e.g. poinsettia in glasshouses across the EU; strawberry in both protected cultivation and field grown across the EU; raspberry field grown in central and northern EU; orange, lemon, peach and grapevine fields grown mainly in southern Europe.

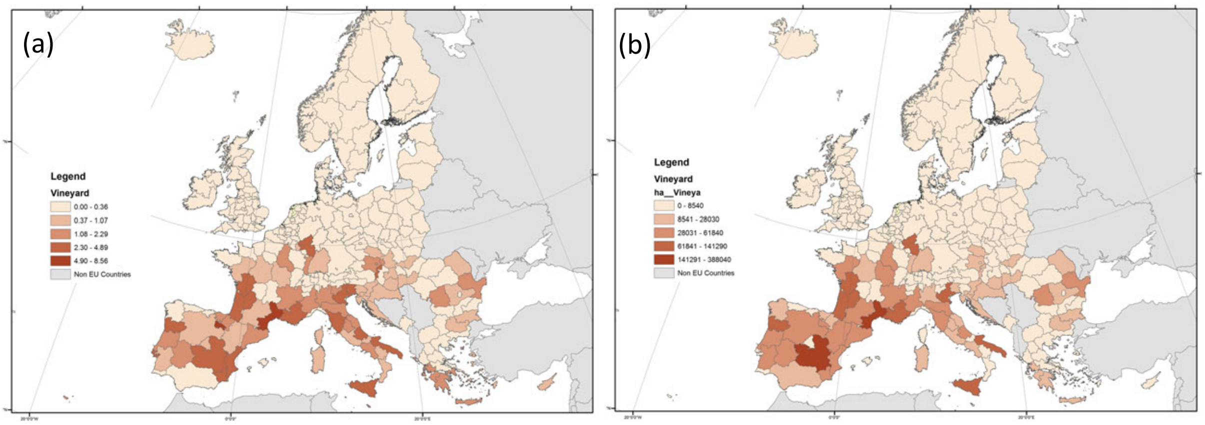
Regarding fruit and berry production in the EU in 2012, Figure E.5 shows the proportion of the NUTS 2 areas occupied for this production and indicates that it is most concentrated in southern EU.

Similarly maps are also presented for EU areas growing vineyards (Figure E.6) and citrus (Figure E.7).



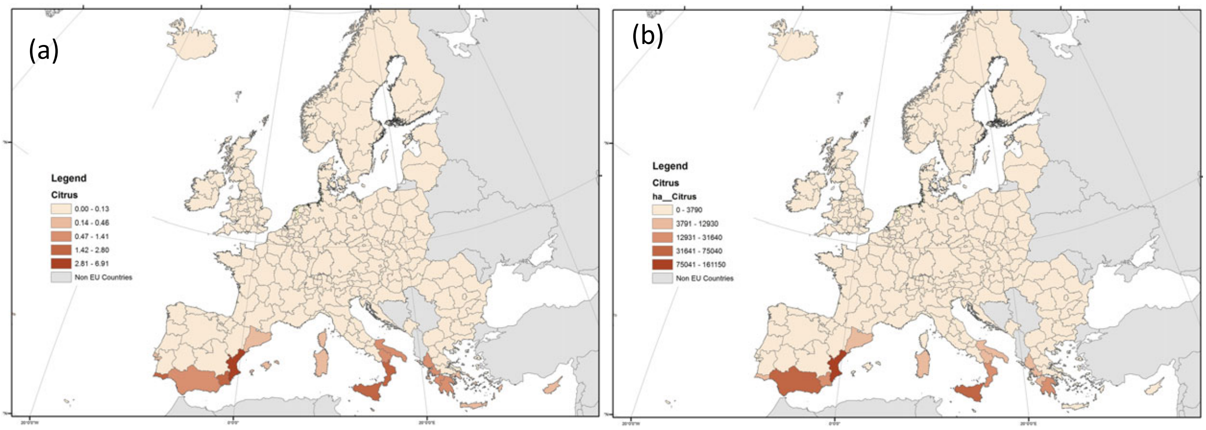
Data source: EUROSTAT 2013.

Figure E.5: EU fruit and berry production: (a) Area of as a percentage of NUTS 2 land area. Darkest shade indicates more than 2% of NUTS 2 region is used for fruit and berry production. (b) Total area of fruit and berry production (in ha) per NUTS 2 area



Data source: EUROSTAT 2013.

Figure E.6: EU grapevine production: (a) Area of vineyards as a percentage of NUTS 2 land area. Darkest shade indicates more than 2% of NUTS 2 region is used for vineyards. (b) Total area of vineyards (in ha) per NUTS 2 area



Data source: EUROSTAT 2013.

Figure E.7: EU Citrus growing areas in 2012: (a) Area of Citrus as a percentage of NUTS 2 land area. Darkest shade indicates more than 2% of NUTS 2 region is used for Citrus production. (b) Total area of Citrus production (in ha) per NUTS 2 area

The Panel concludes that taking into account the many other wild plants on which *E. lewisi* has been reported and which commonly occur in the EU, host plants can be considered widely available within the EU.

E.2.2. Transfer onto hosts

In comparison to many insects, mites disperse more poorly; success depends on the number of dispersing individuals and successful colonisation of a host requires the production of a large number of colonisers (Kennedy and Smitley, 1985). However, being inconspicuous organisms, mites are prone to disperse assisted by human activities. Only plants that have low numbers of mites on them which escape detection are assumed to exit from an infested nursery.

The majority of poinsettia plants are marketed in a short period before Christmas and will be kept indoors. If disposed off outdoors after Christmas, in northern Europe individuals of the mite *E. lewisi* are not expected to survive.

E.2.3. Competition from other mites

In California, *T. urticae* is the common mite pest of strawberries (Oatman, 1971; Oatman et al., 1982). Howell and Daugovish (2013) conducted laboratory trials showing *T. urticae* populations beginning to displace *E. lewisi* populations when both mites were originally on the same strawberry leaf. *T. urticae* occurs widely in Europe (Migeon and Dorkeld, 2006–2017) and could therefore potentially inhibit the establishment of *E. lewisi.*

E.2.4. Host cultivation

E. lewisi was noted as a pest of strawberry in the USA within organic production (Howell and Daugovish, 2013). Conventional crop management is assumed to contribute to suppression of the mite. Conventional crop husbandry practices and use of pesticides is assumed to inhibit establishment of *E. lewisi*.

Appendix F – Outcome of the model for spread of the Lewis spider mite in the EU

F.1. Conceptual model for spread

The dispersal of the mite under scrutiny is assessed using a spread model that takes into account the 10-year time horizon considered within this assessment. The objective of the assessment of the spread is to estimate the number of spatial units likely to be occupied by the pest at the time horizon. Two components of spread can be distinguished, the long-distance dispersal and the short distance dispersal. The dispersal strategies can be described using complex mathematical models integrating the contribution of both continuous dispersal and long distance dispersal (Shigesada et al., 1995). In this scientific opinion, the Panel used a simplified approach for the spread assessment. Like other mites, the natural dispersal of *E. lewisi* is slow and the detailed process of local spread and population increase within each spatial unit is not quantitatively assessed. The Panel considers mainly the long-distance dispersal that essentially depends on human-assisted spread (e.g. trade of the host plants or parts of them, movement of machinery, conveyances, hitch-hiking, wood packaging material) as responsible for the colonisation of territory across the whole area of the EU. The Panel assessed the spread running a logistic growth model.

Given the low number of populations that are likely to establish from the various pathways considered, it is assumed that establishment is a rare even and that there will be no aggregation. Thus, each population is assumed to establish in a different NUTS 2 region. From the initial number of NUTS 2 regions that an individual founder population occupies, the spread to other NUTS 2 regions is assumed to follow a logistic growth; the carrying capacity is the number of NUTS 2 regions potentially suitable for establishment. The extent of pest spread up to the time horizon of the assessment of 10 years is the sum of the number of NUTS 2 regions initially occupied by founder populations (one NUTS 2 region per founder population) plus the number of regions newly occupied each year up to the time horizon for the assessment (Figure F.1).

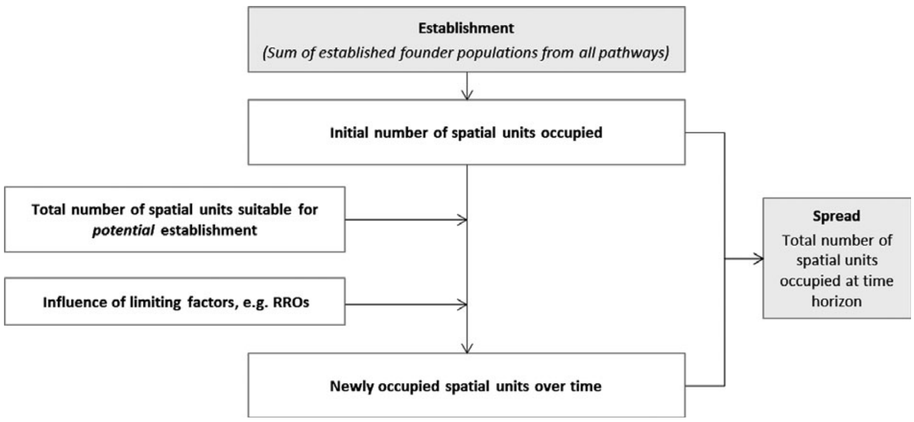


Figure F.1: Conceptual model for spread of *Eotetranychus lewisi* in the EU

F.2. Formal model for spread

A logistic equation was used to model potential spread of *E. lewisi* over a period of 10 years.

$$\mu = e^{r+\frac{\epsilon}{K}} = \lambda \times e^{\epsilon/K} \quad \text{and} \quad r = \ln(\lambda).$$

The spread equation has two meta-parameters μ and *r* that are automatically calculated from previously defined parameters.

λ is the yearly multiplication factor that describes the increase of the number of spatial units occupied by the pest.

$\lambda = 1.13$

λ was estimated by considering the rate that three other mites recently spread following introduction into the EU. The mites were *Tetranychus evansi,* detected in the late 1990s, *Eutetranychus orientalis* and *Eutetranychus banksi*, both detected in the early 2000s (Navajas et al., 2014).

ϵ is the rate at which new populations establish expressed in NUTS regions per year and is derived from the establishment model.

K is the carrying capacity, expressed as the maximum number of NUTS regions that can be colonised (due to presence of hosts or host habitat and suitability of climate).

K = 276

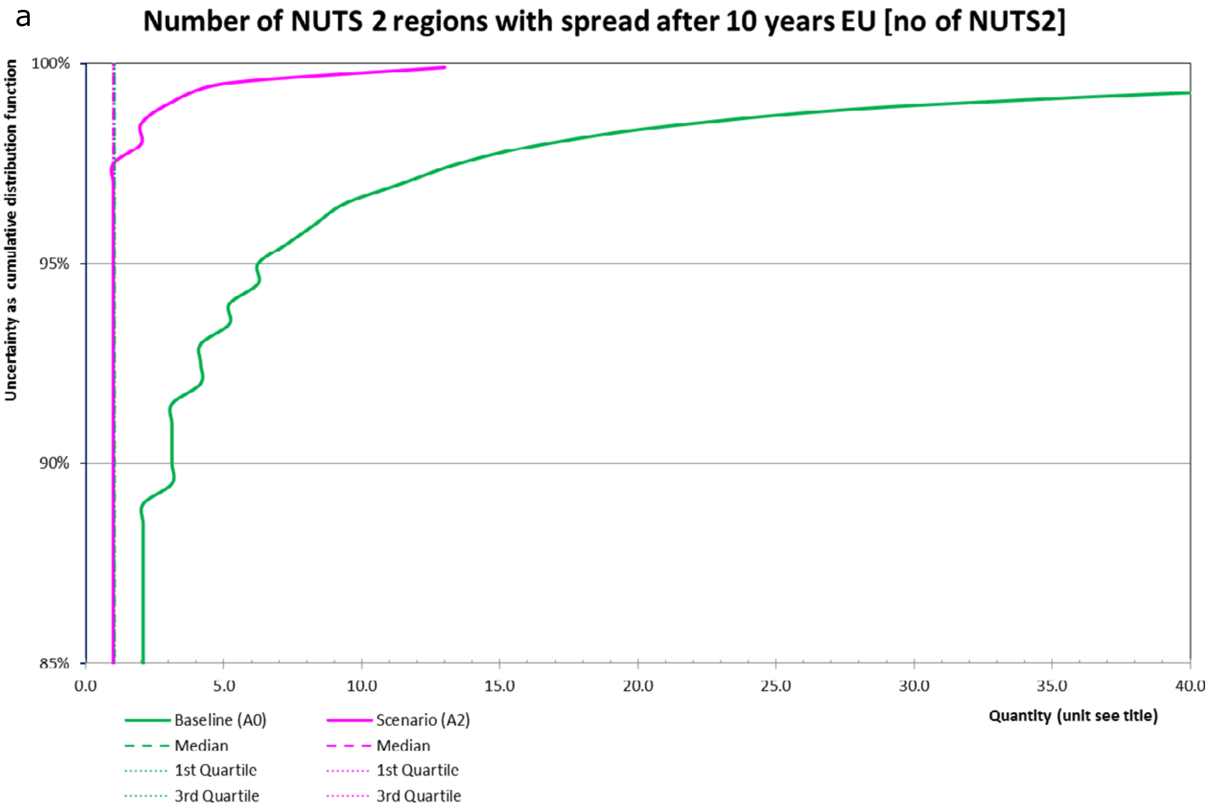
F.3. Results of the assessment of the spread of *E. lewisi*

F.3.1. Results of the modelling

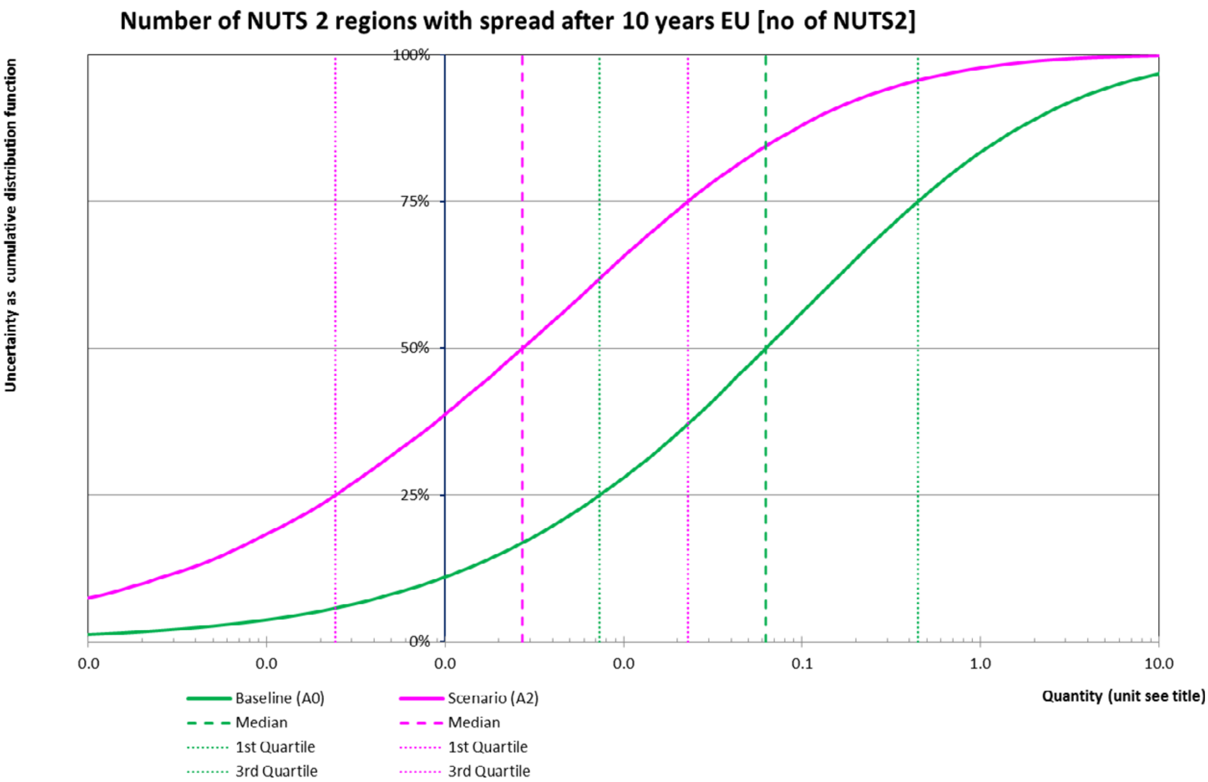
Table F.1: Computed distribution of the estimated spread of the Lewis spider mite in Number of NUTS 2 regions with established populations under scenario A0 and scenario A2

Quantile (percentile)	*K*	λ	No of NUTS 2 areas infested	
			Scenario A0	Scenario A2
Lower (1%)	276	1.13	1	1
Q1 (25%)	276	1.13	1	1
Median (50%)	**276**	**1.13**	**1**	**1**
Q3 (75%)	276	1.13	1	1
Upper (99%)	276	1.13	30	3

a



b



a: Discrete distribution b: cumulative distribution

Figure F.2: Distribution of the estimated spread of the Lewis spider mite in number of NUTS 2 regions with established populations for scenario A0 and scenario A2

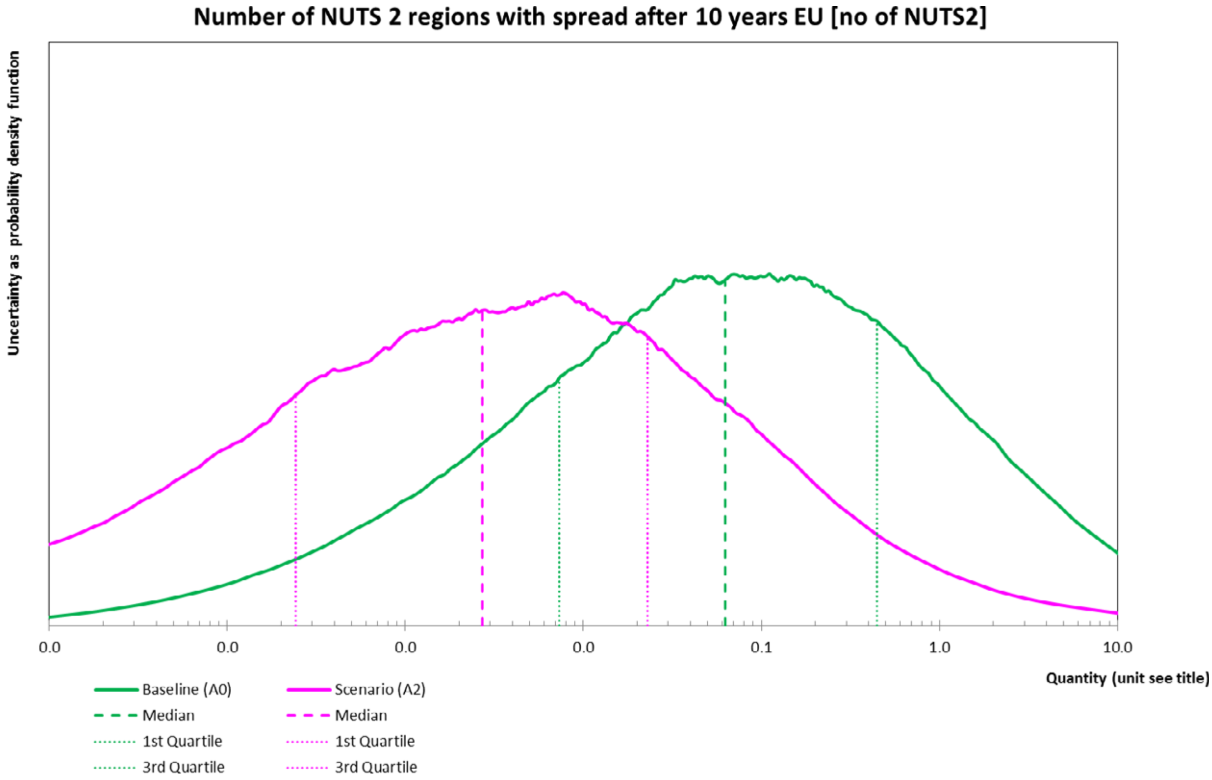


Figure F.3: Probability density function of the estimated spread of the Lewis spider mite in number of NUTS 2 regions with established populations for scenario A0 and scenario A2

F.3.2. Panel interpretation

Three of the four pathways considered (citrus fruits, raspberry plants for planting and strawberry plants for planting) are highly unlikely to lead to the introduction of a population of *E. lewisi* in the next 10 years. The pathway most likely to introduce *E. lewisi* into the EU is poinsettia plants for planting.

The logistic growth/spread model suggests that at the time horizon a *E. lewisi* founder population has established in a NUTS 2 region of the EU and there is a 15% chance that it has spread to occupy more than one NUTS 2 region; hence, there is also a 85% likelihood that one NUTS 2 region is occupied. There is a 5% likelihood that *E. lewisi* would have spread to more than six NUTS 2 regions after 10 years (Figure F.4). It is extremely unlikely that *E. lewisi* would establish within 10 years in scenario A2 hence spread is also extremely unlikely.

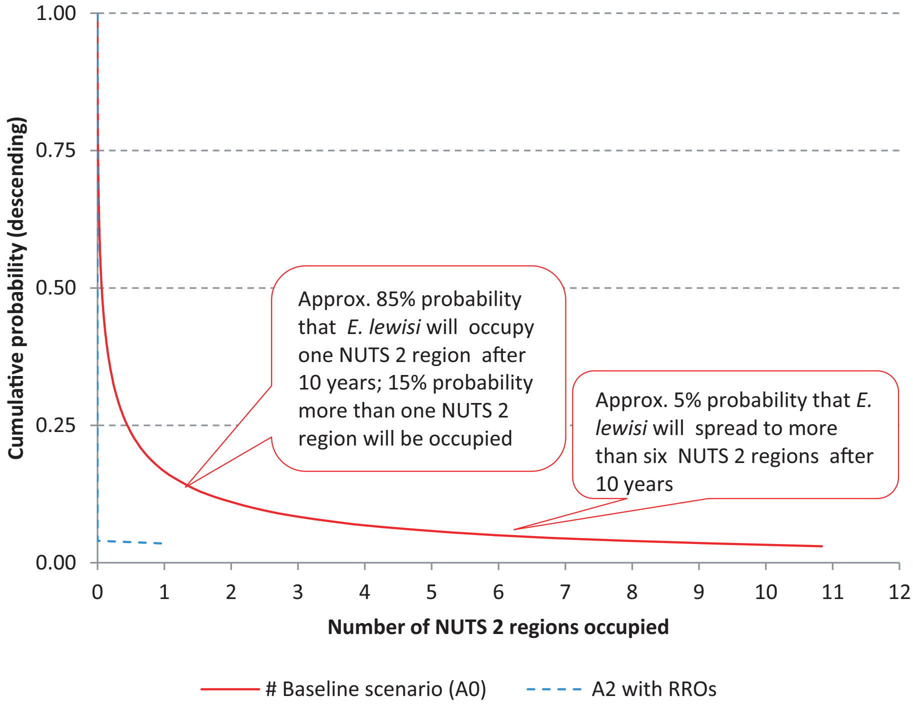


Figure F.4: Panel's expectation in terms of the descending cumulative likelihood of the number of NUTS 2 regions occupied by *E. lewisi* after 10 years

Appendix G – Systematic identification of the RROs for the scenarios of the risk assessment

G.1. Scenarios

The following scenarios for risk assessment were identified:

- **Scenario A0:** Current regulation in place: specific requirements laid down in Annex IIAI of Council Directive 2000/29/EC[3] for the pest (only for plants of the genera *Citrus*, *Fortunella* and *Poncirus*, and their hybrids, other than fruit and seeds) and host prohibitions according to Annex IIIA to Council Directive 2000/29/EC[3].

E. lewisi being a regulated quarantine pest, this scenario assumes that, when detected eradication measures would be implemented. This was the case when the mite was detected in the UK (EPPO, 2014) and Poland (Labanowski, 2009).

- **Scenario A1:** Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]) and in addition all imported host commodities should come from Pest Free Areas (PFA) in the country at origin (ISPM 4 (FAO, 1995)) and enforced measures on specific pathways.Same as scenario A0, scenario A1 assumes that *E. lewisi* is a regulated quarantine pest and if detected, would be subjected to eradication.

- **Scenario A2:** Current regulation in place without the *E. lewisi* specific requirements (Annex IIAI to Council Directive 2000/29/EC[3]) and in addition all imported host commodities should come from Pest Free Places of Production (PFPP)/Pest Free Production Sites (PFPS) in the country at origin (ISPM 10 (FAO, 1999)) enforced measures on specific pathways.

In Tables G.1 and G.2, the different RRO's pertaining to the above mentioned scenarios are presented.

G.2. RROs to prevent entry of *E. lewisi* in the EU

The measures applied at the place of production in the countries at origin to ensure a pest-free environment for each scenario are**:**

- **Scenario A0:** No specific measures.
- **Scenario A1:** *E. lewisi* host plant material (plants for planting and fruits) are imported from countries where *E. lewisi* is not known to occur. This scenario includes a prohibition for import from countries where this mite is known to occur. Supporting measures aimed at enforcement of the PFA for the country of origin in place.
- **Scenario A2:** Plants may be imported from countries where *E. lewisi* is known to occur. However, measures to ensure that the place of production is free of the pest must be put in place. These should include the establishment of buffer zones around the areas where plants for export to the EU are produced. Different RROs (see Table G.2) must be applied to reduce the likelihood that plants are infested and several supporting measures should be enforced to allow pest-freedom certification of the production.

The measures applied to the commodities reducing pest load after harvest and before entry into to the EU for each scenario are:

- **Scenario A0:** No specific measures are applied. However, good agricultural practices including cold storage and transport (plants for planting and citrus fruit), fruit washing and waxing (citrus fruit), and pesticide treatments (plants for planting and citrus fruit) may have an impact on the mite. Several supporting measures are applied to ensure the pest-free status of the commodity.
- **Scenario A1:** As plants are imported from countries where *E. lewisi* is not known to occur (PFA), no specific measures targeting *E. lewisi* in the commodity are applied. However, good agricultural practices including cold storage and transport (plants for planting and citrus fruit), fruit washing and waxing (citrus fruit), and pesticide treatments (plants for planting and citrus fruit) may have an impact on the mite in case it was there. Several supporting measures are applied to ensure the pest-free status of the commodity (e.g. inspection, laboratory testing).
- **Scenario A2:** As plants are imported from *E. lewisi*-free environments (PFPP and PFPS), no specific measures targeting *E. lewisi* in the commodity are applied. However, good agricultural

practices including cold storage and transport (plants for planting and citrus fruit), fruit washing and waxing (citrus fruit), and pesticide treatments (plants for planting and citrus fruit) may have an impact on the mite in case it was there. Several supporting measures are applied to ensure the pest-free status of the commodity (e.g. inspection, laboratory testing).

G.3. RROs preventing establishment of *E. lewisi* in the EU

Although no specific measures are applied currently to prevent pest establishment in the EU, the possible measures for all scenarios (A0, A1, A2) include the good agricultural practices including cold storage before planting (plants for planting), fruit grading and cold storage (citrus fruit), pesticide treatments (plants for planting and citrus fruit), or biological control (plants for planting) that may have an effect on the establishment of *E. lewisi*.

As *E. lewisi* is a regulated quarantine pest for the EU, if detected, eradication measures (including pesticide treatments, roguing, agricultural waste management) would be implemented. Several supporting measures (delimitation of buffer zones and surveillance) would be applied to ensure the containment of the pest within demarcated areas and monitoring the eradication success.

G.4. RROs preventing spread of *E. lewisi* in the EU

Although no specific measures are applied currently to prevent the spread of *E. lewisi* in the EU, the possible measures for all scenarios (A0, A1, A2) include good agricultural practices including cleaning, crop rotation, use of resistant cultivars, pruning, roguing, or biological control that may have an effect on the spread of *E. lewisi*.

As *E. lewisi* is a regulated quarantine pest for the EU, if detected, eradication and containment measures (including pesticide treatments, roguing, agricultural waste management) would be implemented. Several supporting measures (delimitation of buffer zones and surveillance) would be applied to ensure the containment of the pest within demarcated areas and monitoring the eradication success.

G.5. RROs reducing impacts of *E. lewisi* in the EU

Although no specific measures are applied currently to reduce impact of *E. lewisi* in the EU, the possible measures for all scenarios (A0, A1, A2) include good agricultural practices including pesticide treatments, biological control, crop rotations, or use of resistant cultivars that may have an effect on the impact caused by *E. lewisi*.

Table G.1: First identification of RROs for the three scenarios of the risk assessment

RA step			ENTRY	ESTABLISHMENT	SPREAD	IMPACT
Control measures						
1.01	Growing plants in isolation	Description of possible exclusion conditions that could be implemented to isolate the crop from pests and if applicable relevant vectors. E.g. a dedicated structure such as glass or plastic greenhouses	A2 (at origin)			
1.02	Timing of planting and harvesting	The objective is to produce phenological asynchrony in pest/crop interactions by acting on or benefiting from specific cropping factors such as: cultivars, climatic conditions, timing of the sowing or planting, and level of maturity/age of the plant seasonal timing of planting and harvesting				
1.03	Chemical treatments on crops including reproductive material		A2 (in the buffer zone (BZ) and on the plant propagating material entering the PFPP	A2 (in combination with roguing)*		A0, A1 & A2 as chemical control may be applied to other pests, mostly *T. urticae*
1.04	Chemical treatments on consignments or during processing	Use of chemical compounds that may be applied to plants or to plant products after harvest, during process or packaging operations and storage. The treatments addressed in this fiche are: (a) fumigation; (b) spraying/dipping pesticides; (c) surface disinfectants; (d) process additives; (e) protective compounds	A2 (in the BZ and on the plant propagating material entering the PFPP)			
1.05	Cleaning and disinfection of facilities, tools and machinery	The physical and chemical cleaning and disinfection of facilities, tools, machinery, transport means, facilities and other accessories (e.g. boxes, pots, pallets, palox, supports, hand tools) . The measures addressed in this fiche are: washing, sweeping and fumigation	A2 (at origin)			
1.06	Soil treatment	The control of soil organisms by chemical and physical methods listed below: (a) fumigation; (b) heating; (c) solarisation; (d) flooding; (e) soil suppression; (f) augmentative biological control; (g) biofumigation				
1.07	Use of non-contaminated water	Chemical and physical treatment of water to eliminate waterborne microorganisms. The measures addressed in this fiche are: chemical treatments (e.g. chlorine, chlorine dioxide, ozone); physical treatments (e.g. membrane filters, ultraviolet radiation, heat); ecological treatments (e.g. slow sand filtration)				
1.08	Physical treatments on consignments or during processing	This fiche deals with the following categories of physical treatments: irradiation /ionisation; mechanical cleaning (brushing, washing); sorting and grading, and; removal of plant parts (e.g. debarking wood). This fiche does not address: heat and cold treatment (fiche 1.14); roguing and pruning (fiche 1.12)	A2 (at origin)			
1.09	Controlled atmosphere	Treatment of plants by storage in a modified atmosphere (including modified humidity, O_2, CO_2, temperature, pressure)				
1.10	Waste management	Treatment of the waste (deep burial, composting, incineration, chipping, production of bio-energy, etc.) in authorised facilities and official restriction on the movement of waste	A2 (at origin)			
1.11	Use of resistant and tolerant plant species/varieties	Resistant plants are used to restrict the growth and development of a specified pest and/or the damage they cause when compared to susceptible plant varieties under similar environmental conditions and pest pressure It is important to distinguish resistant from tolerant species/varieties	A2 (use of cold-tolerant cultivars, as this could make conditions during transport less favourable for the mite)	A0 & A2 (use of cold-tolerant cultivars could make establishment less likely in areas of Europe where winter temperatures fall below threshold)		A0, A1, A2 (use of cold-tolerant cultivars may decrease symptom expression as mite densities will be lower)
1.12	Roguing and Pruning	Roguing is defined as the removal of infested plants and/or uninfested host plants in a delimited area, whereas pruning is defined as the removal of infested plant parts only without affecting the viability of the plant	A2 (in the BZ)	A2 (in combination with chemical treatments)*		
1.13	Crop rotation, associations and density, weed/volunteer control	Crop rotation, associations and density, weed/volunteer control are used to prevent problems related to pests and are usually applied in various combinations to make the habitat less favourable for pests The measures deal with (1) allocation of crops to field (over time and space) (multicrop, diversity cropping) and (2) to control weeds and volunteers as hosts of pests/vectors				
1.14	Heat and cold treatments	Controlled temperature treatments aimed to kill or inactivate pests without causing any unacceptable prejudice to the treated material itself. The measures addressed in this fiche are: autoclaving; steam; hot water; hot air; cold treatment				
1.15	Conditions of transport	Specific requirements for mode and timing of transport of commodities to prevent escape of the pest and/or contamination. a) physical protection of consignment b) timing of transport/trade	A2 (to prevent/limit infestation of the consignment)			
1.16	Biological control and behavioural manipulation	Other pest control techniques not covered by 1.03 and 1.13 a) Biological control b) Sterile Insect Technique (SIT) c) Mating disruption d) Mass trapping				A0, A1 & A2 as biological control may be applied to other target pests, mostly *T. urticae* , which can feed also on *E. lewisi*
1.17	Post-entry quarantine and other restrictions of movement in the importing country	This fiche covers post-entry quarantine (PEQ) of relevant commodities; temporal, spatial and end-use restrictions in the importing country for import of relevant commodities; prohibition of import of relevant commodities into the domestic country 'Relevant commodities' are plants, plant parts and other materials that may carry pests, either as infection, infestation or contamination	A1 (prohibition of poinsettia from countries/areas where the pest occurs)			

RA step			ENTRY	ESTABLISHMENT	SPREAD	IMPACT
Supporting measures						
2.01	Inspection and trapping	Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5) The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques	A0, A1 & A2 (in combination with lab testing)			
2.02	Laboratory testing	Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests	A0, A1 & A2 (following positive results from inspection to confirm pest identity)			
2.03	Sampling	According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing For inspection, testing and/or surveillance purposes the sample may be taken according to a statistically based or a non-statistical sampling methodology	A0, A1 & A2 (a prerequisite for inspection, lab testing and surveillance)			
2.04	Phytosanitary certificates and plant passport	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade)	A0, A1 & A2 (Phytosanitary certificates)			
2.05	Certified and approved premises	Mandatory/voluntary certification/approval of premises is a process including a set of procedures and of actions implemented by producers, conditioners and traders contributing to ensure the phytosanitary compliance of consignments. It can be a part of a larger system maintained by the NPPO in order to guarantee the fulfilment of plant health requirements of plants and plant products intended for trade. Key property of certified or approved premises is the traceability of activities and tasks (and their components) inherent the pursued phytosanitary objective. Traceability aims to provide access to all trustful pieces of information that may help to prove the compliance of consignments with phytosanitary requirements of importing countries	A2 (at origin)			
2.06	Certification of reproductive material (voluntary /official)	See ex Pest free Plant for planting: Focus on commodity type allowed in trade ? Delete? This is a strategy covered by measures for pest free production place or consignment To merge with certification schemes????	A2 (at origin)			
2.07	Delimitation of buffer zones	ISPM 5 defines a buffer zone as 'an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimize the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate' (ISPM 5). The objectives for delimiting a buffer zone can be to prevent spread from the outbreak area and to maintain a pest free production place (PFPP), site (PFPS) or area (PFA)	A2 (at origin)	A2*	A2*	
2.08	Surveillance	To be elaborated	A0, A1 & A2	A2*	A2*	

*: enforced measures in case of incidental finding of *E. lewisi* in EU

A0 : Current regulations in place =>	Current regulation in place: specific requirements according to Annex IIAI to CD 2000/29 EC for the pest (only for plants of the genera *Citrus* , *Fortunella* and *Poncirus,* and their hybrids, other than fruit and seeds) and host prohibitions according to Annex IIIA to Council Directive 2000/29 EC. This scenario assumes that as a regulated quarantine pest, in case that *E. lewisi* is detected, eradication measures would be implemented. This was the case when this mite was detected in the UK and Poland.	
A1: A0 + PFA =>	Current regulation without specific requirements (Annex IIAI to Council Directive 2000/29 EC) and in addition, all imported host commodities should come from Pest Free Areas (PFA) in the country at origin (ISPM 4 (FAO, 1995)) and enforced measures on specific pathways. Same as scenario A0, A1 assumes that *E. lewisi* is a regulated quarantine pest and if detected, would be subjected to eradication.	
A2: A0 + PFPP =>	Current regulation without specific requirements (Annex IIAI to Council Directive 2000/29 EC) and in addition all imported host commodities should come from Pest Free Places of Production (PFPP)/Pest Free Production Sites (PFPS) in the country at origin (ISPM 10 (FAO, 1999)) enforced measures on specific pathways. Same as previous scenarios, A2 assumes that *E. lewisi* is a regulated quarantine pest and if detected, would be subjected to eradication.	

Table G.2: Detailed identification of RROs for the three scenarios of the risk assessment

LEGEND	
	In blue: measures pertaining to A1 scenario
	In green: measures pertaining to A2 scenario
	in yellow: common measures to all scenarios (A0, A1, A2)

RA step		ENTRY								ESTABLISHMENT				SPREAD			IMPACT					
Fiches		Pest free environment before production of commodity			Pest Free Commodity					Delimitation of infested regions												Delimitation of pest free regions
		Pest Free Area (ISPM 4)	Pest Free Place of Prod (ISPM 10)	Pest Free Prod. Site (ISPM 10)	Pest Free crop	Pest Free consignment	Transport	Entry	Transfer	Influence of host plants	Influence of pest biology	Influence of vector	Influence of environment	Human assisted	Vector spread	Natural spread	Pest abundance	Crop production	Crop quality	Ecosystem services	Biodiversity	Protected zone
Control measures																						
1.01	Growing plants in isolation	A1	A2 (including the establishment of buffer zones, if necessary). See ISPM 36 for pest management programme for P4P										A0, A1, A2 (glasshouse cultivation of poinsettia and other potential hosts in northern Europe as well as production of strawberry P4P could result in transient establishment during the summer)									
1.02	Timing of planting and harvesting																					
1.03	Chemical treatments on crops including reproductive material		A2 (applied to buffer zones and P4P entering the PFPP)								A0, A1, A2 eradication measures in case of mite detection)						A0, A1, A2 (treatments applied to control other pests , especially spider mites, would have an effect on *E. lewisi* densities)	A0, A1, A2 (pesticides reducing mite densities may in turn reduce yield losses)	A0, A1, A2 (pesticides reducing mite densities would in turn reduce damage)	A0, A1, A2 (pesticides may affect biological control and pollination services)	A0, A1, A2 (pesticides may reduce biodiversity of non-target species)	
1.04	Chemical treatments on consignments or during processing		A2 (applied to buffer zones and P4P entering the PFPP)			A0, A1, A2 (pesticide applications to poinsettia and strawberry P4P and to citrus fruit)																
1.05	Cleaning and disinfection of facilities, tools and machinery		A2								A0, A1, A2			A0, A1, A2								
1.06	Soil treatment																					
1.07	Use of non-contaminated water																					
1.08	Physical treatments on consignments or during processing		A2			A0, A1, A2 (washing and waxing of citrus fruit)					A0, A1, A2											

RA step		ENTRY								ESTABLISHMENT				SPREAD			IMPACT					
Fiches		Pest free environment before production of commodity			Pest Free Commodity					Delimitation of infested regions												Delimitation of pest free regions
		Pest Free Area (ISPM 4)	Pest Free Place of Prod (ISPM 10)	Pest Free Prod. Site (ISPM 10)	Pest Free crop	Pest Free consignment	Transport	Entry	Transfer	Influence of host plants	Influence of pest biology	Influence of vector	Influence of environment	Human assisted	Vector spread	Natural spread	Pest abundance	Crop production	Crop quality	Ecosystem services	Biodiversity	Protected zone
Control measures																						
1.09	Controlled atmosphere																					
1.10	Waste management		A2								A0, A1, A2											
1.11	Use of resistant and tolerant plant species/varieties		A2 (use of cold-tolerant cultivars would be less favourable for mites to develop and reproduce)								A0, A1, A2 (use of poinsettia cold-tolerant cultivars would make establishment less likely as temperatures in the glasshouse would be less favourable for mites to develop and reproduce)						A0, A1, A2 (use of poinsettia cold-tolerant cultivars would probably reduce pest density)		A0, A1, A2 (as use of poinsettia cold-tolerant cultivars would result in lower mite densities, this would in turn result in less cosmetic damage to the crop)			
1.12	Roguing and Pruning		A2 (used in combination with chemical control if needed in the buffer zone)							A0, A1, A2 (eradication measures in case of mite detection)	A0, A1, A2			A0, A1, A2		A0, A1, A2						
1.13	Crop rotation, associations and density, weed/volunteer control									A0, A1, A2	A0, A1, A2			A0, A1, A2		A0, A1, A2						
1.14	Heat and cold treatments						A0, A1, A2 (cold treatment applied to *Rubus* and *Fragaria* P4P (-1.5ºC) and to citrus fruit (2ºC)															
1.15	Conditions of transport						A0, A1, A2 (boxes, sleeves and other packaging material limiting the possible spread of the mite within the consignment)															
1.16	Biological control and behavioural manipulation										A0, A1, A2					A0, A1, A2 (naturally occurring Phytoseiidae and other spider mites predators could limit spread)	A0, A1, A2 (predators of other spider mites occurring on hosts can also feed on *E. lewisi*)	A0, A1, A2 (predators of other spider mites occurring on hosts can also feed on *E. lewisi*)	A0, A1, A2 (biological control resulting in lower mite populations would in turn result in less damage)			
1.17	Post-entry quarantine and other restrictions of movement	A1 (prohibition of import from countries where pest is present)																				

	RA step	ENTRY								ESTABLISHMENT				SPREAD			IMPACT					
Fiches		Pest free environment before production of commodity			Pest Free Commodity					Delimitation of infested regions												Delimitation of pest free regions
		Pest Free Area (ISPM 4)	Pest Free Place of Prod (ISPM 10)	Pest Free Prod. Site (ISPM 10)	Pest Free crop	Pest Free consignment	Transport	Entry	Transfer	Influence of host plants	Influence of pest biology	Influence of vector	Influence of environment	Human assisted	Vector spread	Natural spread	Pest abundance	Crop production	Crop quality	Ecosystem services	Biodiversity	Protected zone
Supporting measures																						
2.01	Inspection and trapping	A1 (routine monitoring, inspection of exported consignments)	A2 (routine monitoring and inspection of exported consignments)			A0, A1, A2		A0, A1, A2														
2.02	Laboratory testing	A1	A2			A0, A1, A2		A0, A1, A2														
2.03	Sampling	A1	A2			A0, A1, A2		A0, A1, A2														
2.04	Phytosanitary certificates and plant passport	A1	A2			A0, A1, A2		A0, A1, A2														
2.05	Certified and approved premises		A2																			
2.06	Certification of reproductive material (voluntary/official)		A2																			
2.07	Delimitation of buffer zones		A2										A0, A1, A2 eradication measures in case of mite detection)									
2.08	Surveillance	A1 (general surveillance)	A2										A0, A1, A2 eradication measures in case of mite detection)									