

Annex A –PROMETHEUS Protocol: supporting the pest risk assessment of *Eotetranychus lewisii* for the EU territory

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Annex to:

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Caffier D, Candresse T, Chatzivassiliou E, Dehnen-Schmutz K, Gilioli G, Gregoire J-C, Jaques Miret JA, MacLeod A, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van Der Werf W, West J, Winter S, Bergeretti F, Bjorklund N, Mosbach-Schulz O, Vos S and Navajas Navarro M, 2017. Scientific Opinion on the pest risk assessment of *Eotetranychus lewisii* for the EU territory. EFSA Journal 2017; 15(10):4878, 122 pp. <https://doi.org/10.2903/j.efsa.2017.4878>

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1. Introduction

1.1. Background

In 2014, the Panel on Plant Health performed a pest categorisation of the Lewis spider mite, *Eotetranychus lewisi* for the European Union (EU) (EFSA PLH Panel, 2014a). The Lewis spider mite is a well-defined and 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/EC². 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 regards 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, whilst 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/EC² – 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 *Eotetranychus lewisi*.

In 2015 the European Commission requested EFSA to further elaborate on the risk assessment of *Eotetranychus lewisi* for the EU territory providing EFSA with the above mentioned recommendations.

1.2. Terms of Reference

EFSA is requested, pursuant to Article 22(5.b) and Article 29(1) of Regulation (EC) No 178/2002¹, 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.

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

Recommendation of the Working Group³ on the Annexes of the Council Directive 2000/29/EC² – Section II – Listing of Harmful Organisms as regards the future listing of *Eotetranychus lewisii* (McGregor)

Based on the pest categorisation prepared by EFSA, *E. lewisii* 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 EU, it has been found for example also on plants of *Corokia* *Cotoneaster* in 1999. The pathways of spreading are numerous.

The Working Group³ 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 Group³ above acknowledges the absence of data in this respect.

At the same time, the Working Group³ 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 IVAIL 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 or pest free place of production or site, or removal of diseased plants and appropriate treatments.

Lastly, the Working Group³ 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.

2. Problem formulation

The scope of this scientific opinion is to assess the risk posed to plant health in the EU territory of *E. lewisii*.

The pest distribution in the EU is currently restricted to Madeira Island in Portugal. The Panel first considers reasons why *E. lewisii* 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 pest risk assessment area.

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

² 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.

³ PAFF Committee Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms

2.1. Objectives of the assessment and sub-questions

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. lewisii*
 - Is *E. lewisii* currently present in Madeira?
 - What is the distribution of *E. lewisii* in the EU excluding Madeira?
 - What is the world distribution of *E. lewisii*?
2. Assess the potential impact of *E. lewisii* 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. lewisii* in the EU (excluding Madeira)
 - Which are the pathways that remain open for internal movement?

2.1.1. Pest Risk Assessment Area

In this scientific opinion, the pest risk assessment (PRA) area is defined as the area of application of Council Directive 2000/29/EC² 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.

2.1.2. Piloting exercise

The risk assessment will be performed considering two different pilot exercises:

- New method developed by the Plant Health Panel to perform quantitative pest risk assessment in line with the EFSA Uncertainty guidance
- Prometheus case study

EFSA recommends that efforts should be made to work towards a more quantitative expression of both risk and uncertainty whenever possible (EFSA Scientific Committee, 2012): the probability expression of the negative effects together with their effect should be reported quantitatively.

The method used in this assessment seeks to address the call for increased quantitative reporting of risk. The first iteration of the method was applied to four case study pests (EFSA Panel on Plant Health 2016a,b,c,d). Feedback from users has been taken into

account to refine the method and the revised method is being used in a further series of tests on four more pilot case studies. This is one of these second phase pilot studies. Following feedback received from the second series of pilot case studies, 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.

This Annex A to the pest risk assessment of *E. lewisi* for the EU territory presents the preparatory work that was performed following the guiding principles and the stochastic model in a quantitative approach in the context of the EFSA risk assessment framework currently under development for Plant Health.

Moreover, this pest risk assessment is performed in accordance to the principles described in the EFSA PROMETHEUS⁴ (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. PROMETHEUS is an organisational development project aiming to further improve 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): the protocol for the risk assessment has been prepared and is presented in this Annex to the pest risk assessment of *Eotetranychus lewisi* for the EU territory.

3. Data and evidence retrieval

3.1. Literature and data collection

For the preparation and planning of the risk assessment, from the list of sub-question the ones for which it was considered feasible to plan and develop search strategies for performing systematic and/or extensive literature searches are the following:

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?

For each of the sub-questions mentioned above, three different types of information will be retrieved: (i) scientific literature through systematic consultation of the databases of peer reviewed literature; (ii) grey literature through the systematic consultation of web

⁴ European Food Safety A, 2015. Principles and process for dealing with data and evidence in scientific assessments. EFSA Journal 2015;13(6):4121

sites of institutions and through queries of online search engines; (iii) the literature reviewed by the Panel and referenced in the pest categorisation (EFSA PLH Panel, 2014a); (iv) scientific and grey literature identified through the consultation of experts in the field.

Different types of information will be consulted for addressing the above mentioned questions and respective sub-questions

3.1.1. Peer reviewed scientific literature

Due to the very small number articles found in the scientific literature on *E. lewisi* in the context of the extensive literature search performed in 2014 for preparing the pest categorisation of the mite (EFSA PLH Panel, 2014a), the search of the peer reviewed literature will be performed on the name of the organism only. This strategy will permit to include all articles related to the pest under scrutiny. Due to the low numbers hits expected it is considered feasible to systematically screen all the articles that will be identified for the different questions of this study.

- Type of studies to be used: primary and secondary studies.
- Inclusion criteria:
 - Language: English, Spanish, French, Portuguese.
 - Timespan: all available years
 - All the articles reporting on *E. lewisi* will be selected for further scrutiny specifically on any geographical information on location where is known to occur and on any information relevant for the pest host association and observed or potential impact the mite has or could cause
- Appraisal of the studies: the studies will be appraised using expert judgment. Non-reliable studies will be excluded and an explanation provided.
- Synthesis of the studies: A summary of the studies will be presented in tabular format providing an overview of:
 - the geographical location of the pest according to the pest reports;
 - the geographical distribution of the natural host species in the EU and their presence in Madeira.
- Sources of information to be consulted
 1. Databases
 - Regarding pest distribution and impact
 - CABI Distribution Map of Plant Pests⁵/EPPO global database⁶; key words: *Eotetranychus lewisi*
 - Montpellier spidermite web;
 - EPPO reporting services; key words: *Eotetranychus lewisi*
 - Regarding host occurrence in the EU
 - CORINE land cover⁷
 - LUCAS survey database⁸

⁵ <http://www.cabi.org/dmpp/>

⁶ <https://gd.eppo.int/>

⁷ <https://www.eea.europa.eu/publications/COR0-landcover>

- EUROSTAT⁹
- National landcover databases

2. Literature databases

An Extensive Literature search (ELS) will be performed on Web of Science™, Thomson Reuters 2016.

Table 1: scientific literature search on Web of Science™, Thomson Reuters 2016.

Information source	Coverage	Search string
Web of Science™ Core Collection	Since 1975	TS=(((eotetranychus OR tetranychus) AND lewisi) OR ("E lewisi")) OR TS=((Lewis AND "spider mite") OR "araña roja del duraznero")
BIOSIS Citation Index SM	Since 1926	
CABI : CAB Abstracts [®]	Since 1910	
Chinese Science Citation Database SM	Since 1989	
Current Contents Connect [®]	Since 1998	
Data Citation Index SM	Since 1900	
FSTA [®] - the food science resource	Since 1969	
KCI-Korean Journal Database	Since 1980	
MEDLINE [®]	Since 1950	
Russian Science Citation Index	Since 2005	
SciELO Citation Index	Since 1997	
Zoological Record [®]	Since 1864	

3.1.2. Grey literature

Table 2: Grey literature databases and search engines queried.

Information source	Interface	Search terms or strings
Google Scholar	https://scholar.google.com/ Publish or Perish software version 5.23.0 6142 ¹⁰ field "Any of the words"	"eotetranychus lewisi" OR (lewis AND "spider mite") OR ("arana" OR "araña") AND "roja del duraznero"
United States Department of Agriculture (US NAPPO)	http://www.usda.gov/wps/portal/usda/usdahome	search terms to be used: eotetranychus lewisi
United States Department of Agriculture Agricultural Research Service (USDA ARS research projects)	https://www.ars.usda.gov/research/projects/?q=&type=all	eotetranychus lewisi OR eotetranychus OR lewis OR spider mite
California Department of Food & Agriculture	https://www.cdfa.ca.gov/	eotetranychus lewisi OR eotetranychus
Canadian Food Inspection Agency (Canadian NPPO)	http://www.inspection.gc.ca/eng/1297964599443/1297965645317	eotetranychus
Phytosanitary Alert System of Nord America Plant Protection Organisation (NAPPO)	http://www.pestalert.org/main.cfm	eotetranychus
Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria de México (SENASICA)	http://www.senasica.gob.mx/	eotetranychus lewisi OR lewisi OR white mite OR acaró blanco OR araña cristalina OR Durazno OR viña
Chilean State Agricultural and Livestock Service (SAG)	http://www.sag.cl	eotetranychus lewisi OR lewisi OR white mite OR acaró blanco OR araña cristalina OR Durazno OR viña

⁸ <http://esdac.jrc.ec.europa.eu/projects/lucas>

⁹ <http://ec.europa.eu/eurostat>

¹⁰ Harzing, A.W. (2007) Publish or Perish, available from <http://www.harzing.com/pop.htm>

3.1.3. Pest categorisation of *E. lewisi* (EFSA PLH Panel, 2014a)

The relevant information provided in the previous Panel's opinion on the pest categorisation of *E. lewisi* for the EU (EFSA PLH Panel, 2014a) and not captured by the above listed literature searches, will be added to the information to be considered and assessed.

Moreover, the search results from the previous opinion on pest categorisation (EFSA PLH Panel; 2014a) will be compared to the current ones as a tool to check how the newly adjusted and developed literature searches performs.

This source of information will be used as well when dealing with the other questions addressed for this risk assessment, including the references found to be relevant for the pathways analysis including the movement of the relevant commodities into and within the EU, for the RRO identification, for the assessment of the environmental suitability and the potential consequences the pest could cause.

3.1.4. Consultation of experts

Information on impacts caused by *Eotetranychus lewisi* will be requested to the following networks and experts:

- PHRA listserv¹¹
- Acarology List¹²
- Anna Howell, Staff Research Associate at University of California Cooperative Extension Ventura County.
- European and Mediterranean Plant Protection Organization (EPPO/OEPP)
- Consultation of scientists¹³ in Canada about the possible pest presence and impact

3.1.5. Specific data collection

- With regards to the question: Is *E. lewisi* present in Madeira?

In addition to the above mentioned searches, local authorities and experts in Madeira will be consulted to obtain additional information about the mite presence in the island. Consultation of the Portuguese National Plant Protection Organisation with regards to the pest occurrence in Madeira.

- With regards to the question: What is the distribution of *E. lewisi* in the EU excluding Madeira?

In addition to the above mentioned searches, the preliminary results of the Member states surveying for *E. lewisi* will be provided to EFSA (final results would be available from April 2017);

¹¹ Plant Health Risk Assessment list server is an electronic mailing list software application. It was developed to allow discussion of issues related to PRA. It is managed as PHRA-L, hosted at PHRA-L@WWW.AGR.GC.CA. https://www.ippc.int/static/media/uploads/ippc-irss_diversion_from_intended_use.pdf

¹² http://www.nhm.ac.uk/hosted_sites/acarology/acarolist.html

¹³ Tracy Hueppelsheuser: entomologist, Plant and Animal Health Branch at the British Columbia Ministry of Agriculture

The IOBC bulletin (International Organisation for Biological and Integrated Control) will be checked systematically using the following keywords: "lewisi OR eotetranychus OR lewis"

- With regards to the questions: What is the host occurrence in Madeira? / What is the host occurrence in the EU excluding Madeira?

In addition to the above mentioned searches, regarding the movement and production of host plants in the EU the statistical yearbook from the International Association of Horticultural Producers¹⁴ (AIPH). Also previous EFSA work providing information on the occurrence of the hosts of interests will be consulted (e.g. EFSA PLH Panel, 2013; EFSA PLH Panel, 2014a; EFSA PLH Panel, 2014b). Moreover, if available, yearly agricultural statistics will be consulted for Madeira. In case sufficient information would not be found, Madeira agricultural services will be asked for information about the presence of such natural host species in the island.

- With regards to the questions: What is the trade activity and the main flows related to the hosts from Madeira to the rest of the EU and from third countries to the EU excluding Madeira?

For natural hosts, trade databases (EUROSTAT, ISEFOR and National authorities databases) will be consulted in order to collect information on trade data and flows of the natural hosts from Madeira to the rest of the EU and from third countries to the EU excluding Madeira. The natural host species will be classified using expert judgement as species of major and minor importance. The following criteria will guide the classification: estimation of the possible flow of mites, pathway, and impact of the pest on the particular species.

- With regards to the question: Explore reasons for a possible absence of *E. lewisi* in the EU (excluding Madeira)

The question will be addressed narratively following the oral agreement with the European Commission. Based on the results of the EU MS surveys on *E. lewisi* that will be provided to EFSA, if the pest seems to occur in continental Europe than this question will not be addressed. The narrative analysis will focus on the internal movement from Madeira to the rest of the EU for the relevant pathways.

- With regards to the other questions that might arise in the context of the risk assessment, in particular in relation with (i) Trade data and flows; (ii) Definition of pathways; (iii) Crop production cycles; (iv) Climate data; (v) RROs and more generally pest management on the plants/commodities including legislation and Certification schemes,

a broader and more flexible search strategy is needed and the relevant documents reporting information about the listed topics will be selected based on expert knowledge and judgement, in the course of the process of the risk assessment and on an ad-hoc bases. Relevant information sources for statistical data could include: NL import inspection data, EUROSTAT, TRADEMAP¹⁵, ISEFOR, AIPH statistical yearbook¹⁶, FloraHolland facts and figures 2014¹⁷, HorticultureGermany¹⁸, DGAGRI flowers and ornamental plants statistics¹⁹, Spanish Ministry of Agriculture and Rural Affairs²⁰. Also

¹⁴ AIPH statistical yearbook <http://aiph.org/statistical-yearbook/>

¹⁵ www.trademap.org

¹⁶ <http://aiph.org/statistical-yearbook/>

¹⁷ <https://www.royalfloraholland.com/media/3949227/Kengetallen-2014-Engels.pdf>

¹⁸ <http://www.bmel.de/SharedDocs/Downloads/EN/Publications/HorticultureGermany-Brochure.html>

¹⁹ https://ec.europa.eu/agriculture/sites/agriculture/files/fruit-and-vegetables/product-reports/flowers/statistics-2016_en.pdf

previous EFSA scientific opinion providing information on the occurrence of the hosts of interests could be relevant and used. In addition, experts could be consulted to gather data, papers or contacts. In this context a hearing expert Anna Howell has been involved in the risk assessment to address the questions listed in Appendix C.

3.2. Study selection and data extraction/article evaluation

The revision of the articles gathered through the extensive literature search is carried out in a two-steps process.

3.2.1. Screening of the articles

The aim of this first step is to exclude obviously irrelevant papers on the basis of the title and abstract only: if a reference appears to be relevant for the assessment, it will be subjected to the second step.

This process will be carried out in parallel by two reviewers (EFSA staff) for each single paper. In case of uncertainty or discrepancy between the two reviewers the article will proceed anyway to the next stage.

The reviewers will be asked for each paper if any information is reported on *Eotetranychus lewisii* with regards to:

- its geographical distribution OR
- its possible hosts species OR
- the other sections of the pest risk assessment:
 - (i) the entry and
 - (ii) establishment of the pest into the EU territory;
 - (iii) the spread of the mite within the EU, and;
 - (iv) potential consequences the mite could cause.

The following replies will be possible: Yes; No; Unclear.

3.2.2. Data extraction and appraisal

In the second step, each paper's relevance will be assessed on the basis of the full text.

This step will be carried out by one reviewer. The reviewer is a working group expert that has a good knowledge about the mite.

Using the DistillerSR software, the full texts of the references retained after the screening processed are necessary at this stage, and data will be extracted and categorised within pre-specified categories providing also a judgment on the reliability of the paper.

In certain cases there could be a delay between the moment a paper passes to the Data Extraction and Appraisal and the moment in which the WG is able to obtain the full text. In order to avoid any problem it is better for the experts to work only on the articles for which the full text is available. At the end of all the processes we will be able to identify all the articles for which the full text cannot be obtained in any way.

With regards to the questions on impact, in particular "What is the host range of the pest? / What is the host-pest association in the world?", the Experts will be requested their opinion on the possible host classification and impact of *E. lewisii* on the hosts identified, taking into consideration both primary and secondary studies.

For each study the host-pest association will be assessed in terms of the conditions of such association i.e. natural conditions; experimental conditions; uncertain.

²⁰ <http://www.mapama.gob.es/es/>

Moreover, for each study the impact of *E. lewisi* on the host plants will be classified in the following categories: Yes there is impact; No impact; Not mentioned in the paper; Unclear impact). In case the impact is classified as Yes or Unclear.

Further information on the type of impact should be provided in terms of: Yield loss; Quality loss; Trade loss; Effect ecosystem services & biodiversity; other effects.

Host species will be categorised in terms of their ability to support the pest multiplication (natural host or not). The following definition from Bernays and Chapman (1994) will guide the classification of the host species: "A host plant for a mite should only be a plant species where it can complete its development and reproduce under natural conditions. In the most evolved cases this involves the active location and selection of the plant by the mite, especially by the female to lay eggs, the overcome of the plant defences and profitable feeding by the immature stages, which can complete their development".

Appendix A presents the DistillerSR data extraction and appraisal form developed for questions related to the distribution of *E. lewisi* and to the potential impact of *E. lewisi* in the EU.

3.3. Planning the pest risk assessment

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

This opinion will use probability to express knowledge, belief and related uncertainty of experts about parameters in models for entry, establishment and spread. The outcomes of the models will be in the form of probability distributions of calculated measures of entry, establishment and spread. These distributions will reflect the Panel's expectation of the event under scrutiny and will be expressions of uncertainty of the calculated outcome variables. Both available data and expert judgement will be considered in the estimated distributions. Each distribution will be 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 will be made by stochastic simulation, whereby values are drawn randomly from the distribution specified for each parameter. The Monte Carlo simulations will be 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 @Risk software version 7.5.1 for this work.

In the model calculation, the contribution each model component to the overall uncertainty on the final result will be shown.

Regarding entry and establishment of *E. lewisi* in the EU territory, for each pathway a conceptual model has to be developed.

Regarding the spread of *E. lewisi* within the EU, a specific conceptual model will be developed.

Regarding the potential consequences the mite could cause in the EU, the ToR indicate to provide additional information if available compared to the analyses performed in the EFSA PLH Panel (2014a). Therefore the impact analyses will be a narrative assessment that will be substantiated by the information and data collected on *E. lewisi*.

3.3.1. Specification of the scenarios

The different scenarios assessed within the pest risk assessment were identified based on the interpretation of the Terms of Reference 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:

Scenario A0: Current regulation in place: specific requirements laid down in Annex IIAI of Council Directive 2000/29/EC² 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/EC².

Scenario A1: Current regulation in place without the *E. lewisii* specific requirements (Annex IIAI to Council Directive 2000/29/EC²) 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. lewisii* specific requirements (Annex IIAI to Council Directive 2000/29/EC²) 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.

3.3.1.1 Specification of the pathways

Within the pest categorisation of *E. lewisii* (EFSA PLH Panel, 2014a), the Panel provided a list of 69 plants species on which *E. lewisii* 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 seems to be the most likely pathway for introduction, this pathway includes both potted plants and cuttings.

E. lewisii 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. 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

Depending on the results of the analysis of the host-pest association and of the trade data other pathways might be explored.

3.3.1.2 Specification of different units used

Table 1 provides a summary of the units to be used for each risk assessment step. The choice of the units is 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	N° infested packs imported per year			N° of infested fruits per year
Units for Establishment	N° of infested glasshouses with at least 1 established population	N° of infested ha with at least 1 established population		
Units for Spread	N° of newly infested NUTS2 areas for 10 years			
Units for Impact	Yield losses on host crops			
Production unit	N° potted plants per ha	N° plants per ha	N° plants per ha	tons per ha
Time Step	<u>1 year</u> : Taking into account the yearly seasonality of host crops the time step is set to 1 year.			
Time horizon	<u>10 years</u> : A substantial amount of trade data for the EU is available since 2004 when 10 countries joined the EU to enlarge the EU from EU15 to EU25. This would allow project forward the model results by the same time. Considering the geographical area, the availability of information and the upcoming new legislative framework in plant health the time horizon is 10 years.			
Spatial resolution	1 hectare/NUTS 2 level			

4. Risk assessment

4.1. Risk assessment framework

Figure 1 summarises the framework to be followed when performing the risk assessment for the different scenarios

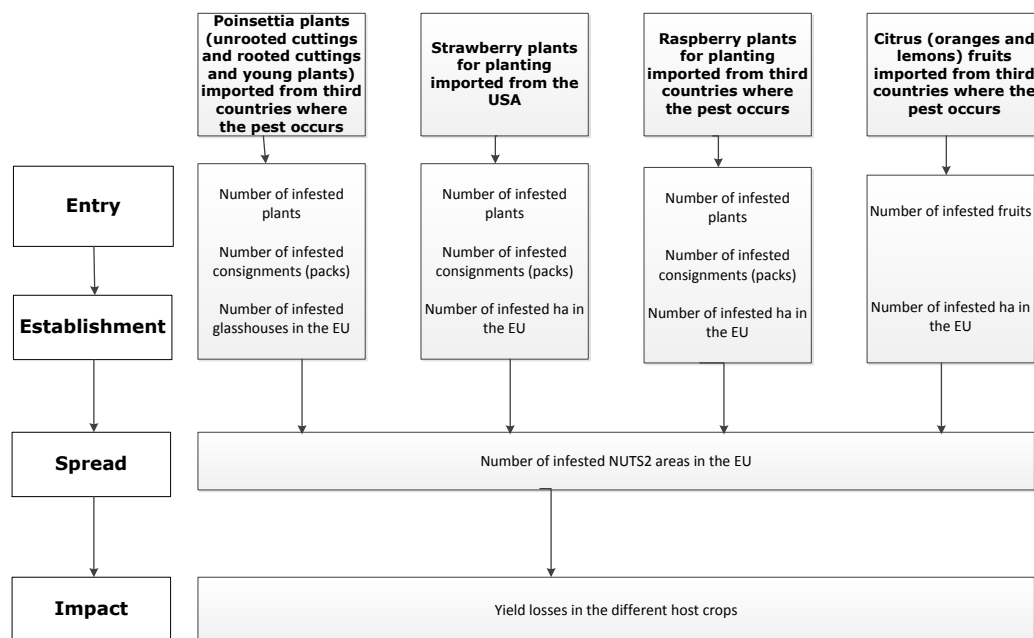


Figure 1: Risk assessment framework developed for assessing the risk posed by *E. lewisi* to the EU territory under different scenarios

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).

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.

The level of detail of the assessment will vary depending on the pathway being modelled and the data available. If needed, informal expert elicitation will be used.

4.2. Sub steps of the risk assessment

For the design and development of the conceptual models of the different steps of the risk assessment, the production and trade processes of the commodities need to be described in terms of processes and critical points (see table below). The critical points being the check points along the pathway where the commodities could undergo plant health controls for pest freedom and where pest abundance could be measured. In particular, the measurement of the effectiveness of the RROs in terms of estimated pest abundance could take place on these critical points.

The critical points of the process of a commodity along the pathways could include for Entry:

Table 2: Example of processes and corresponding critical points for the Entry step of the risk assessment

Process	Critical points
Ensuring a pest free environment	Start of the production cycle
Production of the commodity	Harvest of the commodity
Preparation of the consignments (packing, grading, culling)	Prepared consignment
Export certification	Immediately prior to export
Transport	Multiple points where relevant
Storage	
Import inspection	Immediately prior to customs clearance
Movement to final destination (end use of the commodity)	Destination (glass house, open field, retailer, final consumer)

The Panel recommends schematizing this information that should facilitate the development of the conceptual models.

The Panel recommends to keep the description of the processes as simple as possible as the level of resolution of the models is related to the complexity of the processes and the number corresponding critical points.

4.3. Identification of relevant RROs

The applicable risk reduction options will be systematically identified and their point of application in the process will be indicated using the tools prepared by the Panel working group on methodology development. The points of applications of the measures will then be summarised in critical points or sub steps of the risk assessment where the combinations of RROs applied are measured and for which a specific evaluation will be performed.

The systematic identification of potential measures to be implemented to reduce the pest abundance is performed for all scenarios under scrutiny.

Whereas the evaluation of these combinations of RROs will first be performed for the A0 scenario and depending on the model outcome the evaluations for the alternative scenarios A1 and A2 will be performed.

In an appendix of the scientific opinion further details on the systematic identification of the RROs will be presented.

4.4. Conceptual models

The models for assessing the pest abundance in the different steps of the assessment will be developed using as a basis the sub steps that were identified as explained in section 4.2 and 4.3. The different parameters of the models and corresponding notations will be summarised in an appendix of the scientific opinion.

4.4.1. Entry and establishment

The assessment of the introduction of the pest in the EU territory will be 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.

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

The conceptual models for the different pathways under scrutiny have been developed except for the Raspberry pathway. This is because of the similarity with the strawberry pathway, and because in the worst case it is estimated that the number of founder populations entering the EU through this pathway would be equal to the ones entering through the strawberry pathway.

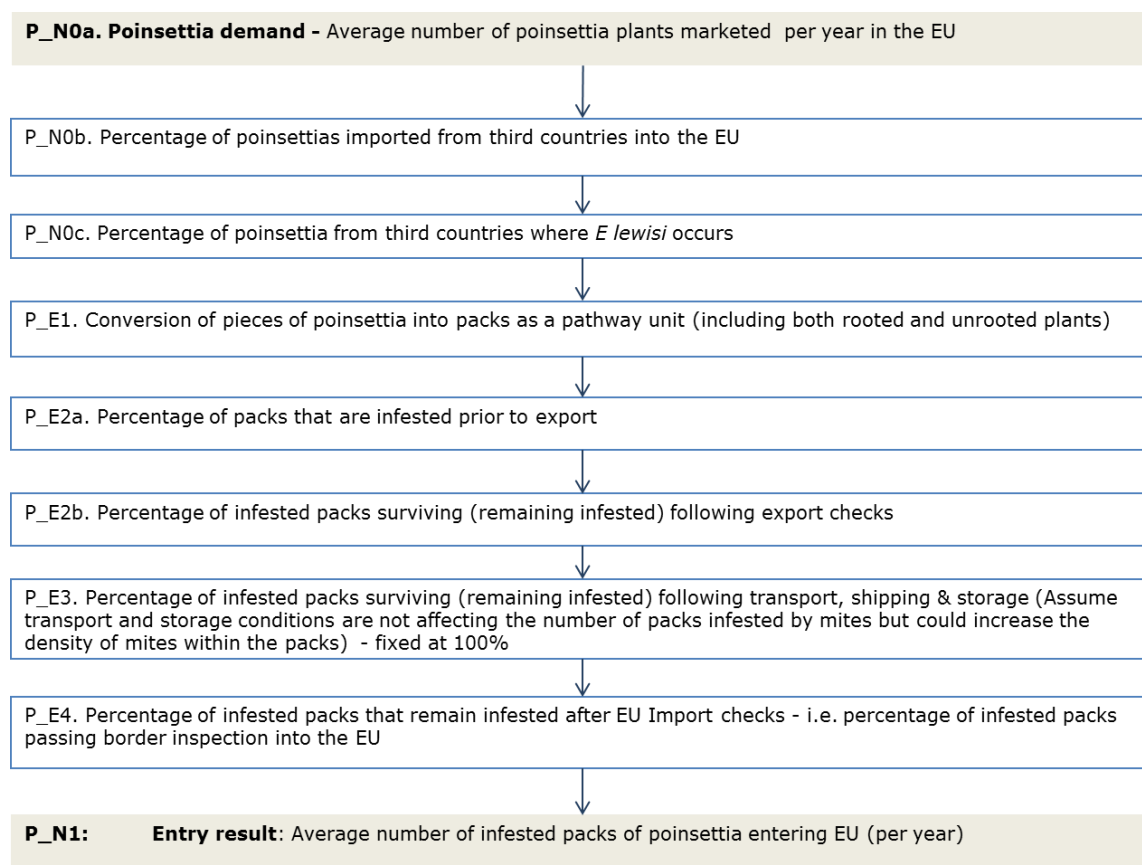


Figure 2: *Eotetranychus lewisi* conceptual model for entry via poinsettia plants for planting imported from countries where the pest occurs

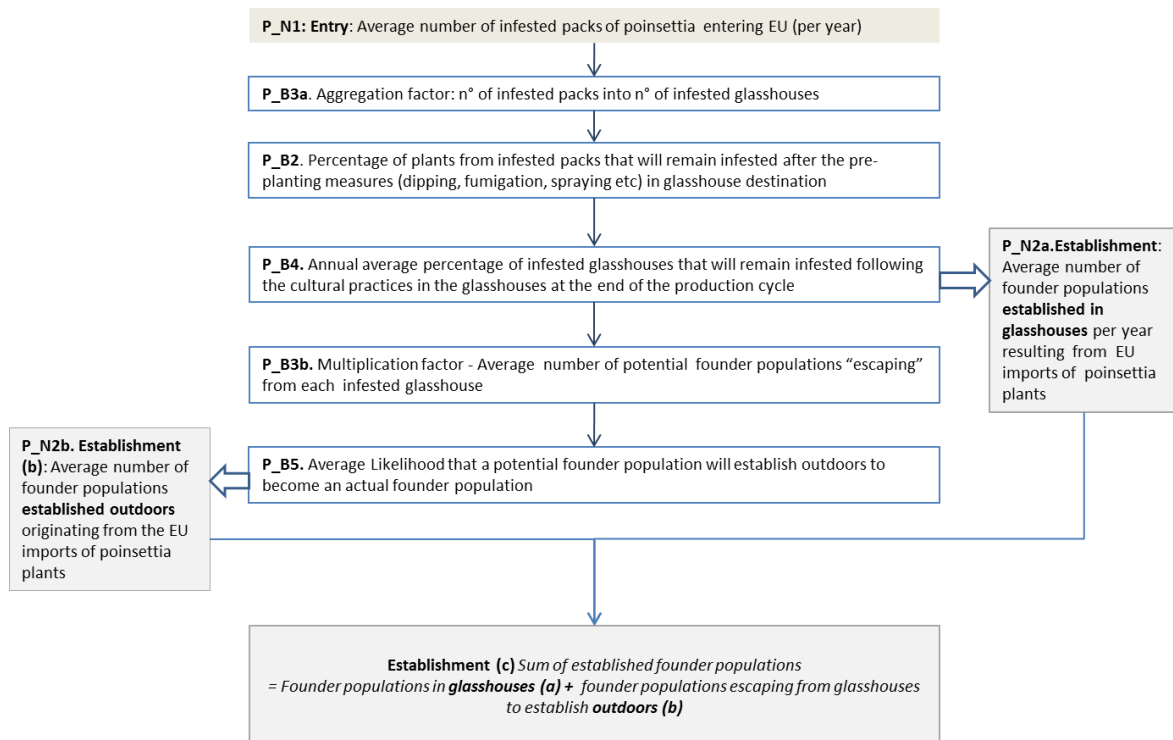


Figure 3: Conceptual model for establishment considering the intended use of poinsettia

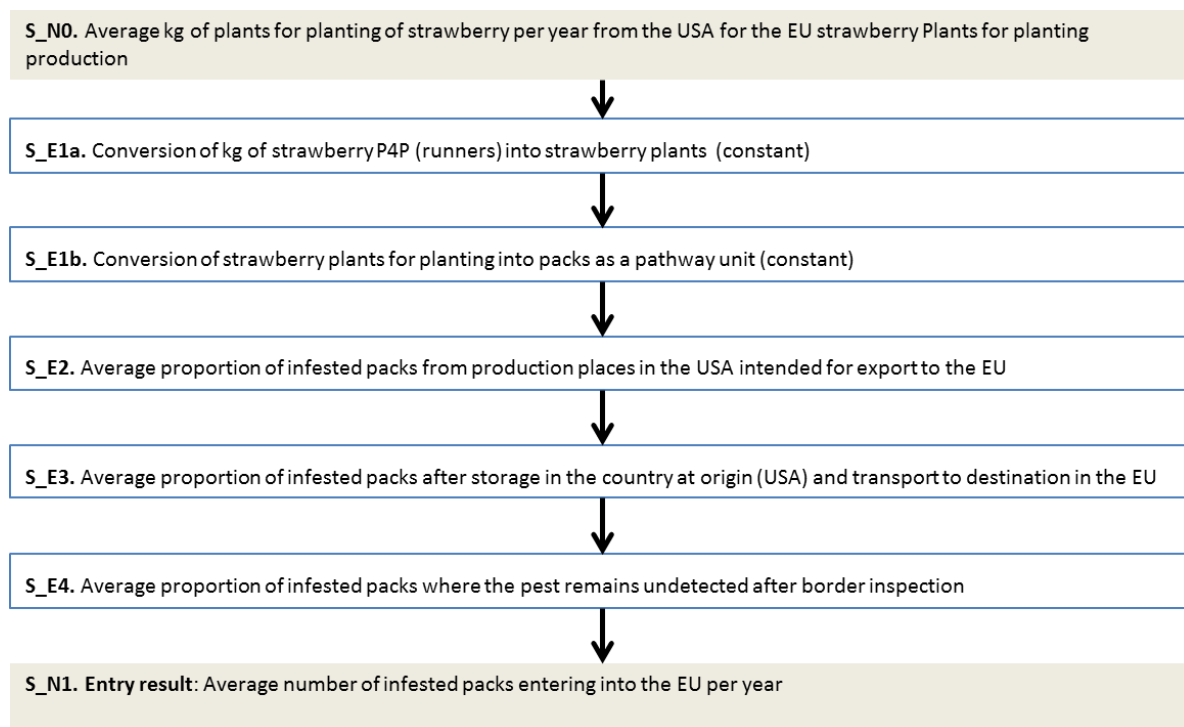


Figure 4: *Eotetranychus lewisi* conceptual model for entry via strawberry plants for planting imported from the USA.

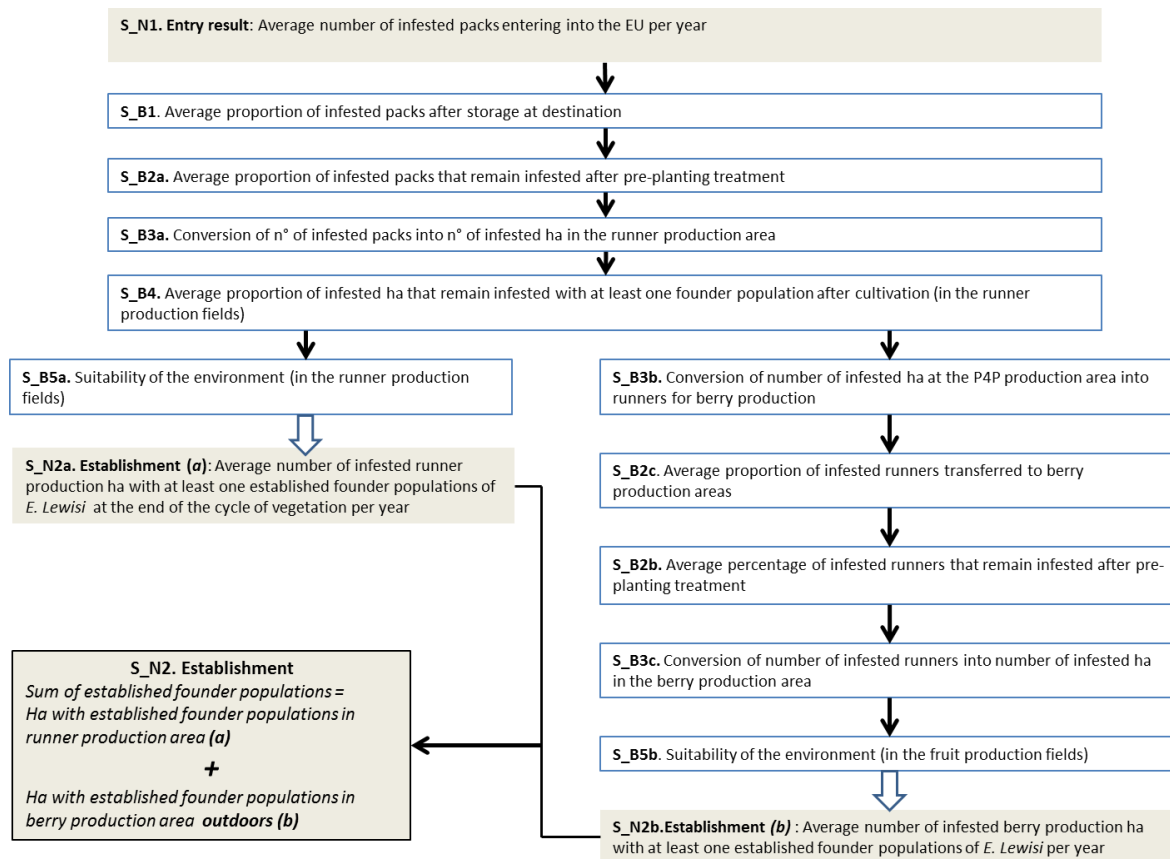


Figure 5: Conceptual model for establishment of *Eotetranychus lewisi* considering the intended use of strawberry plants for planting

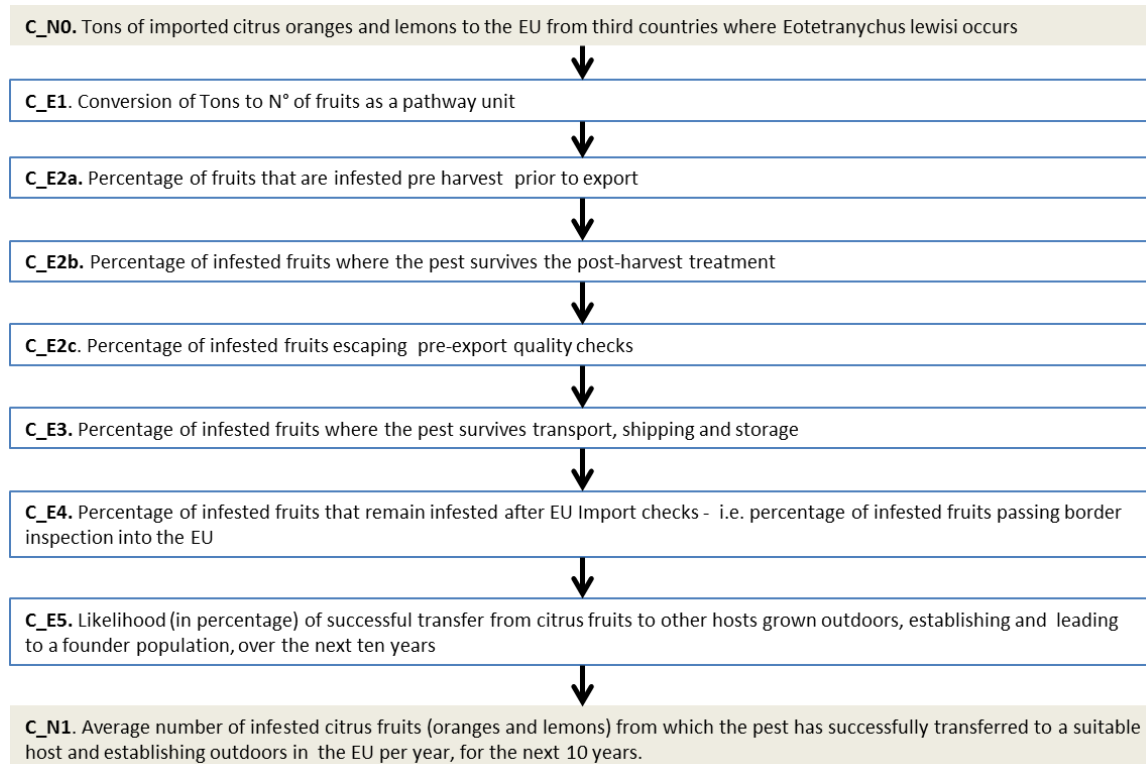


Figure 6: Model for entry and establishment of *Eotetranychus lewisi* into the EU through citrus fruits (lemons and oranges) imported from third countries where the pest occurs

4.4.2. Spread

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. Like other mites, the natural dispersal of *E. lewisi* is slow and we will consider 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 colonization of territory across the whole area of the EU.

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

Below the conceptual models for the spread is shown.

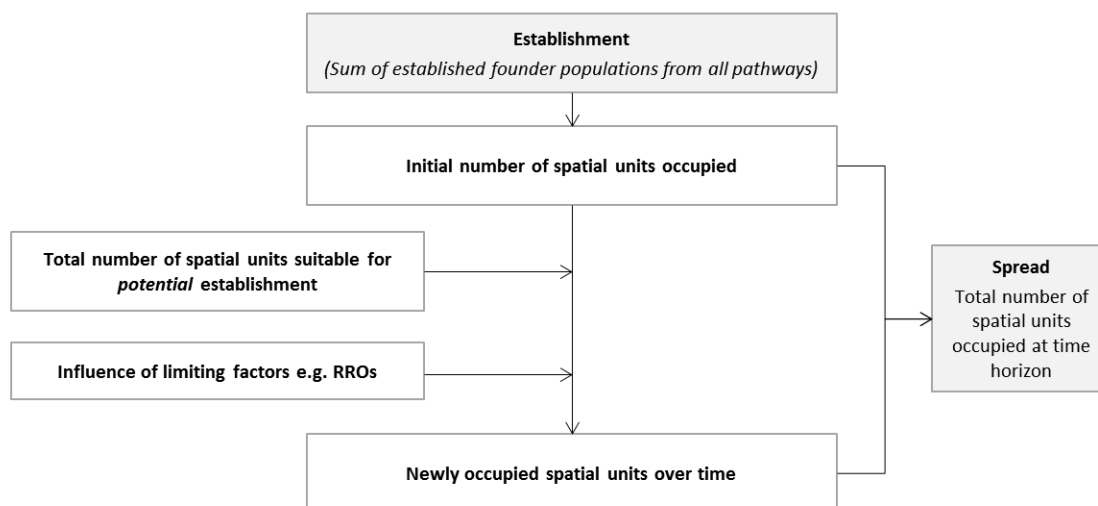


Figure 7: Conceptual model for spread of *Eotetranychus lewisi* in the EU

For modelling the human assisted spread, a logistic growth model will be used.

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

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 2000's. (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 NUTS2 regions that can be colonized (due to presence of hosts or host habitat and suitability of climate).

$$K = 276$$

4.4.3. Potential consequences

Regarding the potential consequences the mite could cause in the EU, the ToR indicate to provide additional information if available, compared to the analyses performed in the EFSA PLH Panel (2014a). Therefore the impact analyses will be a narrative assessment that will be substantiated by the information and data collected on *E. lewisi*.

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.

4.5. Model parameter estimation

4.5.1. Expert knowledge elicitation

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
- (iv) Documenting the process.

4.5.2. Parameter expression

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. See example below from *E. lewisi* risk assessment:

Table 3: Example of a quantile distribution resulting from an informal expert elicitation

Quantile (Percentile)	Average number of poinsettia plants required within the EU each year for the next ten 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 99 th percentile.
Upper (99%)	180	The Panel would be extremely surprised if the average number of poinsettia plants was above this estimate

In this assessment, a stochastic model for risk assessment with quantitative expression of the risks and probabilities and related uncertainties is used. This 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 PRA constitutes a test case for the new approach. The main output for this risk assessment are the results obtained from multiplying the inputs for each entry sub-steps in the stochastic (Monte Carlo) simulation, done through calculation with the @RISK tool.

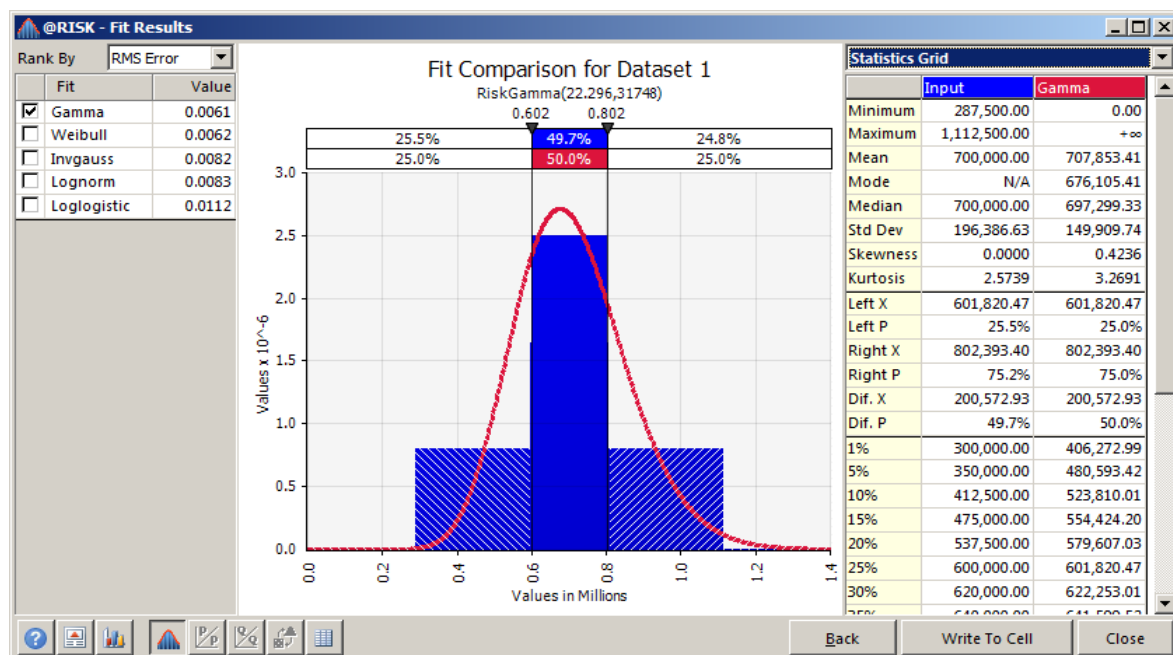


Figure 8: Example of an @RISK calculation

5. Unquantified uncertainties

A list of all the uncertainties that cannot be dealt with by the process of expert knowledge elicitation and the Pest Risk Assessment model will be provided in the opinion. If possible, it will be indicated how this unquantified uncertainties influence the overall risk estimate.

It is reasonable to expect uncertainties not considered in the assessment and their influence on the results of the analyses relative to:

- Current real occurrence of *E. lewisii* in EU
- Other pathways not considered in this risk assessment
- Trade flows
- Entry and establishment steps
- Model design

6. Human resources, software and timelines for performing the assessment

6.1. Human resources

The working group will include:

- PLH Panel members: Maria Navajas (Chair), Josep Jaques Miret and Alan MacLeod
- EFSA staff:
 - ALPHA Unit: Sybren Vos (coordinator), Filippo Bergeretti and Niklas Björklund (Visiting Scientist)
 - AMU Unit: Olaf Mosbach-Schulz (model development), Fulvio Barizzone (Prometheus pilot),
- Hearing expert: Anna Howell, Staff Research Associate at University of California Cooperative Extension Ventura County.

In total a group of 5 persons was involved in the entire process, in addition one person provided support for the development of the PROMETHEUS protocol and one person provided support was provided

6.2. Software

For this risk assessment several IT tools were used:

Endnote X8, DistilleSR²¹, @RISK, ArcGis²², Microsoft office 2010.

6.3. Timeline

Following the 2014 *E. lewisii* pest categorisation, on the 1st of April 2015, the European Commission requested a full PRA with a deadline set at May 2017.

The working group scheduled the meetings according to that, drafting a work plan, and provisional deadlines are given in the table below, which is subject to changes depending on the volume of data retrieved and its relevance (capacity of answering the addressed questions).

²¹ <https://systematic-review.ca/>

²² <https://www.arcgis.com>

Table 4: Drafted task planning of the working group: milestones and indicative month of delivery

Milestones	N° of persons involved	Tool	Month
Search process for questions in section 3.1	1	Endnote	December 2016
Screening of results	2	DistillerSR	January 2017
Data extraction for questions in section 3.1	2	DistillerSR	January & February 2017
Pathway identification	5		January 2017
Scenario definition	5		January 2017
Collection of trade data	2		February 2017
RROs table development	2		February 2017
Development of conceptual models	3		February 2017
Search for other relevant RA issues	5	Endnote	March 2017
Hearing expert consultation	5		March & April 2017
Parameters elicitation	3		April 2017
Model computation	2	@RISK	April 2017
Drafting of the opinion	5	Microsoft Office 2010	April & May 2017

7. History of the amendments

Throughout the risk assessment process, the availability of relevant new evidences will be monitored and in particular, before the finalisation of the opinion a check on the EUROPHYT database will be done in order to check the possible new notifications by the MSs.

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. This decision was taken by the working group in March 2017.

Regarding the potential consequences the mite could cause in the EU, the EC request indicates that we could restrict ourselves to providing additional information if available compared to the analyses performed in the EFSA PLH Panel (2014a). Therefore the impact analyses will be a narrative assessment that will be substantiated by the information and data collected on *E. lewisii*. This decision was taken by the working group in March 2017.

Many papers that were considered relevant by the experts of the working group were not searched for in the systematic literature search as not complying to some of the search criteria in particular the language, this is the case of Lai and Lin (2005) and Labanowski (2009). The arbitrary inclusion of these documents was agreed in the month of February.

Regarding the scenarios of the assessment, the A1 (PFA) and A2 (PFPP/PFPSP) scenarios were not assessed for the pathways where the A0 scenario results show a very unlikely establishment of the pest. Only for the poinsettia pathway it was considered relevant to address the A2 scenario. This decision was taken by the working group in April 2017.

The conceptual models for the Scenario A0 of the different pathways were revised and adjusted after the full development of the Poinsettia model in the month April 2017.

When analysing the climate suitability, climatic data were retrieved from the JRC and maps were generated to indicate the areas in the EU where the temperatures are not

impeding the mite to fulfil its life cycle and where the pest can overwinter. The maps were generated using R studio in April 2017.

Host availability was mapped in the EU with regards to the spread potential of the pest using EUROSTAT data and ARCGIS tool in the month of April 2017.

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- EFSA Panel on Plant Health (PLH), Jeger M, Bragard C, Chatzivassiliou E, Dehnen-Schmutz K, Gilioli G, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Urek G, Van Bruggen A, Van der Werf W, West J, Winter S, Santini A, Tsopeles P, Vloutoglou I, Pautasso M and Rossi V, 2016a. Scientific opinion on the risk assessment and reduction options for *Ceratocystis platani* in the EU. EFSA Journal 2016;14(12):4640, 65 pp. doi:10.2903/j.efsa.2016.4640
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Appendix A: Data extraction/Appraisal for questions section 3.1

1. Bibliographic information

- 1.1. Refid
Type: numeric. Provided by EndNote database.
- 1.2. Author
Type: text. Provided by EndNote database.
- 1.3. Year of publication
Type: numeric. Provided by EndNote database.
- 1.4. Abstract
Type: text. Provided by EndNote database.
- 1.5. Is the paper a primary or a secondary study?
Type: radio.
 - a) Primary
 - b) Secondary

2. Geographical information

- 2.1. Geographical information reported.
Type: radio.
 - a) Yes
 - b) No
- 2.2. Is the study reliable in relation to the geographical information reported?
Type: hidden field (appear if Yes selected in 2.1), radio.
 - a) Yes
 - b) No
- 2.3. Please specify the reasons why the study should not be considered reliable in relation to the geographical information reported.
Type: hidden field (appear if No selected in 2.2), text.
- 2.4. Geographical location as described in the text.
Type: hidden field (appear if Yes selected in 2.1), text.
- 2.5. Geographical location as coded for data extraction.
Type: hidden field (appear if Yes selected in 2.1), checkbox (add list of countries in Distiller).

3. Information for the "Entry" module of the Pest Risk Assessment

- 3.1. Is there any information reported in the paper that may be useful for the "Entry" module of the Pest Risk Assessment?
Type: radio.
 - a) Yes
 - b) No
- 3.2. Please report the useful information for the "Entry" module.
Type: hidden field (appear if Yes selected in 3.1), text.

4. Information for the "Establishment" module of the Pest Risk Assessment

- 4.1. Is there any information reported in the paper that may be useful for the "Establishment" module of the Pest Risk Assessment?
Type: radio.
 - a) Yes
 - b) No
- 4.2. Please report the useful information for the "Establishment" module.
Type: hidden field (appear if Yes selected in 4.1), text.

5. Information for the "Spread" module of the Pest Risk Assessment

5.1. Is there any information reported in the paper that may be useful for the "Spread" module of the Pest Risk Assessment?

Type: radio.

- a) Yes
- b) No

5.2. Please report the useful information for the "Spread" module.

Type: hidden field (appear if Yes selected in 5.1), text.

6. Information for the "Impact" module of the Pest Risk Assessment

6.1. Is there any information reported in the paper that may be useful for the "Impact" module of the Pest Risk Assessment?

Type: radio.

- a) Yes
- b) No

6.2. Please report the useful information for the "Impact" module.

Type: hidden field (appear if Yes selected in 6.1), text.

7. Host information

7.1. Information on possible hosts reported.

Type: radio.

- a) Yes
- b) No

7.2. Is the study reliable in relation to the information on possible host reported?

Type: hidden field (appear if Yes selected in 7.1), radio.

- a) Yes
- b) No

7.3. Please specify the reasons why the study should not be considered reliable in relation to the information on possible hosts reported.

Type: hidden field (appear if No selected in 7.2), text.

7.4. Please report the host species as described in the text.

Type: hidden field (appear if Yes selected in 7.1), text.

7.5. Please report the host species as coded for data extraction.

Type: hidden field (appear if Yes selected in 7.1), radio (add list of host species in Distiller).

7.6. Please classify the host-species association according to the information reported in the paper

Type: hidden field (appear if Yes selected in 7.1), radio.

- a) Natural conditions
- b) Experimental conditions
- c) Uncertain

7.7. Please provide the justification for the host-species association categorisation according to the information reported in the paper

Type: hidden field (appear if Yes selected in 7.1), text.

7.8. Please specify if there is an impact on the host-species according to the information reported in the paper

Type: hidden field (appear if Yes selected in 7.1), radio.

- a) Yes, there is an impact
- b) No impact
- c) Not mentioned in the paper
- d) Unclear impact

7.9. Please classify the impact according to the information reported in the paper.

Type: hidden field (appear if Yes or Unclear selected in 7.8), checkbox.

- a) Yield loss
- b) Quality loss
- c) Trade loss

- d) Effect ecosystem services & biodiversity
- e) Others

7.10. Please provide the justification for the impact on the host-species according to the information reported in the paper
Type: hidden field (appear if Yes or Unclear selected in 7.8), text.

Appendix B: Analysis of the data collected in the context of the *E. lewisi* assessment

DistillerSR software was used for the management of the articles collected. The results of the data extraction and appraisal are summarised in the tables below. This information was not used as such in the risk assessment. The experts involved in the risk assessment completed these results by ad-hoc searches and expert knowledge.

For the correct interpretation of the tables below, some elements have to be taken into consideration:

- Each papers has been attributed automatically a unique reference identification number (Rfid) that appears in the tables of this Appendix
- The references are transferred from an endnote library to DistillerSR (ie. Authors surnames) and the automatic reporting tool does not align the format with the style guidelines of EFSA. Moreover, misspellings and symbols might occur due to the actual exporting function from DistillerSR into a text document.
- The table numbering is automatized during the exporting process from DistillerSR to MS Word.

1. GEOGRAPHICAL INFORMATION

Table 1: Studies appraised as “Reliable” with regards the geographical information

Summary of countries on which the presence of *E. lewisi* was reported for each paper containing primary information and judged as reliable for the geographical information reported. The reason for considering the geographical information as reliable is given in column three: "geogr_reliab_descr" (Selection in the database Primary study + geographical info = Yes + Reliable info = Yes).

Paper/Author/Year	Countries	"geogr_reliab_descr" (Reviewers comments on geographical distribution)
1087 // NA	Taiwan	I have no reasons to doubt
1088 // NA	United Kingdom	I have no reasons to doubt
1093 / Zalom F / NA	USA	Report from an Entomologist
1094 / Pantoja A / NA	Central and South America, USA	USDA report
1095 / Various Authors / 2005	USA	Report of the California Department of Food and Agriculture of 1 detected <i>Eotetranychus</i> sp
1096 / Servicio Agric / 2014	Chile	Servicio Agrícola y Ganadero, Ministerio de Agricultura de Chile
1097 / Abato-Zarate M / 2011	Mexico	PhD thesis
1098 / Citalan Estrada / 1998	Mexico	extensive work (PhD thesis)
1099 / Sazo Rodriguez / 2008	Chile	Good description of the infestations
1100 / Dara S / 2011	USA	Report from UC Cooperative Extension
1101 / Tuttle D. et al / 1974	Mexico	field collections made by specialists
1103 / Keith L. Andrew / 1980	El Salvador	report in the Florida Entomologist journal
1105 / Various	Mexico	I have no reasons to doubt

authors / 2007			
1108 / Ho CC / 2007	Taiwan		I have no reasons to doubt. Determinations look accurate
1113 / Perez-Santiago, / 2007	Mexico		I have no reasons to doubt
1118 / Beyzavi G, Ueck / 2013	Iran		While this is a literature review for mite records in Iran, this is done by very good specialists in the field, some of them from Iran
1119 / Flechtmann CHW / 1996	Bolivia		Field record reported by an expert in the field
1120 / Urueta EJ / 1975			Extensive field work
1120 / Urueta EJ / 1975			Report on field samples
1122 / Flechtmann CHW, / 2012	Peru		Field collections made by specialists
1123 / Flechtmann CHW, / 1999	Saint Barthélemy Island		I have no reasons to doubt
1124 / Howell AD, Daug / 2016	USA		I have no reasons to doubt
1125 / Lee Goff M / 1986	Hawaiian Is.		I have no reasons to doubt
1126 / Perez Santiago / 2002	Mexico		I have no reasons to doubt
1127 / Tuttle DM, Bake / 1964	USA		I have no reasons to doubt
1128 / Tuttle DM, Bake / 1976	Mexico		I have no reasons to doubt
16 / Perez-Santiago, / 2007	Mexico		The mite is an important pest in many peach orchards (Enriquez 1993) in Mexico. The species should be well identified
20 / Ho, C. C.,Shih, / 2004	Taiwan		Article in Chinese with abstract in English
25 / Corpuz-Raros, L / 2001	Philippines		no reason to doubt about reliability
28 / Ehara, Shozo / 1999	Central and South America, Hawaiian Is., Japan, Mexico, USA		Report made by specialists in Acarology
33 / Carmona, M. M. / 1992	Madeira		Reported by an expert in Acarology. This is the 1st report for Madeira
35 / Quintero, M. T. / 1991	Mexico		mite identification probably correct, report of presence made by specialists in acarology
38 / Anonymous, / 1982	USA		TRI-OLOGY report (probably edited by the Florida Department of Agriculture
39 / Helle, W.,Bolla / 1981	USA		collected by experts
4 / Abato-Zarate, M / 2014	Mexico		mite collections on papaya orchards

45 / Smith Meyer, M. / 1975	Japan, South Africa	I have no reasons to doubt. The report comes from a well-known acarologist
54 / Garrett, L. E., / 1967	USA	I have no reasons to doubt about it
6 / Howell, Anna D. / 2013	USA	Reported by strawberry experts from UC-Extension
63 / Doucette, Charl / 1962	Costa Rica, Mexico, USA	No reasons to doubt about it. This document contains both primary and secondary information
64 / Baker, E. W.,Pr / 1962	Costa Rica, Honduras, Nicaragua	I have no reasons to doubt about it
66 / Jeppson, L. R. / 1958	USA	I have no reasons to doubt about it
67 / Jeppson, L. R. / 1958	USA	I have no reasons to doubt about it
76 / Jeppson, L. R. / 1953	USA	I have no reasons to doubt about it
77 / Jeppson, L. R. / 1951	USA	I have no reasons to doubt about it
79 / Jeppson, L. R., / 1950	USA	I have no reasons to doubt about it
80 / McGregor, E. A. / 1943	USA	I have no reasons to doubt about it

Table 2: List of countries where *E. lewisi* was reported based on “Reliable studies”

List of countries on which the presence of *E. lewisi* was reported for each paper containing primary information and judged as reliable for the geographical information reported.

(Selection in the database Primary study + geographical info = Yes + Reliable info = Yes)

Country	N of papers	Country	N of papers
Bolivia	1	Madeira	1
Central and South America	2	Mexico	12
Chile	2	Nicaragua	1
Colombia	2	Peru	1
Costa Rica	2	Philippines	1
El Salvador	1	Saint Barthélemy Island	1
Hawaiian Is.	2	South Africa	1
Honduras	1	Taiwan	3
Iran	1	United Kingdom	1
Japan	2	USA	18

Table 3: Studies appraised as “Non Reliable” with regards the geographical information

Summary of countries on which the presence of *E. lewisi* was reported for each paper containing primary information and judged as not reliable for the geographical information reported. The reason for considering the geographical information as not reliable is given in column three: "geogr_reliab_descr" (*Selection in the database Primary study + geographical info = Yes + Reliable info = No*)

Paper/Author/Year	Countries	"geogr_reliab_descr" (Reviewers comments on geographical distribution)
1100 / Dara S / 2011	USA	no detailed information provided
12 / Coss, M. E. de, / 2009	Mexico	Experimental work, no information on the origin of the mites used
14 / Labanowski, G. / 2009	China, Costa Rica, Honduras	This is a report on imported potted plants
19 / Ho, C., Wang, / 2005	Taiwan	publication in Chinese, only a table with records of <i>E. lewisi</i> in English. However, the authors mention that they checked for the presence of mite mites, suggesting that they identify mites properly

Table 4 List of countries where *E. lewisi* was reported based on “Non Reliable studies”

List of countries on which the presence of *E. lewisi* was reported for each paper containing primary information and judged as not reliable for the geographical information reported. (*Selection in the database Primary study + geographical info = Yes + Reliable info = No*)

Country	N of papers
China	1
Costa Rica	1
Honduras	1
Mexico	1
Taiwan	1
USA	1

2. INFORMATION USEFUL FOR PEST RISK ASSESSMENT

Table 5: Papers appraised useful for assessing Entry

Detailed information that can be useful for the "Entry module" of the Pest Risk Assessment. (*Selection in the database Primary study + Entry info = Yes*).

Paper/Author/Year	Entry module information
1087//NA	Country-host associations: Taiwan-Bauhinia variuegata, Pueraris sp., Musa sp. & E. pulcherrima
1088//NA	Host-pest association
1097/Abato-Zarate M/2011	"recently detected in the Filipines and Taiwan transported with poinsettia (Corpus-Raros, 2001; Ho and Shih, 2004)" (page 44)

1105/Various authors/2007		The pest occurs in Mexico on peaches
1108/Ho CC/2007		Mite occurs in several places of Taiwan mostly on <i>E. pulcherrima</i> but also on other plant species
1113/Perez-Santiago,/2007		Pest occurs naturally on peaches in Mexico
1116/Pilon P/2010		Poinsettia is a host for <i>E. lewisi</i>
1123/Flechtmann CHW,/1999		The mite occurs in a French COM, the island of Saint Barthélemy
1124/Howell Daug/2016	AD,	The mite occurs as a pest on strawberry in coastal California
1125/Lee M/1986	Goff	The mite occurs in Oahu (Hawaii) on poinsettia only
1126/Perez Santiago /2002		The mite occurs as a pest in the states of Durango and Zacatecas in Mexico
1127/Tuttle Bake/1964	DM,	The mite occurs in Arizona
1128/Tuttle Bake/1976	DM,	The mite is abundant and widely distributed throughout Mexico
14/Labanowski, G./2009		mites found on ornamental potted plants
19/Ho, C.,Wang,/2005	C.	Some reports of mite presence are on potted seedlings of poinsettia. (Are there imports from poinsettia from Taiwan to EU ?)
28/Ehara, Shozo/1999		"It is probable that it was accidentally introduced together with poinsettia imported from Mexico or elsewhere"
4/Abato-Zarate, M/2014		"it has been dispersed most likely by trading contaminated poinsettia <i>Euphorbia pulcherrima</i> Willd. ex Klotzsch 1834 (Corpus-Raros 2001, Ho & Shih 2004)"
42/Lal, L.,Mukharj/1977		<i>E. lewisi</i> is not reported in West Bengal, India (2003)
45/Smith M./1975	Meyer,	Pest present on poinsettia in South Africa (Pretoria)
54/Garrett, E.,/1967	L.	Mites found on <i>E. pulcherrima</i> leaves
63/Doucette, Charl/1962		The mite is reported from Pacific-Northwest greenhouses in the US in 3 Euphorbiaceae (<i>E. pulcherrima</i> , <i>E. marginata</i> and <i>Ricinus communis</i>) (primary information) but also from other locations in US (Eastern coast and Florida) and additional hosts (secondary information)
64/Baker, W.,Pr/1962	E.	Countries and commodity of origin: <i>E. pulcherrima</i> in Costa Rica) and papaya in Nicaragua and Honduras
66/Jeppson, R./1958	L.	<i>E. lewisi</i> is present in Californian citrus
67/Jeppson, R./1958	L.	The mite is present in Californian citrus
76/Jeppson, R./1953	L.	The pest is present in Californian citrus orchards
77/Jeppson, R./1951	L.	The mite is injurious to Valencia oranges in California

- 79/Jeppson, R.,/1950 L. The pest is present and injurious to citrus in California. Mites can be found on leaves and green fruit. More mature fruit appear to favor its development
- 80/McGregor, A./1943 E. The pest was identified on Navel oranges and lemons in California

Table 6: Papers appraised useful for assessing Establishment

Detailed information that can be useful for the "Establishment module" of the Pest Risk Assessment. (*Selection in the database Primary study + Establishment info = Yes*)

Paper/Author/Year	Establishment module information
1087//NA	same as for entry
1088//NA	Host-pest association
1105/Various authors/2007	The pest occurs in peaches
1107/Gonzalez Castil/2002	Several demographic parameters obtained at laboratory conditions (25°C; 50 % RH; host plant not specified) for two predators (G. occidentalis and P. persimilis) of E. lewisi are presented. As these parameters are not scored for E. lewisi, the usefulness of these results for the RA remains doubtful
1108/Ho CC/2007	Eotetranychus lewisi is mainly found in mountainous areas with cooler temperatures. Those found at lower elevations were always on potted seedlings of poinsettia (Euphorbia sp.) Probably the high temperature in the lower land of Taiwan is not suitable for E. lewisi. The study of Lai and Lin. (2005) also found E. lewisi lived better under 24C.
1113/Perez-Santiago,/2007	Same as for entry
1116/Pilon P/2010	Poinsettia is a host for E. lewisi
1123/Flechtmann CHW,/1999	The mite has been in the French COM of the island of Saint Barthélemy feeding on Carica papaya
1124/Howell Daug/2016	AD, The mite occurs as a pest on strawberry in coastal California
1125/Lee M/1986	Goff The mite occurs in Oahu (Hawaii) on poinsettia only
1126/Perez Santiago /2002	The mite occurs as a pest in the states of Durango and Zacatecas in Mexico
1127/Tuttle Bake/1964	DM, The mite occurs in Arizona on several host plants
1128/Tuttle Bake/1976	DM, The mite is abundant and widely distributed throughout Mexico on different host plants
28/Ehara, Shozo/1999	Because climatic conditions are partially similar in Honshu and in the EU, the mite could also establish in the EU
45/Smith M./1975	Meyer, Pest present on poinsettia in South Africa (Pretoria)
63/Doucette, Charl/1962	The mite spread to neighboring plants in 4 weeks (time elapsed since E. pulcherrima cuttings had been received and symptoms became obvious). A similar fast rate of increase was observed in R. communis. Mites also persist in grapefruit foliage and on squash in the greenhouse but increase slowly.
64/Baker, W.,Pr/1962	E. Same as for entry

66/Jeppson, R./1958	L. Same as for entry
67/Jeppson, R./1958	L. Same as for entry
76/Jeppson, R./1953	L. Same as for entry
77/Jeppson, R./1951	L. Same as for entry
79/Jeppson, R./1950	L. Same as for entry
80/McGregor, A./1943	E. Same as for entry. Complete life cycle lasts about 12 days

Table 7: Papers appraised useful for assessing Spread

Detailed information that can be useful for the "Spread module" of the Pest Risk Assessment. (*Selection in the database Primary study + Spread info = Yes*)

Paper/Author/Year	Spread module information
1087//NA	same as for entry
1088//NA	Host-pest association
1105/Various authors/2007	Pest occurs in Mexico and its populations peak with temperature, low relative humidity and the presence of dust in the orchard
1108/Ho CC/2007	In November, 2003, only one poinsettia near was found to be infested (heavily) by <i>E. lewisi</i> . One year later, in December, 2004, all poinsettias around Ts-en pagoda were heavily infested.
1113/Perez- Santiago,/2007	Same as for entry
1116/Pilon P/2010	Poinsettia is a host for <i>E. lewisi</i>
45/Smith Meyer, M./1975	Pest found on poinsettia
63/Doucette, Charl/1962	Different rates of infestation on poinsettia were detected between 1958 and 1960
64/Baker, W.,Pr/1962	E. Same as for entry
66/Jeppson, R./1958	L. Same as for entry
67/Jeppson, R./1958	L. Same as for entry
76/Jeppson, R./1953	L. Same as for entry
77/Jeppson, R./1951	L. Same as for entry
79/Jeppson, R./1950	L. Same as for entry
80/McGregor, A./1943	E. Same as for entry

Table 8: Papers appraised useful for assessing potential impacts

Detailed information that can be useful for the "Impact module" of the Pest Risk Assessment. (*Selection in the database Primary study + Impact info = Yes*)

Paper/Author/Year	Impact module information
1088//NA	Upon detection, hygiene measures and restrictions on the movement of plants were implemented to reduce the risk of spreading the pest to other production sites. In addition, a programme of chemical treatments was initiated.
1093/Zalom F/NA	"E. lewisi has recently become problematic"
1097/Abato-Zarate M/2011	Severe reduction of foliar area (Ochoa et al 1991)
1098/Citalan Estrada/1998	occasional pest in dry season
1099/Sazo Rodriguez/2008	amarillamiento y posterior enrojecimiento del follaje en variedades tintas. Ello produce debilitamiento de las plantas e incluso en casos extremos defoliacion
1100/Dara S/2011	Growers appear to be noticing increased infestations in the recent years. Mite feeds on the underside of the leaves and fine stippling or flecking on foliage, which can be nutrient deficiency. Infestations can build to high before mites and their webbing are noticed
1103/Keith Andrew/1980	L. scarred, deformed and chlorotic leaves
1105/Various authors/2007	Una planta con defoliacion severa por daño de Ácaros necesita varios años para recuperarse (Welter, et al., 1991). Como resultado del daño causado por E. lewisi se tiene una reduccion de 57, 62 y 54% en la produccion de kilogramos de durazno por hectarea, kilogramos por arbol y peso promedio del fruto, respectivamente (Cuadro 1) Mena, 1997).
1108/Ho CC/2007	Predacious insects or mites had been observed among <i>E. lewisi</i> in poinsettia samples collected from Gienshih, Sun Moon Lake, Baolai, Taoyuan (Kaohsiung County), Haiduang, Tsulai, Guanshan, including <i>Amblyseius longispinosus</i> , <i>A. ovalis</i> , <i>Phytoseius minutus</i> , <i>P. rugauts</i> , ceccidomyiids, <i>Scolothrips</i> spp., <i>Oligota</i> sp., <i>Lasioseius</i> sp., stigmaeid, and <i>Orius</i> sp. Among these predators, <i>Amblyseius longispinosus</i> , <i>Phytoseius minutus</i> , <i>Scolothrips</i> sp., ceccidomyiid larvae, <i>Oligota</i> larvae, and <i>Orius</i> larvae were observed to feed on <i>E. lewisi</i> . These preying behaviors were observed from samples collected from Taoyuan, Hsinchu, Nantou, Kaohsiung, and Taitung Counties. It reveals local predators are adapting to restrain <i>E. lewisi</i> .
1113/Perez-Santiago,/2007	The paper reports on the effects of mite density on sugar content (soluble sugars and starch) in different plant organs (roots, leaves, bark). No defoliation was observed In this study. However, there was a significant reduction of the amount of reserves for growth in the following season .
1116/Pilon P/2010	Mites can be either treated with chemicals or subjected or biological control with predators. Impact is therefore anticipated
1122/Flechtmann CHW,/2012	At Senasa (Lima), high infestations of E. lewisi were observed on R. communis, causing chlorosis (pale stippling) on mature leaves.
1124/Howell Daug/2016	AD, The mite can reach the pest status on strawberry in coastal California
1126/Perez	The mite occurs as a pest in the states of Durango and Zacatecas in Mexico

Santiago /2002

- 16/Perez-Santiago,/2007 In North-Central Mexico, the mite is an important pest in many peach orchards (Enriquez 1993).
- 20/Ho, C.,Shih,/2004 C. pictures of heavily damaged poinsettia by mite infestation
- 33/Carmona, M./1992 M. Plants suffer of slower development and defoliation (not precise if this is on poinsettia or on Vitis)
- 4/Abato-Zarate, M/2014 Known in Mexico as papaya pest Increasing concerns for papaya growers
- 6/Howell, Anna D./2013 Anna Damage to strawberry by *E. lewisi* is similar to that of *T. urticae*: chlorosis and bronzing of the leaves and reduction in fruit production at high mite densities. In coastal California, the recent *E. lewisi* outbreaks have caused significant damage to production fields, particularly organic fields, thereby becoming a problematic pest in commercially cultivated strawberries, and raspberries.
- 60/McMurtry, A./1964 J. *Typhlodromus rickeri* can feed on *E. lewisi* (laboratory experiments)
- 63/Doucette, Charl/1962 Populations on poinsettia increase rapidly and result in leaf discoloration, webbing and even in defoliation. Discoloration can ruin production
- 66/Jeppson, R./1958 L. The paper describes the benefits of the acaricide "Kelthane" as a new pesticide effective on *E. lewisi*
- 67/Jeppson, R./1958 L. The mite is chemically treated with Chlorobenzilate
- 76/Jeppson, R./1953 L. The mite can be chemically treated when it appears on the fruit with Ovotran and Aramite
- 77/Jeppson, R./1951 L. Although the type of damage is not explicitly mentioned, the paper deals with a pesticide targeting this mite on Valencia oranges
- 79/Jeppson, R.,/1950 L. Same as for entry. Infested fruit have a "dirty" appearance

3. HOST INFORMATION

Table 9: *E. lewisi* host plant classification based on information from studies appraised as "Reliable"

Information on the association of host plants with *E. lewisi*. (Selection in the database Primary study + Host info = Yes + Host reliable info = Yes)

Host species	Experimental conditions	Natural conditions	Uncertain
<i>Acacia constricta</i>	0	0	1
<i>Acacia pennatula</i>	0	0	1
<i>Antigonon leptopus</i>	0	0	1
<i>Bauhinia variegata</i>	0	2	0
<i>Bebbia juncea</i>	0	1	0
<i>Brickellia californica</i>	0	1	0
<i>Brugmansia arborea</i>	0	1	0
<i>Cardiospermum corindum</i>	0	1	0
<i>Carica papaya</i>	1	4	2
<i>Ceiba acuminata</i>	0	1	0

<i>Citrus limon</i>	0	2	0
<i>Citrus reticulata</i>	0	1	0
<i>Citrus sinensis</i>	0	5	0
<i>Citrus spp.</i>	0	2	0
<i>Cleome sp.</i>	0	1	0
<i>Cnidoscolus sp.</i>	0	0	1
<i>Croton sonorae</i>	0	1	0
<i>Cucurbita sp.</i>	0	1	0
<i>Ditaxis lanceolata</i>	0	0	1
<i>Encelia frutescens</i>	0	0	1
<i>Erica sp.</i>	0	0	1
<i>Euphorbia heterophylla</i>	0	2	0
<i>Euphorbia marginata</i>	0	2	0
<i>Euphorbia pulcherrima</i>	0	10	5
<i>Euphorbia sp.</i>	0	0	1
<i>Ficus carica</i>	0	1	1
<i>Fragaria x ananassa</i>	0	5	0
<i>Gossypium hirsutum</i>	0	1	0
<i>Haplopappus sp.</i>	0	0	1
<i>Haplopappus spinulosus</i>	0	0	1
<i>Hydrangea arborescens</i>	0	0	1
<i>Ipomoea sp.</i>	0	1	0
<i>Jatropha cardiophylla</i>	0	0	1
<i>Koeleria paniculata</i>	0	0	1
<i>Lycium sp.</i>	0	0	1
<i>Malpighia sp.</i>	0	0	1
<i>Malus sp.</i>	0	1	0
<i>Mimosa biuncifera</i>	0	1	0
<i>Mimosa laxiflora</i>	0	1	1
<i>Monarda sp.</i>	0	0	1
<i>Musa sp.</i>	0	1	0
<i>Phaseolus vulgaris</i>	1	0	0
<i>Populus tremuloides</i>	0	0	1
<i>Prunus communis</i>	0	1	0
<i>Prunus persica</i>	2	2	1
<i>Pueraria sp.</i>	0	2	0
<i>Quercus sp.</i>	0	0	1
<i>Ricinus communis</i>	1	3	0
<i>Rubus sp.</i>	0	2	0
<i>Scirpus californicus</i>	0	0	1
<i>Solanum elaeagnifolium</i>	0	0	1
<i>Solanum sp.</i>	0	0	1
<i>Sphaeralcea orcuttii</i>	0	0	1

Vitis sp. 0 2 0

Table 10: E. lewisi host plant classification based on information from studies appraised as “Non Reliable”

Information that can be useful for the type of the association in regards to specific host. (Selection in the database Primary study + Host info = Yes + Host reliable info = No)

Host species	Natural conditions	Uncertain
<i>Bauhinia variegata</i>	0	1
<i>Carica papaya</i>	1	0
<i>Citrus sp.</i>	0	1
<i>Euphorbia pulcherrima</i>	1	0
<i>Euphorbia sp.</i>	0	1
<i>Musa sp.</i>	0	2

Table 11: E. lewisi host plants for which impact are reported in natural conditions

Detailed information for evaluation of host impact in natural conditions. (Selection in the database Primary study + Host info = Yes + Host reliable info = Yes + Conditions = Natural)

Host_species_code	No impact	Not mentioned in the paper	Unclear impact	Yes, there is an impact
<i>Bauhinia variegata</i>	0	1	1	0
<i>Begonia juncea</i>	0	1	0	0
<i>Brickellia californica</i>	0	1	0	0
<i>Brugmansia arborea</i>	0	1	0	0
<i>Cardiospermum corindum</i>	0	1	0	0
<i>Carica papaya</i>	0	1	0	3
<i>Ceiba acuminata</i>	0	1	0	0
<i>Citrus limon</i>	0	2	0	0
<i>Citrus reticulata</i>	0	1	0	0
<i>Citrus sinensis</i>	0	2	0	3
<i>Citrus spp.</i>	0	2	0	0
<i>Cleome sp.</i>	1	0	0	0
<i>Croton sonorae</i>	0	1	0	0
<i>Cucurbita sp.</i>	0	1	0	0
<i>Euphorbia heterophylla</i>	1	1	0	0
<i>Euphorbia marginata</i>	0	0	0	2
<i>Euphorbia pulcherrima</i>	0	3	1	6
<i>Ficus carica</i>	0	1	0	0
<i>Fragaria x ananassa</i>	0	1	0	4
<i>Gossypium hirsutum</i>	0	1	0	0

<i>Ipomoea sp.</i>	0	1	0	0
<i>Malus sp.</i>	0	0	0	1
<i>Mimosa biuncifera</i>	0	1	0	0
<i>Mimosa laxiflora</i>	0	1	0	0
<i>Musa sp.</i>	0	0	1	0
<i>Prunus communis</i>	0	1	0	0
<i>Prunus persica</i>	0	0	0	2
<i>Pueraria sp.</i>	0	1	1	0
<i>Ricinus communis</i>	0	3	0	0
<i>Rubus sp.</i>	0	0	0	2
<i>Vitis sp.</i>	0	0	0	2

Table 12: Type of impact caused by *E. lewisi* on host plants in natural conditions

Information on the association of *E. lewisi* and specific host plants (i.e. which kind of impacts have been recorded for a specific host). (*Selection in the database Primary study + Host info = Yes + Host reliable info = Yes + Conditions = Natural + host-impact = Yes*)

Host	Type_Impact
<i>Carica papaya</i>	not specified, Yield loss
<i>Citrus sinensis</i>	not specified, Quality loss
<i>Euphorbia marginata</i>	Quality loss, Yield loss
<i>Euphorbia pulcherrima</i>	not specified, Quality loss, Yield loss
<i>Fragaria x ananassa</i>	not specified, Yield loss
<i>Malus sp.</i>	Quality loss
<i>Prunus persica</i>	not specified, Quality loss, Yield loss
<i>Rubus sp.</i>	not specified, Yield loss
<i>Vitis sp.</i>	not specified, Quality loss

Table 13: Impacts caused by *E. lewisi* in natural conditions on hosts reported in papers appraised as “Reliable”

(*Selection in the database Primary study + Host info = Yes + Host reliable info = Yes + Conditions = Natural + host-impact = Yes*)

	Host species	Type_Impact	“Description” (Relevant description extracted by the reviewers)
1	<i>Carica papaya</i>	Yield loss	Causes severe malformations and reductions of leaf area
2	<i>Fragaria x ananassa</i>	Yield loss	Reduction in fruit production at high mite densities. In coastal California, the recent <i>E. lewisi</i> outbreaks have caused significant damage to production fields, particularly organic fields, and thereby becoming problematic pest in commercially cultivated strawberries.
3	<i>Rubus sp.</i>	Yield loss	In coastal California, the recent <i>E. lewisi</i> outbreaks have caused significant damage to fields, particularly organic fields, thereby becoming a problematic pest in commercially cultivated raspberries.

7	<i>Euphorbia marginata</i>		Yield loss	In the paper effects of leaf discoloration on commercial value of the crop is included and the result is that this mite can ruin production
8	<i>Euphorbia pulcherrima</i>		Yield loss	In the paper effects of leaf discoloration on commercial value of the crop is included and the result is that this mite can ruin production
22	<i>Prunus persica</i>		Yield loss	Como resultado del daño causado por E. lewisi se tiene una reduccion de 57, 62 y 54% en la producciÓN de kilogramos de durazno por hectÁrea, kilogramos por Árbol y peso promedio del fruto, respectivamente (Cuadro 1) (Mena, 1997).
24	<i>Fragaria ananassa</i>	x	Yield loss	Predatory mites (<i>Neoseiulus californicus</i> , <i>N. fallacis</i> , and <i>Amblyseius andersoni</i>) can successfully decrease Lewis spider mites, but may need to be released early in the season when mite populations are low, and rates and number of releases may need to be increased for successful control.
29	<i>Euphorbia marginata</i>		Quality loss	The article reserves to a new PEST of poinsettia from Taiwan.
30	<i>Euphorbia pulcherrima</i>		Quality loss	Plants suffer of slower development and defoliation (not precise if this is on poinsettia or on <i>Vitis</i>)
31	<i>Vitis sp.</i>		Quality loss	Plants suffer of slower development and defoliation (not precise if this is on poinsettia or on <i>Vitis</i>)
32	<i>Euphorbia marginata</i>		Quality loss	In the paper effects of leaf discoloration on commercial value of the crop is included and the result is that this mite can ruin production
33	<i>Euphorbia pulcherrima</i>		Quality loss	In the paper effects of leaf discoloration on commercial value of the crop is included and the result is that this mite can ruin production
36	<i>Citrus sinensis</i>		Quality loss	Although not much detail is provided, at least a quality impact is describes as infested fruit are described as having a "dirty" appearance
37	<i>Euphorbia pulcherrima</i>		Quality loss	Typical mite damage = leaf discoloration
40	<i>Malus sp.</i>		Quality loss	defoliation affects fruit quality
47	<i>Prunus persica</i>		Quality loss	Como resultado del daño causado por E. lewisi se tiene una reduccion de 57, 62 y 54% en la produccion de kilogramos de durazno por hectarea, kilogramos por arbol y peso promedio del fruto, respectivamente (Cuadro 1) (Mena, 1997).
48	<i>Euphorbia pulcherrima</i>		Quality loss	The injury symptoms observed on poinsettias is best described as stippling, or the presence of numerous small pinpoint spots, creating a mottled or speckled appearance on upper leaf surfaces. Severe infestations often cause the leaves to turn yellow (chlorotic) or bronze and may cause leaf drop. From a distance, growers often describe Lew is mite injury as looking similar to micronutrient deficiencies; closer examination will reveal the fine stippling of the leaf surface.
84	<i>Citrus sinensis</i>		not specified	As the papers deals with a treatment, an impact must occur first

85	<i>Citrus sinensis</i>		not specified	I have no reasons to doubt about it
88	<i>Fragaria ananassa</i>	x	not specified	"E. lewisi has recently become problematic"
89	<i>Carica papaya</i>		not specified	Severe reduction of foliar area (Ochoa et al 1991)
91	<i>Vitis sp.</i>		not specified	reported as a pest in Chile cited as being present in vineyards in the USA, where it is rarely seen as a pest
92	<i>Euphorbia pulcherrima</i>		not specified	mite feeds on the underside of the leaves
93	<i>Fragaria ananassa</i>	x	not specified	not reported
94	<i>Rubus sp.</i>		not specified	growers appear to be noticing increased infestations in the recent years
95	<i>Carica papaya</i>		not specified	scarred, deformed and chlorotic leaves
96	<i>Euphorbia pulcherrima</i>		not specified	scarred, deformed and chlorotic leaves
100	<i>Prunus persica</i>		not specified	The mite occurs as a pest in the states of Durango and Zacatecas in Mexico. The paper deals with the establishment of a baseline for the susceptibility of this mite to different acaricides which will enable the assessment of resistance in the future

Appendix C: List of questions to better understand the association of *E. lewisi* and the strawberry plant production in the USA

On 21/03/2017 and 22/03/2017 the *E. lewisi* working group held, by means of a teleconference, the hearing of the expert Anna D Howell from the University of California Agriculture and Natural Resources, Cooperative Extension Ventura County. The following questions were formulated to structure the discussion and to gather the evidence required for the assessment of the strawberry pathway.

The expert kindly delivered two power point presentations to address these questions and related data needs.

1. Information and data regarding the strawberry plants for planting (P4P) from USA pathway

1. Surfaces (or volumes) of strawberry plants for planting (P4P) production in the USA (in California in particular and in the in the USA more in general)
2. Exports of strawberry plants for planting from USA.
 - a. P4P production for export to Europe. Seasonality? Months when P4P are exported to EU? Export conditions (pest control or prevention)? Packaging size? Chilled transport? Transport temperature? Controlled atmosphere? Plant production Certification schemes? Certified packing premises?
 - b. Does *E. lewisi* affect production of strawberry P4P? If yes, what control methods are used against mites in general, against *E. lewisi* in particular?

2. Information and data regarding the *E. lewisi* impact on strawberry fruit production in USA/California

1. How is strawberry fruit produced in California? Outdoors, under plastic/tunnels, in glasshouses or other systems?
2. Does *E. lewisi* affect all types of strawberry fruit production?
 - a. Are any cultivars more susceptible than others? Is there any explanation for the different susceptibility (i.e., presence of trichomes, antibiosis)?
 - b. What cultivars suffer most?
 - c. What cultivars suffer least?
 - d. Which cultivars are used in California? And in USA?
3. When did *E. lewisi* first become a problem in strawberries in California?
 - a. Is it a sporadic problem (i.e. not every year)? Is it a key pest?
 - b. Is the mite (always/regularly) identified at the species level?
 - c. How much/often do mixed mite infestations (*T. lewisi* / *T. urticae*) occur in the field? Do they usually co-exist or is one of them a superior competitor?
4. Why did *E. lewisi* become a problem?
 - a. Was it due to changes in the mite (e.g. it developed resistance to pesticides used, new more aggressive strains appeared)?
 - b. Was it able to exploit a change in production system (e.g. different season, new fertilization regime, watering)?
 - c. Was it a change in environmental conditions (i.e., cultivation in new zones with a different climate)? Does it get worse in drier years?
 - d. other factors
5. About the approaches used to control the pest:
 - a. Pesticides – active substances

- b. Biocontrol – predatory mites, entomopathogenic fungi
 - c. crop husbandry systems
 - d. Others (cultural, resistant cultivars...)
6. Have impacts been quantified/documentated? What are the impacts?
- a. Loss in yield (e.g. % loss)
 - b. Is there any downgrade in quality (fresh fruit for consumption to industrial / processing use)?
 - c. Is any ecosystem service affected? Is there a loss of biodiversity?

3. Others

- 1. Information about the production of raspberry and poinsettia is needed.
- 2. Information on the impacts of *E. lewisi* on such productions in the USA is needed.