

ADOPTED: 31 December 2020

doi: 10.2903/j.efsa.2021.6395

Commodity risk assessment of *Momordica charantia* fruits from Honduras

EFSA Panel on Plant Health (PLH),

Claude Bragard, Katharina Dehnen-Schmutz, Francesco Di Serio, Paolo Gonthier, Marie-Agnès Jacques, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Juan A. Navas-Cortes, Stephen Parnell, Roel Potting, Philippe Lucien Reignault, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen, Lucia Zappalà, Andrea Lucchi, Antoon Loomans, Olaf Mosbach-Schulz, Eduardo de la Peña and Panagiotis Milonas

Abstract

The European Commission requested the EFSA Panel on Plant Health to prepare and deliver risk assessments for commodities listed in Commission Implementing Regulation (EU) 2018/2019 as 'High risk plants, plant products and other objects'. *Momordica* fruits originating from countries where *Thrips palmi* is known to occur qualify as high risk plants. This Scientific Opinion covers the introduction risk for *T. palmi* posed by fruits of *Momordica charantia* L. imported from Honduras, taking into account the available scientific information, including the technical information provided by the National Service of Agrifood Health and Safety (SENASA) of Honduras. The risk mitigation measures proposed in the technical dossier from Honduras were evaluated taking into account the possible limiting factors. An expert judgement is given on the likelihood of pest freedom taking into consideration the potential pest pressure in the field, the risk mitigation measures acting on the pest in the field and in the packinghouse, including uncertainties associated with the assessment. For *T. palmi* on *M. charantia* fruits from Honduras, an expert judgement is given on the likelihood of pest freedom following the evaluation of the risk mitigation measures acting on *T. palmi*, including any uncertainties. The Expert Knowledge Elicitation indicated, with 95% certainty that between 9,406 and 10,000 *M. charantia* fruits per 10,000 will be free from *T. palmi*.

© 2021 European Food Safety Authority. *EFSA Journal* published by John Wiley and Sons Ltd on behalf of European Food Safety Authority.

Keywords: European Union, plant health, plant pest, quarantine, *Thrips palmi*, *Momordica charantia*, bitter melon, bitter melon, melon thrips

Requestor: European Commission

Question number: EFSA-Q-2020-00044

Correspondence: alpha@efsa.europa.eu

Panel members: Claude Bragard, Katharina Dehnen-Schmutz, Francesco Di Serio, Paolo Gonthier, Marie-Agnès Jacques, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L Reignault, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen and Lucia Zappalà.

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

Acknowledgements: EFSA wishes to acknowledge the important contribution of Oresteia Sfyra to the literature search, the preparation of the data sheets and her support in drafting and reviewing this opinion.

Suggested citation: EFSA PLH Panel (EFSA Panel on Plant Health), Bragard C, Dehnen-Schmutz K, Di Serio F, Gonthier P, Jacques MA, Jaques Miret JA, Justesen AF, MacLeod A, Magnusson CS, Navas-Cortes JA, Parnell S, Potting R, Reignault PL, Thulke H-H, Van der Werf W, Vicent Civera A, Yuen J, Zappalà L, Lucchi A, Loomans A, Mosbach-Schulz O, de la Peña E and Milonas P, 2021. Scientific Opinion on the commodity risk assessment of *Momordica charantia* fruits from Honduras. EFSA Journal 2021;19(2):6395, 34 pp. <https://doi.org/10.2903/j.efsa.2021.6395>

ISSN: 1831-4732

© 2021 European Food Safety Authority. *EFSA Journal* published by John Wiley and Sons Ltd on behalf of European Food Safety Authority.

This is an open access article under the terms of the [Creative Commons Attribution-NoDerivs](https://creativecommons.org/licenses/by-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited and no modifications or adaptations are made.

Reproduction of the images listed below is prohibited and permission must be sought directly from the copyright holder:

Figure 3. Map of Honduras, Wikipedia CC BY-SA 3.0



The EFSA Journal is a publication of the European Food Safety Authority, a European agency funded by the European Union.



Table of contents

Abstract.....	1
1. Introduction.....	4
1.1. Background and Terms of Reference as provided by European Commission.....	4
1.1.1. Background.....	4
1.1.2. Terms of reference.....	4
1.2. Interpretation of the Terms of Reference.....	4
2. Data and methodologies.....	5
2.1. Data provided by the National Service of Agrifood Health and Safety (SENASA) of Honduras.....	5
2.2. Literature searches performed by EFSA.....	5
2.3. Methodology.....	6
2.3.1. Listing and evaluation of risk mitigation measures.....	6
2.3.2. Conceptual model for risk of entry.....	7
3. <i>Thrips palmi</i>	7
3.1. Biology of the pest.....	7
3.2. Symptoms.....	9
3.2.1. General symptoms.....	9
3.2.2. Pest density of <i>Thrips palmi</i> in fruits.....	9
3.3. Confusion with other pests.....	10
3.4. Effectiveness of control options worldwide.....	10
3.5. Detection and monitoring.....	10
3.5.1. Sampling.....	10
3.5.2. Monitoring with traps.....	10
3.6. Management options.....	11
3.6.1. Chemical control.....	11
3.6.2. Mass-trapping.....	11
3.6.3. Cultural control.....	11
3.6.3.1. Fruit bagging.....	11
3.6.4. Biological control.....	12
3.6.5. Host plant resistance.....	12
3.6.6. Post-harvest treatments.....	12
4. Commodity data.....	13
4.1. Description of the commodity.....	13
4.2. Description of the production areas.....	13
4.2.1. Source of planting material.....	14
4.2.2. Production cycle.....	14
5. Overview of interceptions.....	14
6. Pest pressure and risk mitigation measures.....	14
6.1. Pest pressure in production places.....	14
6.2. Risk mitigation measures applied in production fields.....	14
6.3. Risk mitigation measures applied in the packinghouse.....	15
6.4. Overview of the evaluation of <i>Thrips palmi</i>	16
6.5. Outcome of Expert Knowledge Elicitation.....	16
7. Conclusions.....	18
References.....	18
Glossary.....	22
Abbreviations.....	23
Appendix A – Data sheets of pests selected for further evaluation via Expert Knowledge Elicitation.....	24
Appendix B – Web of Science All Databases Search String.....	34

1. Introduction

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

1.1.1. Background

The new Plant Health Regulation (EU) 2016/2031,¹ on the protective measures against pests of plants, has been applied from December 2019. Provisions within the above Regulation are in place for the listing of 'high risk plants, plant products and other objects' (Article 42) on the basis of a preliminary assessment, and to be followed by a commodity risk assessment. A list of 'high risk plants, plant products and other objects' has been published in Regulation (EU) 2018/2019.² Scientific opinions are therefore needed to support the European Commission and the Member States in the work connected to Article 42 of Regulation (EU) 2016/2031, as stipulated in the terms of reference.

1.1.2. Terms of reference

EFSA is expected to prepare and deliver risk assessments for commodities listed in the relevant Implementing Act as "High risk plants, plant products and other objects". Article 42, paragraphs 4 and 5, establishes that a risk assessment is needed as a follow-up to evaluate whether the commodities will remain prohibited, removed from the list and additional measures will be applied or removed from the list without any additional measures. This task is expected to be on-going, with a regular flow of dossiers being sent by the applicant required for the risk assessment.

In view of the above and in accordance with Article 29 of Regulation (EC) No. 178/2002, the Commission asks EFSA to provide a scientific opinion in the field of plant health for *Momordica charantia* fruits from Honduras taking into account the available scientific information, including the technical dossier provided by Honduras.

1.2. Interpretation of the Terms of Reference

The EFSA Panel on Plant Health (hereafter referred to as 'the Panel') was requested to conduct a commodity risk assessment of *Momordica charantia* fruits from Honduras following the Guidance on commodity risk assessment for the evaluation of high-risk plant dossiers (EFSA PLH Panel, 2019).

As stated in the EU implementing regulation 2018/2019, fruits of *Momordica* L. are known to host and provide a significant pathway for the introduction and establishment of the pest *Thrips palmi* Karny, which is known to have the potential to have a major impact on plant species which are of a major economic, social or environmental importance to the Union territory. However, this pest does not occur in all third countries nor in all areas within a third country where it is known to occur. Certain third countries also have effective mitigation measures in place for that pest. In view of this, fruits of *Momordica* L. that originate in third countries or parts thereof where *T. palmi* is known to occur and which lack effective mitigation measures for *T. palmi*, qualify as high-risk plants, within the meaning of Article 42(1) of Regulation (EU) 2016/2031, and therefore, the introduction into the Union of those plants should be provisionally prohibited. Where demand for the importation of these plant products is identified, a risk assessment will be carried out in accordance with an implementing act to be adopted pursuant to Article 42(6) of Regulation (EU) 2016/2031.

Based on the information provided in the dossier, the panel will make an assessment to evaluate if the mitigation measures against *T. palmi* on *M. charantia* fruits from Honduras are effective to substantiate pest freedom. When necessary, additional information was requested to the applicant.

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

¹ Regulation (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants, amending Regulations (EU) 228/2013, (EU) 652/2014 and (EU) 1143/2014 of the European Parliament and of the Council and repealing Council Directives 69/464/EEC, 74/647/EEC, 93/85/EEC, 98/57/EC, 2000/29/EC, 2006/91/EC and 2007/33/EC. OJ L 317, 23.11.2016, pp. 4–104.

² Commission Implementing Regulation (EU) 2018/2019 of 18 December 2018 establishing a provisional list of high risk plants, plant products or other objects, within the meaning of Article 42 of Regulation (EU) 2016/2031 and a list of plants for which phytosanitary certificates are not required for introduction into the Union, within the meaning of Article 73 of that Regulation C/2018/8877. OJ L 323, 19.12.2018, pp. 10–15.

2. Data and methodologies

2.1. Data provided by the National Service of Agrifood Health and Safety (SENASA) of Honduras

The Panel considered all the data and information (hereafter called 'the Dossier') provided by National Service of Agrifood Health and Safety (SENASA) of Honduras on 23 December 2019, including the additional information provided by the SENASA of Honduras on 17 July 2020 after EFSA's request. The Dossier is managed by EFSA.

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

Table 1: Structure and overview of the Dossier

Dossier section	Overview of contents	Filename
1	Main document-dossier	Document Translation Bitter Melon Dossier SENASA
2	Additional information of efficiency of application of pesticides on <i>Thrips</i> control	Application effectiveness.xlsx
3	Methodologies for sampling consignments ISPM31	DP_01_2010_En_2015-12-22_PostCPM10_InkAmReformatted.pdf
4	Integrated measures for plants for planting ISPM36	ISPM_32_2009_En_2015-12-22_PostCPM10_InkAmReformatted.pdf
5	Categorisation of commodities according to their pest risk ISPM32	ISPM_36_2012_En_PlantsForPlanting_2019-04-30_PostCPM14_InkAm.pdf
6	Point by point reply to requested additional information by EFSA	<i>Momordica charantia</i> Final Document 07142020.docx
7	Example of application of pesticides and other chemicals in the production of <i>Momordica charantia</i>	PHYTOSANITARY PROGRAM.xlsx
8	Thrips population dynamics in a production cycle of momordica	Thrips behavior.xlsx

2.2. Literature searches performed by EFSA

A literature search was undertaken by EFSA to assess the state of the art regarding 1) the pest pressure in the applicant country; 2) efficacy of pre- and post-harvest measures applied to control *T. palmi*; 3) efficacy of insecticides to control *T. palmi*. The searches were run on 29/6/2020 (Appendix B). No language, date or document type restrictions were applied in the search strategy. Additional searches, limited to retrieve documents, were run when developing the opinion. The available scientific information, including previous EFSA opinions on the relevant pest (see pest data sheets in Appendix A) and the relevant literature and legislation (e.g. Regulation (EU) 2016/2031; Commission Implementing Regulations (EU) 2018/2019; (EU) 2018/2018 and (EU) 2019/2072) were taken into account.

2.3. Methodology

When developing the opinion, the Panel followed the EFSA Guidance on commodity risk assessment for the evaluation of high-risk plant dossiers (EFSA PLH Panel, 2019). Therefore, the proposed risk mitigation measures for *T. palmi* were evaluated in terms of efficacy or compliance with EU requirements as explained in Section 1.2. A conclusion on the likelihood of the commodity being free from *T. palmi* was determined and uncertainties identified using expert judgements. Pest freedom was assessed by estimating the number of infested fruits out of 10,000 exported fruits.

2.3.1. Listing and evaluation of risk mitigation measures

All currently used risk mitigation measures in the country of export were listed and evaluated.

The risk mitigation measures adopted in the production places and packinghouses as communicated by SENASA were evaluated with Expert Knowledge Elicitation (EKE) according to the Guidance on uncertainty analysis in scientific assessment (EFSA Scientific Committee, 2018).



Figure 1: Conceptual framework to assess the likelihood of pest freedom for *Thrips palmi* on *Momordica charantia* fruits

Estimates of pest pressure of *T. palmi* in the production places and the effect of the mitigation measures taken in the field during production and the post-harvest mitigation measures taken in the packinghouse were summarised in a pest data sheet (see Appendix A).

To estimate the pest freedom of the commodity, a three-step approach was adopted following EFSA guidance (Annex B.8 of EFSA Scientific Committee, 2018). Therefore, three independent elicitations were conducted i.e. one to estimate pest pressure in the field; one to estimate the efficacy of mitigation measures applied in the field; and a final one to estimate the efficacy of post-harvest mitigation measures applied in the packinghouse. Combining these three estimations, the level of pest-freedom for *T. palmi* on *M. charantia* fruits from Honduras was determined (see Section 2.3.2). The final result indicates how many fruits out of 10,000 will be infested with *T. palmi* when arriving in the EU.

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

2.3.2. Conceptual model for risk of entry

The risk of entry of *Thrips palmi* via import of *M. charantia* fruits from Honduras was estimated in three steps using a formal conceptual model. In this model, the estimated pest pressure is used as starting point and corrected by the independent effects of measures in the field and in the packing house. The result of this model is the level of infestation at import calculated as follows:

$$\text{Import risk: } r_{\text{import}} = p_{\text{pressure}} \times p_{\text{field}}/10,000 \times p_{\text{packing}}/10,000$$

$$\text{Pest freedom: } PF_{\text{import}} = 10,000 - r_{\text{import}}$$

All values are expressed in numbers of fruits out of 10,000 (Table 2).

Table 2: Parameters for three-step conceptual model to estimate the likelihood of pest-freedom from *Thrips palmi* in *Momordica charantia* fruits

Parameter	Unit	Description
r_{import}	[No out of 10,000 fruits]	The number (out of 10,000) <i>M. charantia</i> fruits imported to the European Union (EU) from Honduras, which will be infested with <i>Thrips palmi</i> when arriving the EU
p_{pressure}	[No out of 10,000 fruits]	The number (out of 10,000) <i>M. charantia</i> fruits harvested on production sites in Honduras, which will be infested with <i>Thrips palmi</i> without application of specific measures against the pest (pest pressure under general agricultural practise)
p_{field}	[No out of 10,000 fruits]	The number of <i>M. charantia</i> fruits (out of 10,000 infested fruits) that remain infested after applying measures on production sites
p_{packing}	[No out of 10,000 fruits]	The number of <i>M. charantia</i> fruits (out of 10,000 infested fruits) that remain infested after applying measures at the packing house
PF_{import}	[No out of 10,000 fruits]	The number (out of 10,000) <i>M. charantia</i> fruits imported to the EU from Honduras, which will be pest free of <i>Thrips palmi</i> when arriving the EU

The input parameters p_{pressure} , p_{field} and p_{packing} are determined by separate Expert Knowledge Elicitations (EKE). The uncertainties associated with the EKE were taken into account and quantified in the probability distribution applying the semi-formal method described in Section 3.5.2 of the EFSA-PLH Guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018).

The model results r_{import} and PF_{import} were calculated using Monte Carlo simulation. A final distribution is fitted to the simulation results.

Finally, the results were reported in terms of the likelihood of pest freedom. The lower 5% percentile of the uncertainty distribution reflects the opinion that pest freedom is with 95% certainty above this limit.

3. Thrips palmi

3.1. Biology of the pest

Thrips palmi Karny (Thysanoptera: Thripidae), commonly known as melon thrips, oriental thrips and southern yellow thrips, was first described in 1925 from Sumatra and Java (Indonesia) (Karny, 1925). The species previously had the common name 'palm thrips'; however, no palm species are known to host this pest and the origin of this name is in honour of Dr B.T. Palm, a well-known specialist of this group.

At 25°C, the life cycle from egg to egg lasts 17.5 days (OEPP/EPPO, 1989). The life cycle differs little from that of most phytophagous Thripidae (Figure 1). The adults emerge from the pupa in the soil and consequently, move to the leaves, flowers and fruits of the plant, where they lay their eggs in an incision made with the ovipositor. They preferably lay their eggs in young growing tissue of leaves, and also the flowers and fruit of a wide range of host plants, especially Cucurbitaceae, Solanaceae and Leguminosae. The two larval stages (LI and LII) and male and female adults feed on the maturing leaves, stems, flowers and flower petals and surfaces of fruits. They suck the contents of tissue cells with their specialised mouthparts, leaving them empty, causing silvery scars or leaf bronzing. The second-stage larva drops from the plant to the soil (or packing cases or growing medium) and completes its cycle by pupating (pupa I and pupa II) in the substrate (EPPO, 2018a,b).

The life cycle and population dynamics of *T. palmi* in Japan have been reviewed by Kawai (1990).

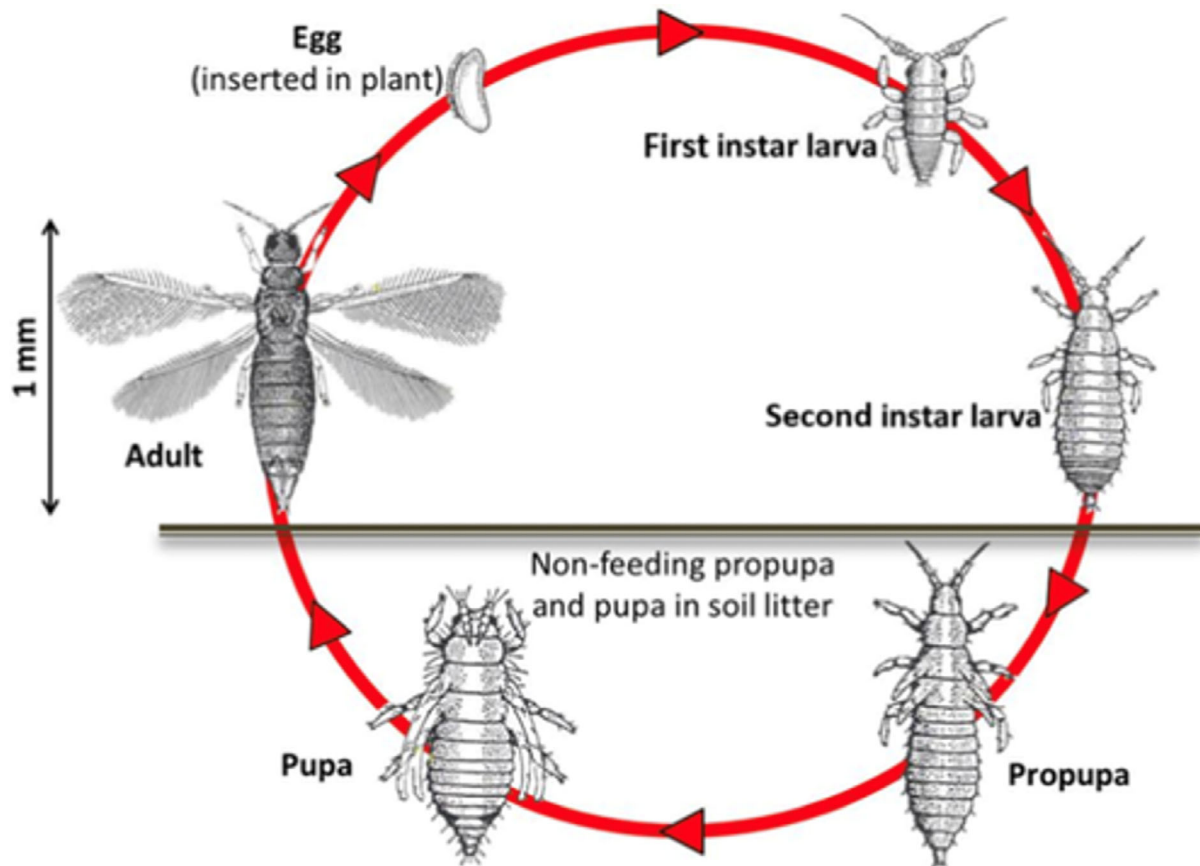


Figure 2: Life cycle of Thripidae (e.g., *Thrips palmi*)

Thrips palmi is primarily a subtropical and tropical species. Tsumuki et al. (1987) analysed the cold hardiness of *T. palmi* in Japan and concluded that it could not survive outdoor winter conditions in southern Honshu island.

Sakimura et al. (1986) set the outdoor northern limit to 34°N, which corresponds to the very south of Honshu. However, Nagai and Tsumuki (1990) reported no reduction of adult populations at temperatures as low as from –3 to –7°C on weeds in an unheated glasshouse between mid-January and mid-February in Japan. Developmental time decreased with increasing temperature up to 32.5°C in all stages. The total developmental time was longest at 12.5°C (64.2 days) and shortest at 32.5°C (9.2 days), 12.7 days at 25°C (Park et al., 2010). The mean developmental time for the egg stage varied between 24 days at 12.5°C, 6–7 days at 25°C, 4–5 days at 30°C and 3.3 days at 32.5°C (Park et al., 2010). Developmental times varied, however, between different lab assays, host plants, photoperiod etc. by a few days between different experiments in particular larval development at lower temperatures. The lower developmental threshold was 10.6, 10.6, 9.1, and 10.7°C for egg, larva, prepupa and pupa, respectively. The thermal constant required to complete the respective stage was 71.7, 59.2, 18.1 and 36.8 degree-days (DD). The lower threshold temperature and thermal requirements varied a bit between different studies ranging from 10.1°C and 194 DD (McDonald et al., 1999) and 10.6°C and 183.3 DD for egg to adult development (Park et al., 2010) to 11.3°C and 196 DD (Yadav and Chang, 2014) and 11.6°C and 189.1 DD (Kawai, 1985).

Parthenogenesis (arrhenotoky) in *T. palmi* has been reported by Yoshihara and Kawai (1982). The oviposition behaviour of the species was observed in Taiwan (Wang et al., 1989); a preoviposition period of 1–3 days for virgin females and 1–5 days for mated ones was recorded. Virgin females laid 3–164 eggs (1.0–7.9 eggs per day) during their lifespan, while mated females laid 3–204 eggs (0.8–7.3 eggs per day). At 25°C, the net reproductive rate (28.0), female fecundity (59.6 eggs/female) and daily oviposition rate (3.8 eggs/day) reached the maximum level (Kawai, 1985). At the optimum temperature for population growth (25–30°C), the number of generations was estimated in 25–26/year (Huang and Chen, 2004). Significant differences in population growth among crops were highlighted (Kawai, 1986). The survival rates of the larval and pupal stages fed on cucumber, kidney bean,

eggplant and balsam pear were high, whereas the survival rates of those fed on okra and chrysanthemum were low. The larvae fed on tomato and strawberry were unable to pupate. Duration of the larval and pupal stages fed on chrysanthemum and okra was longer than the duration of those fed on other crops. The longevity of the adults fed on cucumber, pumpkin, eggplant and kidney bean was increased, whereas the longevity of those fed on chrysanthemum, tomato and strawberry was decreased. The fecundity of adult females (n. eggs/female) fed on cucumber was maximum (60), while the fecundity of those fed on melon, eggplant and pumpkin amounted to 20. The differences in the generation time were not significant among crops, unlike the differences in the net reproductive rate. The intrinsic rate of natural increase of *T. palmi* fed on cucumber was maximum and the value was 0.134, while that of *T. palmi* fed on melon, eggplant and pumpkin ranged from 0.08 to 0.11 (Kawai, 1986).

3.2. Symptoms

3.2.1. General symptoms

On plant material, at inspection, silvery feeding scars on the leaf surface, especially alongside the midrib and veins, can be seen (Cannon et al., 2007). Heavily infested plants are characterised by a silvered or bronzed appearance of the leaves, stunted leaves and terminal shoots. At high densities, feeding by *T. palmi* may cause damage to fruits (Kawai, 1986) as well, such as scarring, discoloration and deformation in developed fruits or fruit abortion in an early stage. Cucumber, eggplant and pepper fruit are damaged when thrips feed in the blossoms. Symptoms may be found on all parts of a wide range of plant species (Sakimura et al., 1986). Although *T. palmi* feeds on *Momordica sp.*, no specific information of symptoms and damage caused to fruits of *M. charantia* is available.

3.2.2. Pest density of *Thrips palmi* in fruits

Despite its wide host range, including fruits and vegetables, the information about the actual pest density levels of *T. palmi* itself in various crops is limited. Most relevant papers measure the economic injury level (EIL) and the economic threshold (ET), which are calculated by the damage caused by the pest correlated with pest density. Yet, no information has been found of EILs and ETs calculated for *T. palmi* infestations in *M. charantia* under greenhouse or semi-field conditions in particular.

Rosenheim et al. (1990) recorded that in cucumber, densities of *T. palmi* (number per unit area of plant substrate) were greatest on foliage, and lowest on fruits, with an average ratio of 0.55 per female flower and 0.19 per fruit compared to foliage. During the early stage of development, fruits physically support the female flowers, but as the densities of *T. palmi* in flowers is low, the opportunities for them to incidentally feed upon and scar young fruit are low as well, this in contrast to *Frankliniella occidentalis*.

At high densities, *T. palmi* feeding may cause damage to fruits (Kawai, 1986; Welter et al., 1990). No records, however, are available specifically for *M. charantia*, and data available in literature for cucumber likely better reflect the incidence on *M. charantia* than those on Solanaceous crops like eggplant or sweet pepper. Kawai (1985) estimated EILs for cucumber the tolerable density of adults – at a constant high density – at 4.4 per leaf for uninjured fruit yield and at 5.3 adults per leaf for the total fruit yield (at a level of yield loss of 5%) and 8.8 adults per leaf (at a level of yield loss of 10%). In addition, Kawai (1990) reported EILs of 0.08 adults per leaf for eggplant and 0.11 adults per flower for sweet pepper. In other studies, in Japan, EILs were estimated at densities of 1–10 adults per cucumber leaf or 2–3 adults or larvae per pepper flower in south Florida, USA (Capinera, 2000). In case of high infestations in eggplant, less fruits are produced and of smaller size (Yadav and Chang, 2014). They recommended as an action threshold 1.05–1.50 thrips per flower or 4.91–10.17 adults per sticky trap over a 4-day period. Welter et al. (1990) calculated an action threshold of 94 thrips/cucumber leaf early in the growing season, showing that an EIL for fruits is relatively high for *T. palmi*. EILs are quite variable and differ per crop, per country, and timing in the season and ETs depend on variable and dynamic economic factors such as costs for control, labour, yield, market price etc. (Pedigo et al., 1986). Yadav and Chang (2014) indicated that the percentage of fruit damage correlates with the population dynamics of the thrips. Besides, thrips-related fruit damage in eggplants can best be evaluated in terms of the damaged fruit percentage, not in terms of yield loss.

3.3. Confusion with other pests

Thrips palmi identification is hampered by its small size and great similarity with other yellow species of thrips. Indeed, *T. palmi* can be mistaken for common thrips species with similar characteristics, e.g. *T. flavus* Schrank and *T. tabaci* Lindeman distributed worldwide, *T. alatus* Bhatti and *T. pallidulus* Bagnall in the Oriental region, *T. nigropilosus* Uzel and *T. alni* Uzel in the Palaearctic region and *T. urticae* Fabricius in Europe. For the distinction between look-alike species, microscopic examination by a seasoned expert of the morphological characteristics is required, or by molecular analysis (EPPO, 2018a,b).

3.4. Effectiveness of control options worldwide

A variety of chemical, cultural, biological and physical measures is used by growers across the world to manage *T. palmi* (Morse and Hoddle, 2006; Cannon et al., 2007), to prevent or maintain populations at a very low-density level. Management measures include the use of systemic and contact insecticides, insecticidal soaps, essential oils/plants extracts, soil treatments, the use of resident or introduced natural enemies, exclusion of the crops by physical barriers such as windbreaks, screenhouses, row covers, bagging of fruits, covering the soil with organic or plastic mulch or film, the removal of alternative weed hosts, trap crops (Salas, 2004), alternation of susceptible crops (Young and Zhang, 1998; Maltby and Walsh, 2005) and the use of less susceptible cultivars. Each of them separately has an effect, to restrict the entry and colonisation of the crop, to limit or suppress population growth (Kawai, 1990; Matsui et al., 1995).

Other techniques are used to monitor the number of thrips in order to establish the level and distribution of thrips infestation in a crop, such as the use of sticky traps, alone or with lures or pheromones, water pan traps, sampling of leaves and leaf beating. Monitoring results can be used to establish the distribution in a crop, to establish economic threshold levels and to facilitate the decision-making for which and when measures need to be taken to manage *T. palmi* infestations (Dong and Hsiu, 2019; Nakamura et al., 2014; Sánchez et al., 2011; Shibao and Tanaka, 2014; Thongjua et al., 2015).

3.5. Detection and monitoring

3.5.1. Sampling

Thrips palmi adults and larvae generally are found on the foliage: adults aggregate on the young vegetative parts, sometimes in the flowers, larvae on the underside of maturing leaves, concentrated in the upper third part of the crop (Kawai, 1990; Zhang et al., 2014). Which parts of the plant best reflect the relationship between the density of thrips and the resulting damage depends on the crop type: flowers in orchids (Maketon et al., 2014) and eggplant (Yadav and Chang, 2013), leaves in cucumber (Bacci et al., 2008) and bean (Osorio and Cardona, 2003). The number of leaves or flowers sampled depends on the crop, stage of infestation, the experimental set-up etc. For cucumber, reflecting best a bitter melon crop, the best sampling size consisted of 35 leaflets per field or 40 leaflets per ha (Osorio and Cardona, 2003), taken at random from the uppermost part of plants to establish the action threshold.

3.5.2. Monitoring with traps

Adults can be sampled with water pan traps, sticky traps and LED light traps. The use of sticky traps is common practice around the world for monitoring thrips, whereas water pan traps are uncommon and LED light traps not yet implemented at a commercial level. Blue and white have shown to be attractive colours for monitoring *T. palmi* in cucumber, eggplant and sweet pepper (Kawai, 1983; Kawai and Kitamura, 1987, 1990; Kawai, 1990; Yadav and Chang, 2013; Zhang et al., 2014) or wax gourd, respectively (Huang, 1989); for some crops, e.g. in orchids, yellow is more attractive (Culliney, 1990; Thongjua et al., 2015; Maketon et al., 2014). Besides trap colour and relation to the background colour of the crop and the environment, its efficacy in a crop also depends on placement height in the crop (upper third). In recent years, a combination of LED lights covered by transparent plates show that *T. palmi* is attracted to light at wavelengths from 500 to 525 nm (Hajime et al., 2014; Shibao and Tanaka, 2014).

3.6. Management options

3.6.1. Chemical control

Contact and systemic insecticides combined with insecticidal soaps, essential oils/plant extracts, are frequently applied for suppression of *T. palmi*, in particular during the first years after invading a new area or when the pest needs to be eradicated (MacLeod et al., 2004; Cannon et al., 2007). Then, efficacy of control can be very high (90–95%) when timely and regularly applied. However, application of insecticides alone is not an adequate tool to control *T. palmi* because the eggs (in the foliar tissue) and the pupae (in the soil) are relatively insensitive to insecticide application. Given the polyphagous nature of *T. palmi* and the short life cycle, the population density in the surrounding environment of a crop may be very high and this may require repeated insecticide applications.

In addition, *T. palmi* is able to develop insecticide resistance already after a few years requiring alternation of different active ingredients which most often do not match with integration of biological or integrated control methods. Insecticide resistance in *T. palmi* was recorded as early as 1994 (Nozawa et al., 1994). In recent years, resistance has been recorded in Asia for insecticides such as cypermethrin (Kim et al., 2019; Ghosh et al., 2020), imidacloprid (Bao et al., 2015; Kim et al., 2019; Ghosh et al., 2020), and in particular spinosad (Kim et al., 2019) and spinetoram (Gao et al., 2019; Shi et al., 2020). Field populations in Korea also showed reduced mortality to emamectin benzoate, chlorfenapyr, cyantraniliprole and dinotefuran (Kim et al., 2019). Resistance varies geographically and locally (Kim et al., 2019). To slow down insecticide resistance, it is important to apply insecticides that are effective in a rotation programme.

3.6.2. Mass trapping

Mass trapping with sticky traps/ribbons can reduce the numbers of *T. palmi* in some crops, such as sweet pepper and eggplant (Kawai, 1990, 2001; Murai, 2002). When these ribbons were set every 2–3 m² in a greenhouse, the density of *T. palmi* was reduced 10–20% compared to that in greenhouses without ribbons (Nonaka and Nagai, 1984). In strawberry, it could reduce adult thrips (*F. occidentalis*) numbers per flower by 61% and fruit bronzing by 55% (Sampson and Kirk, 2013). However, in these and other studies on thrips (see Sampson and Kirk, 2013), either no assessment of crop damage was made, or it failed to prevent damage (Trdan et al., 2005 for *T. tabaci* in onion crops), and therefore, no evidence is available of its economic viability. Nevertheless, mass trapping could be cost-effective at an early stage of invasion (Kawai and Kitamura, 1987, 1990), in high-value crops (Sampson and Kirk, 2013) and when part of an overall IPM programme. As a part of a combination of measures, it could maintain thrips numbers below the damage threshold during specific periods of preharvest, when pesticides cannot be used because of residue levels.

3.6.3. Cultural control

Several cultural practices can effectively reduce the level of infestation by *T. palmi*. Physical barriers hampering the access to the host plants can protect a crop from infestation, such as windbreaks, growing the crop in glasshouses or fine-meshed screenhouses, crop covers and or row covers, bagging of fruits, covering the soil with organic or plastic mulch or silver plastic or spraying kaolin. Additionally, intercropping, the use of trap plants and the removal of alternative weed hosts (Salas, 2004; Cannon et al., 2007) (Ingrid et al., 2012; Kawai, 2001; Razzak and Seal, 2017; Razzak et al., 2018; Salas, 2004; Shiotsuka et al., 2016) also contributes to a better crop hygiene and thus a lower infestation level. Population build-up is often hampered by periods of heavy rains in the open field (Huang, 1989; Etienne et al., 1990), but overhead irrigation of the crop does not.

Cultural control measures can be part of a systems approach for the control of *T. palmi*.

3.6.3.1. Fruit bagging

Preharvest fruit bagging is an extensively used practice in many countries around the world (Faci et al., 2014; Sharma et al., 2014; Shen et al., 2014). The use is twofold, it ensures homogeneity, aesthetics and quality of the product and it protects against diseases and pests, such as fruit flies (Tephritidae) and fruit borers (Lepidoptera). In the literature, there is not so much information for the effect on the prevention of damage by thrips, indicating it is primarily for other insect pests.

Few studies have been performed on the use of fruit bagging in reducing the incidence of thrips pests: Affandi et al. (2008) found a reduction in scarring of mango fruits (caused by an unspecified

species of thrips) of 32–42% in Indonesia using double-layered bags of plastic and paper. Karar et al. (2019) found that harvested fruits of mango in closed paper bags (brown paper inner black and butter – wet resistant/greaseproof – paper) were 100% free of (unspecified) thrips in Pakistan. Martins (2018) noticed a 30–50% reduction in lesions caused by *F. brevicaulis* in Brazil, and according to de López et al. (2020) bagging alone of bananas reduced losses by 90–100% by the red rust thrips (*Chaetanaphothrips signipennis*) compared to bunches with no bags. In banana plantings, covering bunches with polyethylene bags during fruit development provides a physical barrier to insect infestations, but bags cannot fully protect the fruit when a thrips infestation is heavy (Hara et al., 2002). No records have been found in literature on the effect of preharvest fruit bagging of *M. charantia* fruits.

3.6.4. Biological control

Macro-organisms

Augmentative biological control by seasonal or inundative releases of natural enemies such as predatory mites (e.g. *Neoseoiulus* spp. or *Amblyseius* spp.) or predatory bugs (e.g. *Orius* spp.) can be very effective in greenhouses or in an outdoor Mediterranean climate when other crop pests are carefully managed and applications are timely made. Other generalist predators such as lacewings (*Chrysoperla* spp.), mirid bugs (*Macrolophus* spp.) or lady bugs (Coccinellidae) can prey on *T. palmi*, but will predominantly target preys which are prevalent, and thus only partly contribute to thrips control (Van Lenteren and Loomans, 1999). Conservation biological control, relying on the natural colonisation of a crop by natural enemies already present in the environment, is often too late and too less, and therefore, much less effective in an early and timely control of *T. palmi*. Control of thrips pests heavily relies on chemical applications; however, the use of insecticides may have detrimental effects on biological control agents (Cuthbertson, 2014).

Microorganisms

Application of entomopathogens, such as the fungi *Akanthomyces lecanii* (previously named as *Lecanicillium lecanii* and *Verticillium lecani*), *Metarhizium anisopliae*, *M. rileyi* (synonym *Nomuraea rileyi*), *Beauveria bassiana* and *Paecilomyces fumosoroseus* can have a certain control effect on thrips whereas others like *Bacillus thuringiensis* have a limited effect (Vestergaard et al., 1995; Ekesi et al., 2000; Ekesi and Maniania, 2002; Hadiya et al., 2016; Castineiras et al., 1996; Silva et al., 2011; Saito, 1991; Shao et al., 2015; Cuthbertson et al., 2005; North et al., 2006; Saito, 1992; Trujillo et al., 2003; Visalakshy et al., 2004). Others such as *Purpureocillium lilacinum* (Hotaka et al., 2015) and *Isaria javanica* (Park et al., 2018) are still in a developmental phase.

Biotechnical control and semiochemicals

The effect of semiochemicals (Kirk, 2017; Qing et al., 2004) – either as a repellent or attractant – on the behaviour and trapping efficiency is still in an experimental phase. An aggregation pheromone for *T. palmi* has been identified (Akella et al., 2014), it can be used for monitoring, but implementation is still in an experimental phase (Kirk, 2017). In experimental set-ups, methyl salicylate (MeSA) has shown to attract natural enemies and to reduce populations in cucumber plants (Dong and Hsiu, 2019), but has not been developed to a commercial scale.

3.6.5. Host plant resistance

A few research reports mention differences in susceptibility to foliar injury among cultivars of pepper (Nuessly and Nagata, 1995), sweet pepper (Matsui et al., 1995; Yasuda and Momonoki, 1988; Visschers et al., 2019) and bean (Cardona et al., 2002; Frei et al., 2004), but host plant resistance has shown a low or no effectiveness in the management of *T. palmi*. No records have been found which specifically refer to breeding resistance genes into *M. charantia* or other *Momordica* species.

3.6.6. Post-harvest treatments

Potassium salts of fatty acids also known as insecticidal soaps are used as insecticides, herbicides, fungicides and algacides. Mixtures of potassium salts of fatty acids and essential oils may be used as selective acaricides (Tsolakis and Ragusa, 2008), and insecticides (Wafula et al., 2017) as an alternative to synthetic chemical pesticides enabling farmers to produce with acceptable residue levels that meet market requirements. In snap bean in Kenya (Wafula et al., 2017) potassium salts of fatty

acids reduced thrips (*Frankliniella* spp. and *Megalurothrips sjostedti*) populations up to 54%, comparable with synthetic pesticides.

Washing produce – fruits and vegetables – with chlorinated or ozonated water is used to sanitise water systems and to disinfect the surface of produce to prevent decay caused by microorganisms such as bacteria, fungi and yeasts and other pathogens at concentrations between 100 and 200 ppm active ingredient, at pH around 7 (Bornhorst et al., 2018; Ilic et al., 2018). It is not designed to kill insects, and little or no scientific evidence is available that it works as such.

4. Commodity data

4.1. Description of the commodity

The commodity to be imported are fruits of *Momordica charantia* also known as bitter melon or Chinese bitter melons. *M. charantia* fruits from Honduras, intended for human consumption, are targeting two markets i.e. the United States of America with approximately a volume of 78.89% (111,005 boxes per year), and the European Union 21% (29,702 boxes) of the total volume exported (140,707 boxes). Each box contains 4 kg. The expected trade volume for 2020 is ca. of 118,000 kg of fruits (Table 3).

Table 3: Overview of estimated export volumes for *Momordica charantia* fruits designated for export to the EU from Honduras (volumes as provided by Honduras in dossier)

Momordica variety	2019		2020							
	November	December	January	February	March	April	May	June – October	November	December
Chinese (Kg)	22,000	23,300	23,200	21,600	22,900	21,000	19,800	No export	21,500	19,900
Hindu (Kg)	22,000	23,300	23,200	21,600	22,900	21,000	19,800	No export	21,500	19,900

4.2. Description of the production areas

Momordica charantia production is concentrated in one area in Honduras, the Department of Comayagua (Figure 3). All production areas of *M. charantia* in Honduras are destined for exportation. Currently all the production of *M. charantia* is carried out in open fields. As a protection measure for *M. charantia* plants, crop areas and other adjacent crops include living barriers or fences placed in rows around the contours of *M. charantia*. There is a spacing of 50 m distance between crops.



Figure 3: Location of Honduras in Central America and the department of Comayagua within Honduras where *Momordica charantia* production is concentrated (maps taken from Wikipedia CC-BY-SA-3.0)

4.2.1. Source of planting material

According to the information provided in the dossier seeds are used as propagating material.

4.2.2. Production cycle

The growing cycle of *M. charantia* as described in the dossier starts with an initial period of up to 13 days; seeds are sown, germinated and young plants prepared to be transplanted to the field. Fourteen days after germination (and up to 63 days after transplant), plants are brought to a fruiting stage, which usually starts between 56 and 63 days after transplanting, depending on environmental conditions (temperature and precipitation). The harvest period lasts 12 weeks (ca. 84 days). Taking into account the different phases in plant development, a complete growing cycle takes approximately 22 weeks or 154 days, and according to this scheme, the optimal conditions of fruit quality are achieved for export to the EU. Annual production of *M. charantia* fruits for export to the EU usually comprises two growing cycles, starting with plantings in August to start harvesting in mid-October and the second cycle starts in December with a harvesting period in February. There is a 3-month gap (between June and October) without *M. charantia* export.

5. Overview of interceptions

According to Europhyt/TRACES-NT accessed on 14 July 2020 and covering all interceptions since 1995 there was one interception of *T. palmi* in 2019 on *M. charantia* fruits from Honduras destined to the EU.

6. Pest pressure and risk mitigation measures

The evaluation of the efficacy of the risk mitigation measures against *T. palmi* was done in a three-step approach. First, an estimate was made for the pest pressure of *T. palmi* in the production environment. Secondly, the control effect of the pest management measures in the field was estimated. Thirdly, the control effect of the post-harvest measures (packing house) was estimated.

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

6.1. Pest pressure in production places

Based on monitoring data in production fields available in the dossier (see Sections 1, 7 and 8), the Panel estimated pest pressure in the production places under a no-intervention scenario (i.e. no mitigation measures). Moreover, the climatic conditions in Honduras (based on monthly average temperatures) are very favourable for the development of this pest.

6.2. Risk mitigation measures applied in production fields

With the information provided by SENASA (Dossier sections 1, 2, 6, 7 and 8), the Panel summarised the risk mitigation measures that are currently applied in the production places (Table 4).

Table 4: Overview of currently applied risk mitigation measures for *Momordica charantia* fruits designated for export to the EU from Honduras

Risk mitigation measures	Description of applied measures
Export to EU during specific period of the year	There is an intentional 3- to 5-month gap (between June and October) in which <i>M. charantia</i> fruits are not produced and exported to the EU.
Pest-specific monitoring	There is a specific monitoring programme of the fields for thrips that is supervised by SENASA Technical staff. Monitoring occurs weekly throughout the production cycle of the crop and samples are taken for laboratory examination.
Chemical control	Various insecticides are frequently applied (see details in Appendix A).
Biological control	Biological control agents are not applied (dossier section 6). Nonetheless, there are naturally occurring control agents in the area of <i>M. charantia</i> production.
Protected cultivation	Production in greenhouse is in an experimental phase (dossier section 6), however currently there are no <i>M. charantia</i> fruits exported from protected cultivation in Honduras.

6.3. Risk mitigation measures applied in the packinghouse

With the information provided by the SENASA (Dossier sections 1, 2, 6, 7, 8), the Panel summarised the risk mitigation measures that are currently applied in the packinghouse (Table 5).

Table 5: Overview of currently applied risk mitigation measures applied in the packinghouse on *Momordica charantia* fruits designated for export to the EU from Honduras

	Description of applied measures
Inspection	Fruits are visually inspected in the field before transport.
Transport	The collected fruits are transported in vehicles with airtight cargo compartment.
Inspection upon arrival to the packing house	Reception at the packing plant: Upon arrival at the packing facility, the transport conditions are reviewed, pest monitoring is done and the entry or rejection of the fruit is decided.
Sorting/Classification	Once the fruit enters the packinghouse, they proceed to the selection and cleaning process. At this stage, possible physical damages are detected. The selection parameters consist of separating all those fruits that present deformations, inappropriate colour or any type of damage that detracts value and quality.
Brushing	Fruit is brushed.
Washing with pressurised water	The whole fruit is washed with pressurised water in order to eliminate any live insects that may appear, this is done manually to each individual fruit.
Submersion in water (1st)	The fruits are subjected to a post-harvest treatment which consists of submerging the fruit in a container containing a water solution with an undefined disinfectant
Submersion in water (2nd)	15 min post-harvest immersion treatment in cold water (approx. 4–8°C) with sodium hypochlorite.
Pest Inspection	A 15% sample of the fruits that is intended to be packaged is inspected for <i>T. palmi</i> .

6.4. Overview of the evaluation of *Thrips palmi*

Rating of the likelihood of pest freedom	Very frequently pest free (based on the Median)				
Percentile of the distribution	5%	25%	Median	75%	95%
Proportion of pest-free fruits*	9,406 out of 10,000 fruits	9,749 out of 10,000 fruits	9,884 out of 10,000 fruits	9,957 out of 10,000 fruits	9,994 out of 10,000 fruits
Proportion of infested fruits*	6 out of 10,000 fruits	43 out of 10,000 fruits	116 out of 10,000 fruits	251 out of 10,000 fruits	594 out of 10,000 fruits
Summary of the information used for the evaluation	<p>Possibility that the pest could become associate with the commodity Environmental conditions in Honduras are optimal for <i>T. palmi</i> development. <i>T. palmi</i> is widespread in the area of production and is considered by farmers a phytosanitary problem. The frequency and the number of sprays is very high probably underlying high infestation in the field. Thrips are recorded on <i>M. charantia</i> plants throughout a growing cycle.</p> <p>Measures taken against the pest and their efficacy The main control measures applied in the field until harvest are official inspections, monitoring, application of insecticides and inspection during harvesting. Efficacy of the applied insecticides ranges from 35% to 84% during the production stage of the crop and from 33% to 100% during the development and flowering period of the crop (Dossier sections 7 and 8). Measures in the packing house include inspection before processing, brushing and air blowing, washing and pest inspections before packing. Measures in the packing house target mainly adults and larvae and have minimal effect on eggs.</p> <p>Interception records There is a single interception reported in Europhyt/Traces -NT (1995–2020) of <i>T. palmi</i> on <i>M. charantia</i> fruits originating from Honduras, in November 2019.</p> <p>Shortcomings of current measures/procedures Application of insecticides is mainly performed on a calendar-like basis. Continuous use of insecticides is likely to cause development of resistant populations of <i>T. palmi</i>. Most measures applied in the packing house are not likely to have an effect on eggs that may be present on fruits.</p> <p>Main uncertainties There are limited data on population dynamics of <i>T. palmi</i> on <i>M. charantia</i>. Since identification of thrips at species level is difficult in the field, it is possible that field observations of thrips refer to other species than <i>T. palmi</i> (e.g. mixtures of <i>F. occidentalis</i> and <i>T. palmi</i>). Specific efficacy data for field applied measures are either limited or not available. Data on efficacy of the methods applied in the packing house in removing <i>T. palmi</i> from fruits are not available. The level of insecticide resistance against the insecticides applied in Honduras is uncertain.</p>				

*: Numbers rounded off to the nearest whole number.

6.5. Outcome of expert knowledge elicitation

Table 6 and Figure 4 show the outcome of the EKE regarding pest freedom after the evaluation of the currently proposed risk mitigation measures for *T. palmi*.

Figure 4 provides an explanation of the descending distribution function describing the likelihood of pest freedom after the evaluation of the currently proposed risk mitigation measures for *M. charantia* fruits designated for export to the EU for *T. palmi*.

Table 6: Assessment of the likelihood of pest freedom following evaluation of current risk mitigation measures against *Thrips palmi* on *Momordica charantia* fruits from Honduras designated for export to the EU. In panel A, the median value for the assessed level of pest freedom for each pest is indicated by 'M', the 5% percentile is indicated by L and the 95% percentile is indicated by U. The percentiles together span the 90% uncertainty range regarding pest freedom. The pest freedom categories are defined in panel B of the table

Pest species	Sometimes pest free	More often than not pest free	Frequently pest free	Very frequently pest free	Extremely frequently pest free	Pest free with some exceptional cases	Pest free with few exceptional cases	Almost always pest free
<i>Thrips palmi</i>			L	M			U	

PANEL A

	Pest freedom category	Pest-free fruits out of 10,000	Legend of pest freedom categories	
	Sometimes pest free	$\leq 5,000$	L	Pest freedom category includes the elicited lower bound of the 90% uncertainty range
	More often than not pest free	$5,000 \leq 9,000$	M	Pest freedom category includes the elicited median
	Frequently pest free	$9,000 \leq 9,500$	U	Pest freedom category includes the elicited upper bound of the 90% uncertainty range
	Very frequently pest free	$9,500 \leq 9,900$		
	Extremely frequently pest free	$9,900 \leq 9,950$		
	Pest free with some exceptional cases	$9,950 \leq 9,990$		
	Pest free with few exceptional cases	$9,990 \leq 9,995$		
	Almost always pest free	$9,995 \leq 10,000$		

PANEL B

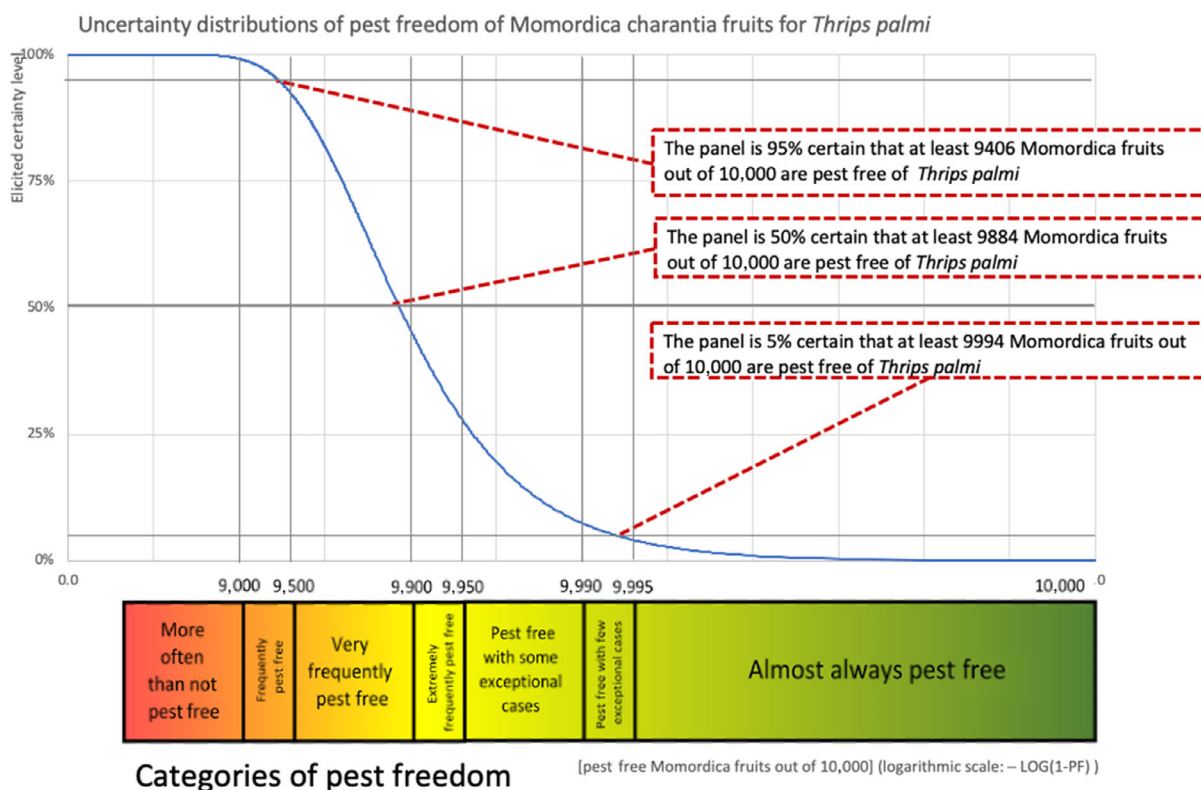


Figure 4: Explanation of the descending distribution function describing the likelihood of pest freedom from *Thrips palmi* after the evaluation of the currently proposed risk mitigation measures for fruits of *Momordica charantia* from Honduras designated for export to the EU

7. Conclusions

For *Thrips palmi* on *Momordica charantia* fruits from Honduras the likelihood of pest freedom following evaluation of current risk mitigation measures was estimated as 'very frequently pest free' with the 90% uncertainty range reaching from 'frequently pest free' to 'pest free with few exceptional cases'. The Expert Knowledge Elicitation indicated, with 95% certainty, that between 9,406 and 10,000 fruits per 10,000 will be free from *T. palmi*.

References

- Affandi A, Emilda D and Jawal ASM, 2008. Application of fruit bagging, sanitation, and yellow sticky trap to control thrips on mangoes. *Indones. J. Agr. Sci.*, 9, 19–23.
- Akella SV, Kirk WD, Lu YB, Murai T, Walters KF and Hamilton JG, 2014. Identification of the aggregation pheromone of the melon thrips, *Thrips palmi*. *PLoS ONE*, 9, e103315.
- Bacci L, Picanço MC, Moura MF, Semeão AA, Fernandes FL and Morais EG, 2008. Sampling plan for thrips (Thysanoptera: Thripidae) on cucumber. *Neotropical Entomology*, 37, 582–590.
- Bao WX, Kataoka Y, Fukada K and Sonoda S, 2015. Imidacloprid resistance of melon thrips, *Thrips palmi*, is conferred by CYP450-mediated detoxification. *Journal of Pesticide Science*, D15-004.
- Bornhorst ER, Luo YG, Millner PD, Nou XW, Park EH, Turner E, Vinyard BT and Zhou B, 2018. Immersion-free, single-pass, commercial fresh-cut produce washing system: an alternative to flume processing. *Postharvest Biology and Technology*, 146, 124–133.
- Cannon RJC, Matthews L and Collins DW, 2007. A review of the pest status and control options for *Thrips palmi*. *Crop Protection*, 26, 1089–1098.
- Capinera JL, 2000. Melon thrips, *Thrips palmi* Karny (Insecta: Thysanoptera: Thripidae). *Electronic Data Information Source (EDIS)*. Publication EENY135. University of Florida, Gainesville, Florida, USA.
- Cardona C, Frei A, Bueno JM, Diaz J, Gu H and Dorn S, 2002. Resistance to *Thrips palmi* (Thysanoptera: Thripidae) in beans. *Journal of Economic Entomology*, 95, 1066–1073.
- Castineiras A, Pena JE, Duncan R and Osborne L, 1996. Potential of *Beauveria bassiana* and *Paecilomyces fumosoroseus* (Deuteromycotina: Hyphomycetes) as biological control agents of *Thrips palmi* (Thysanoptera: Thripidae). *Florida Entomologist*, 458.

- Culliney TW, 1990. Population performance of *Thrips palmi* (Thysanoptera: Thripidae) on cucumber infected with a mosaic virus.
- Cuthbertson AGS, 2014. Compatibility of predatory mites with pesticides for the control of *Thrips palmi* Karny. 103, 17–21.
- Cuthbertson AGS, North JP and Walters KFA, 2005. Effect of temperature and host plant leaf morphology on the efficacy of two entomopathogenic biocontrol agents of *Thrips palmi* (Thysanoptera: Thripidae). Bulletin of Entomological Research, 95, 321.
- de Bon H and Rhino B, 1989. Control of *Thrips palmi* (Karny) in Martinique. Agronomie Tropicale, 44, 129–136.
- Dong YJ and Hsiu BC, 2019. Methyl salicylate attracts predators and reduces melon thrips population (*Thrips palmi* Karny) (Thysanoptera: Thripidae) in cucumber plants. J. Taiwan Agric. Res., 68, 128–136.
- EFSA PLH Panel (EFSA Panel on Plant Health), 2018. Guidance on quantitative pest risk assessment. EFSA Journal 2018;16(8):5350, 86 pp. <https://doi.org/10.2903/j.efsa.2018.5350>
- EFSA PLH Panel (EFSA Panel on Plant Health), 2019. Guidance on commodity risk assessment for the evaluation of high risk plants dossiers. EFSA Journal 2019;17(4):5668, 20 pp. <https://doi.org/10.2903/j.efsa.2019.5668>
- EFSA Scientific Committee, Benford D, Halldorsson T, Jeger MJ, Knutsen HK, More S, Naegeli H, Noteborn H, Ockleford C, Ricci A, Rychen G, Schlatter JR, Silano V, Solecki R, Turck D, Younes M, Craig P, Hart A, Von Goetz N, Koutsoumanis K, Mortensen A, Ossendorp B, Martino L, Merten C, Mosbach-Schulz O and Hardy A, 2018. Guidance on Uncertainty Analysis in Scientific Assessments. EFSA Journal 2018;16(1):5123, 39 pp. <https://doi.org/10.2903/j.efsa.2018.5123>
- Ekési S and Maniania NK, 2002. *Metarhizium anisopliae*: an effective biological control agent for the management of thrips in horti-and floriculture in Africa. In Advances in Microbial Control of Insect Pests. Springer, Boston, MA. pp. 165–180.
- Ekési S, Maniania NK, Akpa AD, Onu I and Dike MC, 2000. Entomopathogenicity of *Beauveria bassiana* and *Metarhizium anisopliae* (Hyphomycetes) to the onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) Nig. J. Ent, 17, 21–30.
- EPPO (European and Mediterranean Plant Protection Organization), 2018a, online. EPPO Global Database. Available online: <https://gd.eppo.int>
- EPPO (European and Mediterranean Plant Protection Organization), 2018b. PM 7/3 (3) *Thrips palmi*. EPPO Bulletin, 48, 446–460.
- Etienne J, Guyot J and van Waetermeulen X, 1990. Effect of insecticides, predation, and precipitation on populations of *Thrips palmi* on aubergine (eggplant) in Guadeloupe. The Florida Entomologist, 73, 339–342.
- EUROPHYT, online. European Union Notification System for Plant Health Interceptions - EUROPHYT. Available online: http://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm
- Faci JM, Medina ET, Martínez-Cob A and Alonso JM, 2014. Fruit yield and quality response of a late season peach orchard to different irrigation regimes in a semi-arid environment. Agricultural Water Management, 143, 102–112.
- Frei A, Bueno JM, Diaz-Montano J, Gu H, Cardona C and Dorn S, 2004. Tolerance as a mechanism of resistance to *Thrips palmi* in common beans. Entomologia experimentalis et applicata, 112, 73–80.
- Gao YF, Gong YJ, Cao LJ, Chen JC, Gao YL, Mirab-balou M and Wei SJ, 2019. Geographical and interspecific variation in susceptibility of three common thrips species to the insecticide, spinetoram. Journal of Pest Science, 1–7.
- Ghosh A, Jagdale SS, Dietzgen RG and Jain RK, 2020. Genetics of *Thrips palmi* (Thysanoptera: Thripidae). Journal of Pest Science, 1–13.
- Hadiya GD, Kalariya GB and Kalola NA, 2016. Efficacy of different entomopathogenic fungus on chilli thrips. Adv Life Sci, 5, 1658–1660.
- Hajime H, Katai Y, Mannen J and Masui S, 2014. Attraction of Melon Thrips, *Thrips palmi* (Karny), to Color Sheets and LED Lights. Japanese Journal of Applied Entomology & Zoology, 58.
- Hara AH, Mau RFL, Heu R, Jacobsen C and Niino-DuPonte R, 2002. Banana Rust Thrips. Damage to Banana and Ornamentals in Hawaii. CTAHR — Insect Pests, IP-10. Available online: https://www.ctahr.hawaii.edu/oc/free_pubs/pdf/IP-10.pdf
- Hotaka D, Amnuaykanjanasin A, Maketon C, Siritutsoontorn S and Maketon M, 2015. Efficacy of *Purpureocillium lilacinum* CKPL-053 in controlling *Thrips palmi* (Thysanoptera: Thripidae) in orchid farms in Thailand. Applied Entomology and Zoology, 50, 317–329.
- Huang KC, 1989. The population fluctuation and trapping of *Thrips palmi* in waxgourd. Bulletin of the Taichung District Agricultural Improvement Station, 25, 35–41.
- Huang LH and Chen CN, 2004. Temperature effect on the life history traits of *Thrips palmi* Karny (Thysanoptera: Thripidae) on eggplant leaf. Plant Protection Bulletin Taipei, 46, 99–111.
- Ilic ZS, Fallik E, Manojlovic M, Kevresan Z and Mastilovic J, 2018. Postharvest practices for organically grown products. Contemporary Agriculture, 67, 71–80. <https://doi.org/10.2478/contagri-2018-0011>
- Ingrid A, Marciano C, Contreras J, Jiménez O, Escalona A and Pérez P, 2012. Characterization of agronomic crop management of cucumber (*Cucumis sativus* L.) at Humocaro Bajo, Lara state, Venezuela. Revista Unellez de Ciencia y Tecnología, Producción Agrícola, 30, 36–42.

- Karar H, Ahmad M, Ullah H, Wajid M, Zubair M and Raza H, 2019. Effectiveness of fruit bagging for the control of insect-pests complex and its impact on quality of mango fruits. *Journal of Horticultural Science and Technology*, 2, 45–48.
- Karny HH, 1925. Thrips found on tobacco in Java and Sumatra. *Bulletin Deli Proefstation*, 23, 3–55.
- Kawai A, 1983. Studies on population ecology of *Thrips palmi* Karny. I. Population growth and distribution pattern on cucumber in the greenhouse. *Japanese Journal of Applied Entomology and Zoology*, 27, 261–264.
- Kawai A, 1985. Studies on population ecology of *Thrips palmi* Karny. VII. Effect of temperature on population growth. *Japanese Journal of Applied Entomology and Zoology*, 29, 140–143.
- Kawai A, 1986. Studies on population ecology of *Thrips palmi* Karny. XI. Analysis of damage to cucumber. *Japanese Journal of Applied Entomology and Zoology*, 30, 12–16. <https://doi.org/10.1303/jjaez.30.12>
- Kawai A, 1990. Life cycle and population dynamics of *Thrips palmi* Karny. *Japan Agricultural Research Quarterly*, 23, 282–288.
- Kawai A, 2001. Population management of *Thrips palmi* Karny. *Jpn. J. Appl. Entomol. Zool.*, 45, 39–59.
- Kawai A and Kitamura C, 1987. Studies on population ecology of *Thrips palmi* KARNY: XV. evaluation of effectiveness of control methods using a simulation model. *Applied Entomology and Zoology*, 22, 292–302.
- Kawai A and Kitamura C, 1990. Studies on population ecology of *Thrips palmi* Karny 18. evaluation of effectiveness of control methods of thrips on eggplant and sweet pepper using a simulation model. *Applied Entomology and Zoology*, 25, 161–175.
- Kim K, Kim MJ, Han SH, Kim SH, Kim JH and Lee SH, 2019. Amount and time course of ingestion of plant subcellular fractions by two thrips and one reference mite species. *Journal of Asia-Pacific Entomology*, 22, 733–736.
- Kirk WD, 2017. The aggregation pheromones of thrips (Thysanoptera) and their potential for pest management. *International Journal of Tropical Insect Science*, 37, 41–49.
- de López MA, Corozo-Ayovi RE, Delgado R, Osorio B, Moyón D, Rengifo D and Rojas JC, 2020. Red rust thrips in smallholder organic export banana in Latin America and the Caribbean: pathways for control, compatible with organic certification. *Acta Horticulturae*, 1272, 153–161.
- MacLeod A, Head J and Gaunt A, 2004. An assessment of the potential economic impact of *Thrips palmi* on horticulture in England and the significance of a successful eradication campaign. *Crop Protection*, 23, 601–610.
- Maketon M, Amnuaykanjanasin A, Hotaka D and Maketon C, 2014. Population ecology of *Thrips palmi* (Thysanoptera: Thripidae) in orchid farms in Thailand. *Applied Entomology and Zoology*, 49, 273–282.
- Maltby J and Walsh B, 2005. Melon thrips in potatoes. The State of Queensland, DPI&F (Department of Primary Industries and Fisheries) note. File No: H0299. Available online: <http://www.dpi.qld.gov.au/horticulture/14155.html>
- Martins RC, 2018. Produção, qualidade e sanidade de frutos de bananeira BRS Conquista ensacados com polipropileno de diferentes cores.
- Matsui M, Monma S and Koyama K, 1995. Screening of resistant plants in the genus *Solanum* to *Thrips palmi* Karny (Thysanoptera: Thripidae) and factors related to their resistance. *Bulletin of the National Research Institute of Vegetables, Ornamental Plants and Tea Series A: Vegetables and Ornamental Plants*, 10, 13–24.
- McDonald JR, Bale JS and Walters KFA, 1999. Temperature, development and establishment potential of *Thrips palmi* in the UK. *European Journal of Entomology*, 96, 169–173.
- Morse JG and Hoddle MS, 2006. Invasion biology of thrips. *Annual Review of Entomology*, 51, 67–89.
- Murai T, 2002. The pest and vector from the East: *Thrips palmi*. In: Marullo R and Mound LA (eds). *Thrips and Tospoviruses: Proceedings of the 7th International Symposium on Thysanoptera*. Australian National Insect Collection, Canberra, pp. 19–32.
- Nagai H and Tsumuki H, 1990. Search for winter host plants of *T. palmi* in winter [in Japanese]. *Japanese Journal of Applied Entomology and Zoology*, 34, 105–108.
- Nakamura Y, Shibao M, Tanaka H and Yano E, 2014. Timing of the Attraction of Melon Thrips, *Thrips palmi* (Thysanoptera: Thripidae), to Reflective-type Traps Combined with Blue Sticky Board and a Blue LED Array. *Japanese Journal of Applied Entomology & Zoology*, 58.
- Nonaka K and Nagai K, 1984. Ecology and control of the thrips infesting fruit vegetables. 8. Control of *Thrips palmi* using blue coloured sticky ribbons. *Kyushu Agric. Res.*, 44, 119.
- North JP, Cuthbertson AG and Walters KF, 2006. The efficacy of two entomopathogenic biocontrol agents against adult *Thrips palmi* (Thysanoptera: Thripidae). *Journal of Invertebrate Pathology*, 92, 89–92.
- Nozawa H, Matsui M and Koyama K, 1994. An examination on susceptibility of *Thrips palmi* Karny to insecticides collected from various locations in Japan *Proc. Kanto Pl. Prot. Soc.*, 41, 205–207 (In Japanese).
- Nuessly GS and Nagata RT, 1995. *Pepper varietal response to thrips feeding. Thrips biology and management*. Springer, Boston, MA. pp. 115–118.
- OEPP/EPPO, 1989. Data sheets on quarantine organisms No. 175, *Thrips palmi*. *Bulletin OEPP/EPPO Bulletin*, 19, 717–720.
- Osorio J and Cardona C, 2003. Phenology, population dynamics and sampling methods for *Thrips palmi* (Thysanoptera: Thripidae) on snap beans and beans. *Revista Colombiana de Entomología*, 29, 43–49.
- Park CG, Kim HY and Lee JH, 2010. Parameter estimation for a temperature-dependent development model of *Thrips palmi* Karny (Thysanoptera: Thripidae). *Journal of Asia-Pacific Entomology*, 13, 145–149.

- Park SE, Kim JC, Lee SJ, Lee MR, Kim S, Li D and Shin TY, 2018. Solid cultures of thrips-pathogenic fungi *Isaria javanica* strains for enhanced conidial productivity and thermotolerance. *Journal of Asia-Pacific Entomology*, 21, 1102–1109.
- Pedigo LP, Hutchins SH and Higley LG, 1986. Economic injury levels in theory and practice. *Annual Review of Entomology*, 31, 341–368.
- Qing Y, Wu W and Liang G, 2004. Natural predators of *Thrips palmi* (Karny) and their role in natural control. *Chinese Agricultural Science Bulletin*, 20, 250–264.
- Razzak MA and Seal DR, 2017. Effect of plastic mulch on the abundance of *Thrips palmi* Karny (Thysanoptera: Thripidae) and yield of jalapeno pepper in South Florida. 130. Florida State Horticultural Society. pp. 124–128.
- Razzak MA, Seal DR and Schaffer B, 2018. Vegetable Section. *Proc. Fla. State Hort. Soc.*, 131, 126–131.
- Rosenheim JA, Welter SC, Johnson MW, Mau RF and Gusukuma-Minuto LR, 1990. Direct feeding damage on cucumber by mixed-species infestations of *Thrips palmi* and *Frankliniella occidentalis* (Thysanoptera: Thripidae). *Journal of Economic Entomology*, 83, 1519–1525.
- Saito T, 1991. A field trial of an entomopathogenic fungus, *Beauveria bassiana* (Bals.) Vuill., for the control of *Thrips palmi* Karny (Thysanoptera: Thripidae). *Japanese Journal of Applied Entomology and Zoology*, 35, 80–81.
- Saito T, 1992. Control of *Thrips palmi* and *Bemisia tabaci* by a mycoinsecticidal preparation of *Verticillium lecanii*. In *Proceedings of the Kanto-Tosan Plant Protection Society* (No. 39, pp. 209–210).
- Sakimura K, Nakahara LM and Denmark HA, 1986. A thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae). A thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae), 280.
- Salas J, 2004. Evaluation of cultural practices to control *Thrips palmi* (Thysanoptera: Thripidae) on green pepper.
- Sampson C and Kirk WDJ, 2013. Can mass trapping reduce thrips damage and is it economically viable? Management of the western flower thrips in strawberry. *PLoS ONE*, 8, e80787. <https://doi.org/10.1371/journal.pone.0080787>
- Sánchez MDC, Figueroa R, Campos A and Romero R, 2011. Evaluación del color y de la orientación de trampas adhesivas en la atracción de trips en siembras comerciales de vainita. *Agronomía Tropical*, 61, 141–148.
- Shao F, Yang D and Ren L, 2015. Field experiment on control effects of 14 biopesticides on *Thrips palmi* Karny. *Journal of Southern Agriculture*, 46, 1237–1242.
- Sharma RR, Reddy SVR and Jhalegar MJ, 2014. Pre-harvest fruit bagging: a useful approach for plant protection and improved post-harvest fruit quality—a review. *The Journal of Horticultural Science and Biotechnology*, 89, 101–113.
- Shen JY, Wu L, Liu HR, Zhang B, Yin XR, Ge YQ and Chen KS, 2014. Bagging treatment influences production of C6 aldehydes and biosynthesis-related gene expression in peach fruit skin. *Molecules*, 19, 13461–13472.
- Shi P, Guo SK, Gao YF, Cao LJ, Gong YJ, Chen JC and Wei SJ, 2020. Variable resistance to spinetoram in populations of *Thrips palmi* across a small area unconnected to genetic similarity. *Evolutionary Applications*.
- Shibao M and Tanaka H, 2014. Attraction of the Melon Thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae), to Traps Combined with a Colored Sticky Board and an LED (Light Emitting Diode). *Japanese Journal of Applied Entomology & Zoology*, 58.
- Shiotsuka K, Hamasaki K, Shibao M and Okada K, 2016. Control of melon thrips, *Thrips palmi* Karny, on greenhouse cucumber with the combined use of a red insect-proof net, *Amblyseius swirskii*, and *Metarhizium anisopliae*. *Annual Report of The Kansai Plant Protection Society.*, 58, 45–49. <https://doi.org/10.4165/kapps.58.45>
- Silva AIE, Morales CAM and Torres MM, 2011. Patogenicidad De Los Hongos *Metarhizium anisopliae* (METSCHN.), *Lecanicillium lecanii* (ZIMM.) ZARE & GAMS Y *Beauveria bassiana* (BALS.-CRIV.) VUILL. sobre *Thrips palmi* karny en el cultivo de la papa (*Solanum tuberosum* L.). *Fitosanidad*, 15, 147–151.
- Thongjua T, Thongjua J, Sriwareen J and Khumpairun J, 2015. Attraction effect of thrips (Thysanoptera: Thripidae) to sticky trap color on orchid greenhouse condition. *Journal of Agricultural Technology*, 11, 2451–2455.
- Trdan S, Valic N, Zezlina I, Bergant K and Znidarcic D, 2005. Light blue sticky boards for mass trapping of onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), in onion crops: fact or fantasy? *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz*, 112, 173–180.
- Trujillo Z, Pérez R, Borroto D and Concepción E, 2003. Efectividad de hongos entomopatógenos y *Bacillus thuringiensis* sobre *Thrips palmi* Karny en el cultivo del pepino. *Fitosanidad*, 7, 13–18.
- Tsolakis H and Ragusa S, 2008. Effects of a mixture of vegetable and essential oils and fatty acid potassium salts on *Tetranychus urticae* and *Phytoseiulus persimilis*. *Ecotoxicology and Environmental Safety*, 70, 276–282.
- Tsumuki H, Nagai K and Kanehisa K, 1987. Cold hardiness of *Thrips palmi*. I. Survival period of winter and summer populations at low temperatures [in Japanese]. *Japanese Journal of Applied Entomology and Zoology*, 31, 328–332.
- Van Lenteren JC and Loomans AJ, 1999. Biological control of thrips: how far are we. *Bull. IOBC*, 22, 141–144.
- Vestergaard S, Gillespie AT, Butt TM, Schreiter G and Eilenberg J, 1995. Pathogenicity of the hyphomycete fungi *Verticillium lecanii* and *Metarhizium anisopliae* to the western flower thrips. *Frankliniella occidentalis*. *Biocontrol Science and Technology*, 5, 185–192.
- Visalakshy PG, Kumar AM and Krishnamoorthy A, 2004. Epizootics of a fungal pathogen, *Verticillium lecanii* Zimmermann on *Thrips palmi* Karny. *Insect Environment*, 10, 134–135.

- Visschers IG, Peters JL, van de Vondervoort JA, Hoogveld RH and van Dam NM, 2019. Thrips resistance screening is coming of age: leaf position and ontogeny are important determinants of leaf-based resistance in pepper. *Frontiers in Plant Science*, 10, 510.
- Wafula GO, Muthomi JW, Nderitu JH and Chemining'wa GN, 2017. Efficacy of potassium salts of fatty acids in the management of thrips and whitefly on snap beans. *Sustainable Agriculture Research*, 6, 45. <https://doi.org/10.5539/sar.v6n4p45>
- Wang CL, Chu YI and Lo KC, 1989. The reproductive mechanism of *Thrips palmi* Karny. 1. The female oviposition behaviour. *Chinese Journal of Entomology*, 9, 251–261.
- Welter SC, Rosenheim JA, Johnson MW, Mau RFL and Gusukuma-Minuto LR, 1990. Effects of *Thrips palmi* and western flower thrips (Thysanoptera: Thripidae) on the yield, growth, and carbon allocation pattern in cucumbers. *Journal of economic entomology*, 83, 2092–2101.
- Yadav R and Chang NT, 2013. Economic thresholds of *Thrips palmi* (Thysanoptera: Thripidae) for eggplants in a greenhouse. *Applied Entomology and Zoology*, 48, 195–204. <https://doi.org/10.1007/s13355-013-0172-8>
- Yadav R and Chang NT, 2014. Effects of temperature on the development and population growth of the melon thrips, *Thrips palmi*, on eggplant, *Solanum melongena*. *Journal of Insect Science*, 14, 78. <https://doi.org/10.1093/jis/14.1.78>
- Yasuda T and Momonoki T, 1988. Varietal resistance of eggplant [aubergine] introduced from southeast Asia to *Leucinodes orbonalis* Guenee and *Thrips palmi* Karny. *Proceedings of the Association for Plant Protection of Kyushu*, No. 34, 139–140.
- Yoshihara T and Kawai A, 1982. 28, 130–131.
- Young GR and Zhang L, 1998. Control of the melon thrips, *Thrips palmi*. *Primary Industry and Fisheries Northern Territory*, Darwin, Australia.
- Zhang J, Idowu OJ, Wedegaertner T and Hughs SE, 2014. Genetic variation and comparative analysis of thrips resistance in glandless and glanded cotton under field conditions. *Euphytica*, 199, 373–383.
- Wikipedia, 2011a. https://es.wikipedia.org/wiki/Departamento_de_Comayagua#/media/Archivo:Comayagua_in_Honduras.svg. Departamento de Comayagua, Honduras.
- Wikipedia, 2011b. https://en.wikipedia.org/wiki/Honduras#/media/File:HND_orthographic.svg. Honduras, orthographic map.

Glossary

Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 1995, 2017)
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2017)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2017)
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2017)
Measures	Control (of a pest) is defined in ISPM 5 (FAO 2017) as 'Suppression, containment or eradication of a pest population' (FAO, 1995). Control measures are measures that have a direct effect on pest abundance. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk mitigation measures that do not directly affect pest abundance.
Pathway	Any means that allows the entry or spread of a pest (FAO, 2017)
Pest pressure	Local population density of a pest (often used in economic threshold levels in IPM)
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2017)
Protected zone	A Protected zone is an area recognised at EU level to be free from a harmful organism, which is established in one or more other parts of the Union.
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2017)

Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party (FAO, 2017)
Risk mitigation measure	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A risk mitigation measure may become a phytosanitary measure, action or procedure according to the decision of the risk manager
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2017)

Abbreviations

CABI	Centre for Agriculture and Bioscience International
EKE	Expert Knowledge Elicitation
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
INS	Insect
ISPM	International Standards for Phytosanitary Measures
PLH	Plant Health
PRA	Pest Risk Assessment
RNQPs	Regulated Non-Quarantine Pests

Appendix A – Data sheets of pests selected for further evaluation via Expert Knowledge Elicitation

A.1. Thrips palmi

A.1.1. Organism information

Taxonomic information	<p>Current valid scientific name: <i>Thrips palmi</i> Karny *</p> <p>Synonyms: <i>Thrips clarus</i> Moulton, 1928; <i>Thrips leucadophilus</i> Priesner, 1936; <i>Thrips gossypicola</i> Ramakrishna & Margabandhu, 1939; <i>Chloethrips aureus</i> Ananthakrishnan & Jagadish, 1967 <i>Thrips gracilis</i> Ananthakrishnan & Jagadish, 1968.</p> <p>Name used in the EU legislation: <i>Thrips palmi</i> Karny [THRIPL]</p> <p>Order: Thysanoptera</p> <p>Family: Thripidae</p> <p>Common name: oriental thrips, palm thrips, southern yellow thrips</p> <p>Name used in the Dossier: <i>Thrips palmi</i></p> <p>* see Symptoms: confusion with other pests</p>
Group	Insects
EPPO code	THRIPL
Regulated status	<p><i>Thrips palmi</i> is regulated in the European Union, and it is listed in the Union Quarantine pests: Annex II Part A - Pests not known to occur in the European Union. Commission Implementing Regulation (EU) 2019/2072.</p> <p>A1 list: East Africa (2001), Egypt (2018), Southern Africa (2001), Argentina (2019), Chile (2019), Paraguay (1993), Uruguay (1993), Bahrain (2003), Jordan (2013), Kazakhstan (2017), Azerbaijan (2007), Georgia (2018), Moldova (2006), Russia (2014), Turkey (2016), Ukraine (2019), EAEU (2016), EPPO (1988)</p> <p>A2 list: CAHFS (1990), COSAVE (2018)</p> <p>Quarantine: Morocco (2018), Tunisia (2012), Mexico (2018), Israel (2009), Norway (2012), New Zealand (2000)</p>
Pest status in Honduras	<p>Present (EPPO, Online; CABI CPC, Online).</p> <p>It is mainly found in the Central Eastern Region where the largest area of vegetable production is concentrated.</p>
Pest status in the EU	Absent (EPPO, Online; CABI CPC, Online)
Host status on <i>Momordica charantia</i> L.	According to the Pest categorization of <i>Thrips palmi</i> (EFSA, 2019), <i>Momordica charantia</i> is one of the main host plants of <i>Thrips palmi</i> .
PRA information	<p>Pest Risk Assessments currently available:</p> <ul style="list-style-type: none"> Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports (Australian Government Department of Agriculture and Water Resources, 2017) Pest categorisation of <i>Thrips palmi</i> (EFSA Scientific Opinion, 2019)
Interceptions (Europhyt/Traces NT)	There is a single interception of <i>T. palmi</i> on <i>M. charantia</i> fruits originating from Honduras in November 2019.
Surveillance information	<p>The National Service of Agrifood Health and Safety (SENASA), through its Department of Diagnosis, Surveillance and Phytosanitary Campaigns, implements the Phytosanitary Epidemiological Surveillance Program since the second half of 2016.</p> <p>For <i>T. palmi</i>, there is a specific sampling methodology in the field as well as instalment of 10 blue sticky traps per field. Sampling in areas under phytosanitary control is carried out weekly, starting from the establishment of the crop and until the beginning of the harvest. Field audits are carried out by the SENASA Technical staff.</p>

Country specific information

A.1.1.1. Pest pressure in the production area

Temperature range between 20°C and 30°C which is an optimal range for multiplication of *T. palmi*.

Thrips palmi is under official surveillance (i.e. audits of monitoring in the field are carried out systematically following the points specified in the Good Agricultural Practices Programme of Honduras see dossier sections 1 and 6). *T. palmi* is widespread in the area of production and is considered by farmers a phytosanitary problem. The frequency and the number of sprays are high probably underlying high pest pressure in the field.

Thrips in *M. charantia* production fields belonging to two species i.e. *Frankliniella occidentalis* and *T. palmi* are present since the beginning of the first flowers in the crop and during harvests. Specific data on *T. palmi* population dynamics in *M. charantia* fields in Honduras are not available. Limited monitoring data of thrips during a production cycle of *M. charantia* were used (see dossier sections 7 and 8).

Uncertainties:

- There are limited data on population dynamics of *T. palmi* on *M. charantia*.
- Since identification of thrips at species level is difficult in the field, it is possible that field observations of thrips refer to other species than *T. palmi* (e.g. mixtures of *F. occidentalis* and *T. palmi*)

A.1.1.2. Evaluation of measures applied in the field

The main control measures applied in the field until harvest are official inspections, monitoring, application of insecticides and inspection during harvesting.

Momordica charantia fields are inspected by farmers and phytosanitary inspectors throughout the growing season on a weekly basis. Application of insecticides occurs at weekly intervals. Insecticides applied based on a specific schedule plan. A sample of efficacy data following a weekly scheduled application plan shows that efficacy range from 35% to 84% during the production stage of the crop and from 33% to 100% during the development and flowering period of the crop (Tables A.1, A.2).

Uncertainties:

- Specific efficacy data are either not available or are limited

Table A.1: Overview, evaluation and uncertainties of measures applied in the field against *Thrips palmi* on *Momordica charantia* fruits from Honduras designated for export to the EU

Measures applied in the field		
Risk mitigation measure	Description of applied measure	Evaluation and uncertainties
Export to EU during specific period of the year	There is an intentional 3- to 5-month gap (between June and October) in which <i>M. charantia</i> fruits are not produced and exported to the EU.	Aim to intervene in production sites, use measures to avoid high population densities <u>Uncertainties</u> <ul style="list-style-type: none"> • Is not clear if this method is applied for <i>T. palmi</i> or for other pests
Pest specific monitoring	There is a specific monitoring programme of the fields that is supervised by SENASA Technical staff. Monitoring occurs weekly throughout the production cycle of the crop and samples are taken for laboratory examination.	Given that Honduras is applying a calendar-based scheme (almost at a weekly basis), it is unclear what the monitoring data are used for.

Measures applied in the field		
Risk mitigation measure	Description of applied measure	Evaluation and uncertainties
Chemical control	Various insecticides are frequently applied (see details in Table A.2 here below).	The frequency of insecticide applications is very high in 130 days, 32 applications, ca. every 4 days). Based on efficacy data provided, thrips' population build up very rapidly. <u>Uncertainties</u> Number of thrips recorded after insecticide application, may also include other species like <i>F. occidentalis</i>
Biological control	Biological control agents are not applied (dossier section 6). Nonetheless, there are naturally occurring control agents in the area of <i>M. charantia</i> production.	
Protected cultivation	Production in greenhouse is in an experimental phase (dossier section 6); however currently, there are no <i>M. charantia</i> fruits exported from protected cultivation in Honduras.	

Table A.2: Overview of insecticides and other phytosanitary products used for the control of *Thrips palmi* in *Momordica charantia* fields in Honduras based on the information provided in sections of the dossier 1, 2, 7 and 8

Insecticides and other phytosanitary products used to control <i>Thrips palmi</i>			
Product	Type of product	Efficacy as reported (see Annex E1 in dossier)	Efficacy Evaluation by the Panel
Abamectin	Translaminar insecticide	Not reported	High effect
Emamectin Benzoate	Translaminar insecticide	Not reported	Low effect
Neem Extract		66–90%	Medium effect
Sulfur (Table E1)	Contact	33–66%	Medium effect
Cinnamon oil 40% Clove oil 10%	Vegetable Contact oil	33–66%	Low effect
Thiametoxam	Systemic insecticide	66–90%	High on thrips
Imidacloprid	Systemic insecticide	66–90%	High on thrips
Lambda-cyhalothrin	Pyrethroid contact	Not reported	Medium effect
Garlic Extract	Repellent	Not reported	Uncertain-low
Flupyradifurone	Systemic	Not reported	Medium effect
Fatty acids/Potassium salts	Contact	Not reported	Medium effect
Extract of citrus peels	Repellent	Not reported	Uncertain-low-medium effect
Spinosad	Contact	66–90%	High on thrips
Spinetoram	Contact	66–90%	High on thrips
Garlic extract and Quassia	Contact insecticide	Not reported	Medium
Vegetal oils	Contact (oil)	33–66%	Low effect
Natural pyrethrine	Contact	Not reported	Medium
Chlorantraniliprole	Ingestion and contact	Not reported	No effect
<i>Beauveria bassiana</i>	Entomopathogenic fungus	Not reported	Low medium
<i>Bacillus thuringiensis</i>	Bacteria	Not reported	No effect

A.1.1.3. Evaluation of measures applied in the packing house

The main control measures applied in the packing house are: (a) inspection before processing, (b) brushing and air blowing, (c) washing and (d) pest inspections before packing.

When *M. charantia* fruits are delivered to packing houses, quality control (QC) officer will take samples to inspect the quality and pest infestation on fruits. If the quality of *M. charantia* fruits is lower than standard or any pest infestation notice over standard, the fruits will be refused to process in the packing house. However, data on frequency of rejections at packing houses were not made available. Fruits are brushed and air blown individually before washing with sanitising products such as peroxyacetic acid. However, these practices are not intended to remove pests such as thrips but mainly for disinfecting fruits. Finally, samples of fruits will be inspected by packing house personnel for signs of insect infestation (Table A.3).

Uncertainties:

- Data on efficacy of the above methods in removing *T. palmi* from fruits were not made available.

Table A.3: Overview of post-harvest measures used in *Momordica charantia* packing houses in Honduras based on the information provided in sections of the dossier 1, 2, 7 and 8

Overview of post-harvest measures applied		
Risk mitigation measure	Description of applied measure	Evaluation and uncertainties
Inspection	Fruits are visually inspected in the field before transport.	This method is intended mainly as first filter to discard fruits infested by pests or do not fulfil quality (visual) requirements. As such, it is not aimed to detect <i>T. palmi</i> . This method will only detect heavily infested fruits showing clear symptoms of infestation.
Transport	The collected fruits are transported in vehicles with airtight cargo compartment.	
Inspection upon arrival to the packing house	Reception at the packing plant: Upon arrival at the packing facility, the transport conditions are reviewed, pest monitoring is done and the entry or rejection of the fruit is decided.	This method is intended mainly as first filter to discard fruits infested by pests or do not fulfil quality (visual) requirements. As such, is not aimed to detect <i>T. palmi</i> . This method will only detect heavily infested fruits showing clear symptoms of infestation.
Sorting/Classification	Once the fruit enters the packinghouse, they proceed to the selection and cleaning process. At this stage, possible physical damages are detected. The selection parameters consist of separating all those fruits that present deformations, inappropriate colour or any type of damage that detracts value and quality.	This method is intended mainly as first filter to discard fruits infested by pests or do not fulfil quality (visual) requirements. As such, is not aimed to detect <i>T. palmi</i> . This method will only detect heavily infested fruits showing clear symptoms of infestation.
Brushing	The fruit is brushed	The brushing has no effect on eggs as eggs are laid inside the fruit tissue, especially when using soft brushing. Brushing has low to intermediate effect on larvae and adults. Brushed adults may not be killed and therefore re-infest other fruits in the packing station. Efficacy data are not provided.

Overview of post-harvest measures applied

Risk mitigation measure	Description of applied measure	Evaluation and uncertainties
Washing with pressurised water	The whole fruit is washed with pressurised water in order to eliminate any live insects that may appear, this is done manually to each individual fruit.	The effect of water on insects is uncertain or very low Pressurised washing has little effect on <i>T. palmi</i> eggs. Data on the efficacy of this method are not provided.
Submersion in water (1st)	The fruits are subjected to a post-harvest treatment which consists of submerging the fruit in a container containing a water solution with an undefined disinfectant.	The phytosanitary product is not defined. Immersion has little effect on <i>T. palmi</i> eggs. If water is not refreshed frequently, there is a risk of re-infesting clean material. Data on the efficacy of this method are not provided.
Submersion in water (2nd)	15 min post-harvest immersion treatment in cold water (approx. 4–8°C) with sodium hypochlorite.	There is no effect on <i>T. palmi</i> eggs and also on other life stages of the pest. If water is not refreshed frequently, there is a risk of re-infesting clean material. Data on the efficacy of this method are not provided
Pest inspection	A 15% sample of the fruits that is intended to be packaged is inspected for <i>T. palmi</i> .	

A.1.2. Information from interceptions

There is a single interception reported in Europhyt/TRACES-NT (1995–2020) of *T. palmi* on *Momordica* fruits originating from Honduras, in November 2019.

A.1.3. Overall likelihood of pest freedom

Rating of the likelihood of pest freedom	Very frequently pest free (based on the Median)				
	5%	25%	Median	75%	95%
Percentile of the distribution					
Proportion of pest free fruits*	9,406 out of 10,000 fruits	9,749 out of 10,000 fruits	9,884 out of 10,000 fruits	9,957 out of 10,000 fruits	9,994 out of 10,000 fruits
Proportion of infested fruits*	6 out of 10,000 fruits	43 out of 10,000 fruits	116 out of 10,000 fruits	251 out of 10,000 fruits	594 out of 10,000 fruits
Summary of the information used for the evaluation	<p>Possibility that the pest could become associate with the commodity Environmental conditions in Honduras are optimal for <i>T. palmi</i> development. <i>Thrips palmi</i> is widespread in the area of production and is considered by farmers a phytosanitary problem. The frequency and the number of sprays is very high probably underlying high infestation in the field. Thrips are recorded on <i>M. charantia</i> plants throughout a growing cycle.</p>				

Measures taken against the pest and their efficacy

The main control measures applied in the field until harvest are official inspections, monitoring, application of insecticides and inspection during harvesting. Efficacy of the applied insecticides ranges from 35% to 84% during the production stage of the crop and from 33% to 100% during the development and flowering period of the crop (Dossier sections 7 and 8).

Measures in the packing house include inspection before processing, brushing and air blowing, washing and pest inspections before packing. Measures in the packing house target mainly adults and larvae and have minimal effect on eggs.

Interception records

There is a single interception reported in Europhyt/Traces-NT (1995–2020) of *T. palmi* on *M. charantia* fruits originating from Honduras, in November 2019.

Shortcomings of current measures/procedures

Application of insecticides is mainly performed on a calendar-like basis. Continuous use of insecticides is likely to cause development of resistant populations of *T. palmi*. Most measures applied in the packing house are not likely to have an effect on eggs that may be present on fruits.

Main uncertainties

There are limited data on population dynamics of *T. palmi* on *M. charantia*.

Since identification of thrips at species level is difficult in the field, it is possible that field observations of thrips refer to other species than *T. palmi* (e.g. mixtures of *F. occidentalis* and *T. palmi*)

Specific efficacy data for field applied measures are either limited or not available.

Data on efficacy of the methods applied in the packing house in removing *T. palmi* from fruits are not available.

The level of insecticide resistance against the insecticides applied in Honduras is uncertain

*: Numbers rounded off to the nearest whole number.

A.1.3.1. Reasoning for a scenario which would lead to a reasonably low number of infested consignments

Pest pressure

- The surrounding environment provides very few hosts for *T. palmi* (i.e. population sources)
- There is general pest management in place for thrips in agricultural areas where *M. charantia* is cultivated
- Natural biological control agents are very active and preserved and keep *T. palmi* controlled
- Thrips monitored are not always *T. palmi*. There are other species of thrips (*F. occidentalis*)

Field measures

- Regular and frequent inspection/monitoring targeted to *T. palmi*
- Exports match harvest periods where pest pressure is low
- There is an appropriate timing and use of active ingredients to control *T. palmi*

Measures in the packing house

- Low number of *T. palmi* flying inside the packing house
- Inspections at packing house and initial sorting of fruits are conducted properly and are effective in detecting and discarding infested fruits
- Cleaning measures (with water and other products, manually or using machines) are effective against *T. palmi* and render pest-free fruits
- Proper replacement of water and other products in the washing area
- Additives and other products used have an effect on the mortality of *T. palmi*
- Large proportion of infestation is in adult stage and/or juveniles (mobile stages)

A.1.3.2. Reasoning for a scenario which would lead to a reasonably high number of infested consignments

Pest pressure

- Density per/plant in examples provided seem to be high and recover very high after pesticide treatments which indicate high background infestation.
- The surrounding environment provides many hosts for *T. palmi*.
- There are uncontrolled sites where the pest occurs (e.g. and eggplant plantation without efficient control).
- Environment contains natural biological control agents are not active and preserved to control *T. palmi* due to poor management in other crops.
- Most monitored thrips are *T. palmi*.

Measures in the field

- Irregular inspection/monitoring and occasional inspections.
- Exports do not match harvest periods where pest pressure is low.
- There is an inadequate timing and use of active ingredients that are not efficient against *T. palmi*.

Measures in the packing house

- High number of *T. palmi* flying inside the packing house.
- Inspections at packing house and initial sorting of fruits are not conducted properly and are not effective in detecting and discarding infested fruits.
- Cleaning measures (with water and other products, manually or using machines) are not effective against *T. palmi* and do not render pest-free fruits.
- Poor replacement of water and other products in the washing area.
- Additives and other products used do not have an effect on the mortality of *T. palmi*.
- Large proportion of infestation are eggs.

A.1.3.3. Reasoning for a central scenario equally likely to over- or underestimate the number of infested consignments (Median)

- The surrounding environment provides sufficient hosts for *T. palmi*.
- Most monitored thrips are likely to be *T. palmi*.
- Insecticides are applied on a regular basis.
- Procedures in the packinghouse are effective in removing larvae and adult stages of *T. palmi* and detecting infested fruits.

A.1.3.4. Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

- Identification of thrips at species level is difficult in the field and observations of thrips may refer to other species than *T. palmi* (e.g. mixtures of *F. occidentalis* and *T. palmi*) and leading to either over- or underestimations of *T. palmi* pressure in the field.
- Specific efficacy data for field applied measures are either limited or not available.
- Data on efficacy of the methods applied in the packing house in removing *T. palmi* from fruits are not available.
- It is uncertain to what extent infestation reported in the field on vegetative plant parts (e.g. leaves) is related to infestation numbers on the fruits.
- The level of insecticide resistance against the insecticides applied in Honduras is uncertain.
- The clarification is given by the level of uncertainty which is higher for the values below the median.

A.1.3.5. Elicitation outcomes of the assessment of the pest freedom for *Thrips palmi*

The following tables show the elicited values for pest freedom in *Momordica charantia* fruits according to a three-step approach (i.e. estimating pest pressure, effectiveness of the measures applied in the field and in the packing house) (Table A.4) to come to a final estimation of likelihood of pest freedom (Table A.5, Figures A.1, A.2)

Table A.4: Elicited values to estimate the likelihood of pest freedom (i.e. no. of pest free fruits out of 10,000, elicited as 10,000 minus no. of infested fruits) and the fitted distributions in a three-step approach (i.e. Import risk: $R_{import} = p_{pressure} \times p_{field}/10,000 \times p_{packing}/10,000$; Pest freedom: $PF_{import} = 10,000 R_{import}$)

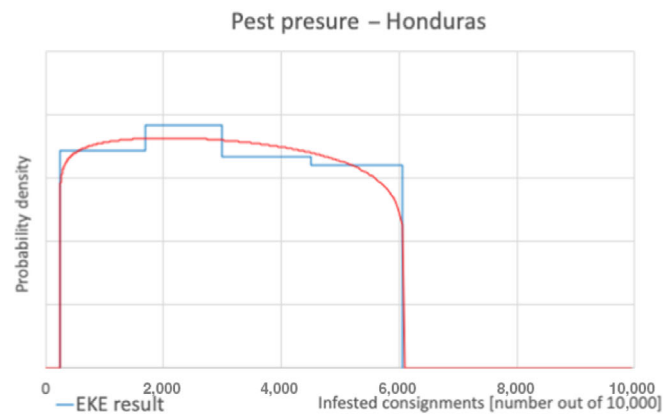
Percentile	Parameter	1%	25%	50%	75%	99%	Fitted distribution
Elicited values for pest pressure	$p_{pressure}$	300	1,700	3,000	4,500	6,000	Beta general (1.0545, 1.1214, 240, 6100)
Elicited values for measures in the field	p_{field}	500	1,800	3,000	4,700	6,700	Beta general (1.0282, 1.3492, 446, 6900)
Elicited values for measures in the packinghouse	$p_{packinghouse}$	100	900	1,700	2,800	4,000	Beta general (0.95631, 1.2207, 75, 4100)
Resulting model values for the import risk after Monte Carlo simulation	r_{import}	8.2	40	108	253	943	Calculated with @Risk version 7.6
As pest-free fruits		9,057	9,747	9,892	9,960	9,991.8	

Table A.5: The uncertainty distribution of fruits free of *Thrips palmi* per 10,000 fruits calculated by taking into account a three-step procedure and according to elicited values in Table A.4

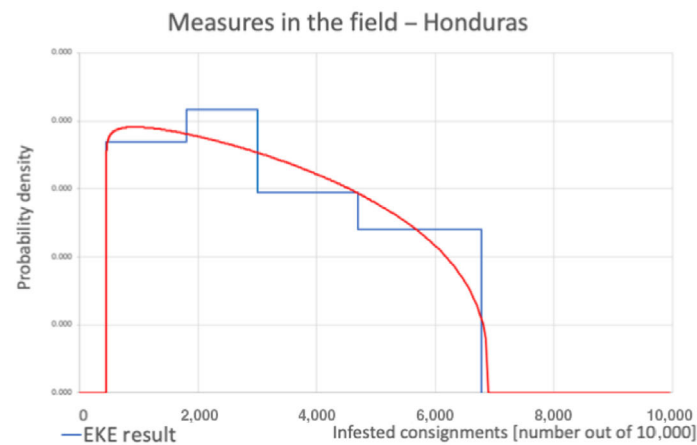
Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Three-step approach for pest freedom	9,057	9,225	9,371	9,531	9,654	9,747	9,811	9,892	9,942	9,960	9,975	9,985	9,991.8	9,995.2	9,997.2
EKE results	9,039	9,250	9,406	9,557	9,666	9,749	9,806	9,884	9,937	9,957	9,974	9,986	9,993.7	9,997.1	9,999.0

The EKE results are the fitted values for a Weibull distribution (0.89484, 174.37) fitted with @Risk version 7.5.

(a)



(b)



(c)

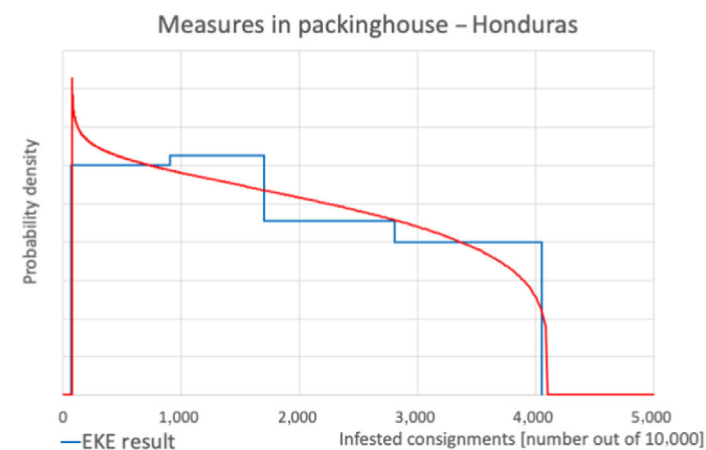


Figure A.1: Probability densities for the number of pest-free *Momordica charantia* fruits (x-axis) out of 10,000 designated for export to the EU introduced according to (a) estimated pest pressure in the field; (b) measures applied in the field; and (c) measures applied in the packing house for *Thrips palmi*

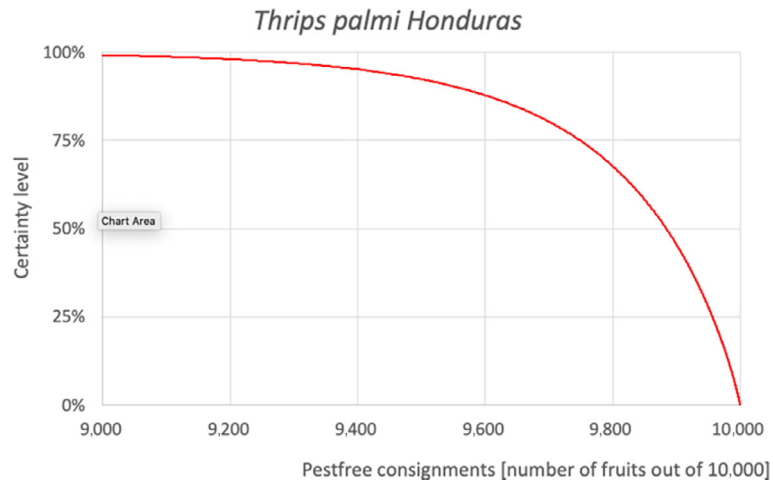


Figure A.2: Elicited certainty (y-axis) of the number of pest-free *Momordica charantia* fruits (x-axis; log-scaled) out of 10,000 plants designated for export to the EU introduced from Honduras for *Thrips palmi* visualised as descending distribution function. Horizontal lines indicate the percentiles (starting from the bottom 5%, 25%, 50%, 75%, 95%). The Panel is 95% sure that 9406 or more fruits per 10,000 will be free from *T. palmi*

A.1.4. Reference list

- Australian Government Department of Agriculture and Water Resources (2017). Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports.
- EFSA PLH Panel (EFSA Panel on Plant Health), Bragard C, Dehnen-Schmutz K, Di Serio F, Gonthier P, Jacques M-A, Jaques Miret JA, Fejer Justesen A, Magnusson CS, Milonas P, Navas-Cortes JA, Parnell S, Potting R, Reignault PL, Thulke H-H, Van der Werf W, Vicent Civera A, Yuen J, Zappala L, Malumphy C, Czwieniczek E and MacLeod A, 2019. Scientific Opinion on the pest categorisation of *Thrips palmi*. EFSA Journal 2019;17(2):5620, 39 pp. <https://doi.org/10.2903/j.efsa.2019.5620>
- EUROPHYT, online. European Union Notification System for Plant Health Interceptions – EUROPHYT Available online: http://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/index_en.htm [Accessed: 22 April 2020].
- EPPO (European and Mediterranean Plant Protection Organization), online. *Thrips palmi* Available online: <https://gd.eppo.int/taxon/THRIPL> [Accessed: 20 July 2020].
- CABI CPC (Centre for Agriculture and Bioscience International), online. Datasheet *Thrips palmi* Available online: <https://www.cabi.org/cpc/datasheet/5374> [Accessed: 22 July 2020]

Appendix B – Web of Science All Databases Search String

In the table below, the search string used in Web of Science is reported.

Web of Science	<p>TOPIC: ("Momordica" OR "<i>Momordica charantia</i>" OR "<i>M. charantia</i>" OR "Momordica anthelmintica Guin." OR "Momordica elegans Salisb." OR "Momordica muricata Willd." OR "Momordica operculata Vell." OR "Momordica senegalensis Lam." OR "bitter gourd" OR "bitter melon" OR "Cucurbitaceae" OR "balsam apple" OR "balsam pear" OR "bitter balsam apple" OR "bitter cucumber" OR "bitter melon" OR "carilla gourd" OR "paria" OR "wild balsam- apple" OR "cucumber" OR "melon") AND TOPIC: ("<i>Thrips palmi</i>" OR "melon thrips" OR "<i>Thrips palmi</i> Karny, 1925" OR "Chloethrips aureus Ananthkrishnan & Jagadish, 1967" OR "Thrips clarus Moulton, 1928" OR "Thrips gossypicola (Priesner, 1939)" OR "Thrips gracilis Ananthkrishnan & Jagadish, 1968" OR "Thrips leucadophilus Priesner, 1936" OR "Thrips nilgiriensis Ramakrishna 1928" OR "Oriental thrips" OR "southern yellow thrips") AND TOPIC: ("pest pressure" OR "population build-up" OR "pesticide application\$" OR "pesticide\$" OR "risk reduction option\$" OR "mitigation measure\$" OR "efficac*" OR "resistance" OR "population dynamic\$" OR "phytosanitary product\$" OR "registered pesticide\$" OR "high pressure water*" OR "air pressur*" OR "population dynamic\$" OR "field densit*" OR "occurrence" OR "monitor*" OR "sticky trap\$" OR "sticky trap\$ efficac*") AND TOPIC: ("Honduras")</p>
----------------	---