EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

Pest Risk Analysis for

Tetranychus mexicanus (Acarida: Tetranychidae); Mexican spider mite

Female in microscopic slide. Courtesy: Bert Vierbergen, NVWA (NL)

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The risk assessment follows EPPO standard PM 5/5(1) *Decision-Support Scheme for an Express Pest Risk Analysis* (available at http://archives.eppo.int/EPPOStandards/pra.htm), as recommended by the Panel on Phytosanitary Measures. Pest risk management (detailed in ANNEX 1, with additional information collected in ANNEX 2) was conducted according to the EPPO Decision-support scheme for quarantine pests PM 5/3(5). The risk assessment uses the terminology defined in ISPM 5 Glossary of Phytosanitary Terms (available at https://www.ippc.int/index.php).

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Based on this PRA, *Tetranychus mexicanus* was added to the EPPO A1 List of pests recommended for regulation as quarantine pests in 2023. Measures for plants for planting with leaves (except tissue cultures) of 'hosts and likely hosts' (category 1) are recommended

Pest Risk Analysis for *Tetranychus mexicanus* (Acarida: Tetranychidae); Mexican spider mite

PRA area: EPPO region in 2022
Prepared by: Expert Working Group (EWG) on *Tetranychus mexicanus*
Date: 17-20 October 2022. Further reviewed and amended by EPPO core members and Panel on Phytosanitary Measures (2023-03, see below).

Composition of the Expert Working Group (EWG)

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Personal communications in this PRA were obtained in July-October 2022 from: Wannes Dermauw (EWG member, ILVO - Flanders Research Institute for Agriculture, Fisheries and Food, Belgium), Carlos Flechtmann (UNESP - São Paulo State University, Brazil), Daniel J. de Andrade (UNESP, São Paulo, Brazil), Adenir Vieira Teodoro (EWG member - Embrapa, Brazil), Dirk Jan van der Gaag (EWG member, NVWA - Netherlands Food and Consumer Product Safety Authority, The Netherlands), Bert Vierbergen (NVWA, The Netherlands), Johan Witters (ILVO, Belgium).

The first draft of the PRA was prepared by the EPPO Secretariat.

Ratings of likelihoods and levels of uncertainties were made during the meeting. These ratings are based on evidence provided in the PRA and on discussions in the group. Each EWG member provided a rating and a level of uncertainty anonymously and proposals were then discussed together in order to reach a final decision. Such a procedure is known as the Delphi technique (Schrader *et al.*, 2010).

Following the EWG, the PRA was further reviewed by the following core members: N. Avendaño Garcia, N. Björklund, J. Boberg, J.M. Guitian Castrillon, S. Hannunen, T. Levi, A. MacLeod, L. Montecchio, E. Pfeilstetter, F. Petter, M. Suffert, R. Tanner.

The PRA, in particular the section on risk management, was reviewed and amended by the EPPO Panel on Phytosanitary Measures on 2023-03. EPPO Working Party on Phytosanitary Regulation and Council agreed that *Tetranychus mexicanus* should be added to the A1 List of pests recommended for regulation as quarantine pests in 2023.

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Describe the endangered area: The endangered area corresponds roughly to the area of potential establishment. Outdoors, *T. mexicanus* could establish in the southernmost part of the EPPO region (where winters are mild), such as the Mediterranean coast, southern Portugal, coastal areas of the Black Sea. There is an uncertainty on the northern and eastern limits of the potential area of establishment. *Tetranychus mexicanus* could establish under protected conditions in areas where it can establish outdoors. In areas where it cannot establish outdoors, it may establish in greenhouses where host plants are present year-round. More impact is expected in areas with low rainfall and warm climate and where host plants are present all year-round. In areas where the pest cannot establish outdoors, management will probably be easier.			
Main conclusions: *Entry*. The likelihood of entry on host plants for planting with leaves was considered as high, with a moderate uncertainty. On other pathways studied (host plants for planting without leaves, cut fresh plant parts of hosts and host fruit), the likelihood of entry was rated as low or very low, with moderate uncertainty. *Establishment.* The environmental requirements of *T. mexicanus* defined the area of establishment (described above), in which the likelihood of establishment outdoors is very high with a low uncertainty. Protected conditions are generally suitable to the pest. In areas where it can establish outdoors, the likelihood of establishment under protected conditions is as for establishment outdoors. In areas where *T. mexicanus* cannot establish outdoors, the likelihood of establishment is assessed to be moderate (with a moderate uncertainty) in greenhouses where host plants are present year-round. In greenhouses or greenhouse areas where host plants are only present part of the year, establishment is unlikely. The *magnitude of spread* was considered moderate with a moderate uncertainty, mainly based on the spread of the invasive (sub)tropical species *Tetranychus evansi* in the Mediterranean area. *Tetranychus mexicanus* could spread locally by natural dispersal, and at long distance through human-assisted pathways. *Impact* in the current distribution of the mite was rated as low overall, with a moderate uncertainty. Evidence of impact is mostly available from Brazil, where *T. mexicanus* is generally considered a secondary pest that only causes economic damage in some crops and only under favourable conditions. In the EPPO region, the potential impact was also rated as low. However, there is a high uncertainty linked to the differences between the EPPO region and the current area of distribution of *T. mexicanus*, in relation to cultivated host plants, cropping practices and environmental conditions. In particular, at least in the EU, the number of registered pesticides may decrease in the future. In addition, the efficacy of natural enemies and commercially available biological control agents that are present in the EPPO region against *T. mexicanus* is not known. Further, the pest may attack plant species in the EPPO region that are currently not damaged by other spider mites and the introduction of *T. mexicanus* on these plants lead to an increased impact by spider mites. The Panel on Phytosanitary Measures further noted that the major uncertainty relating to potential impact is how the pest will affect varieties of orange, as well as other species of *Citrus* and ornamental species, that are grown in the EPPO region. If those varieties and species prove to be susceptible to the pest, the overall potential impact may be higher. *Phytosanitary measures to reduce the probability of entry*: The EWG identified phytosanitary measures for host plants for planting with leaves (except tissue cultures) (details in section 16 and Annex 1).			
Phytosanitary risk for the *<u>endangered area</u>* The phytosanitary risk for the endangered area is driven by the potential impact, and the EWG therefore rated it as low with a high uncertainty (*Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document*)	High ☐	Moderate ☐	Low X
Level of uncertainty of assessment *(Individual ratings of uncertainty of entry, establishment, spread and impact are provided in the document)*	High X	Moderate ☐	Low ☐
Other recommendations: The EWG made recommendations on the need for research to reduce the main sources of uncertainty, as well as to further investigate some COI sequences currently attributed to *T. mexicanus* (see section 18).			

Stage 1. Initiation

Reason for performing the PRA:
In October 2018, *Tetranychus mexicanus* (Acari: Tetranychidae) was found for the first time in the Netherlands in a greenhouse on pot plants of *Beaucarnea recurvata*. In October 2019, this outbreak was officially declared eradicated (NL NPPO, 2018a, 2019). Considering that *T. mexicanus* is polyphagous and could be a risk for greenhouse crops throughout the EPPO region, as well as outdoors in the Southern part of the EPPO region, the Panel on Phytosanitary Measures (PPM) suggested that *T. mexicanus* should be added to the EPPO Alert List (EPPO, 2019). In May 2021, the PPM selected *T. mexicanus* as a possible priority for PRA, and in June 2021 the Working Party for Phytosanitary Regulations selected it for PRA.

The EPPO standard PM 5/5 Decision-Support Scheme for an Express Pest Risk Analysis was used, as recommended by the PPM. Pest risk management (detailed in Annex 1) was conducted according to the EPPO Decision-support scheme for quarantine pests PM 5/3(5).

PRA area: EPPO region in January 2022 (52 countries, see list in the summary at the start of the PRA; map at https://www.eppo.int/ABOUT_EPPO/eppo_members)

Note: In this PRA, all elements considered relevant are presented in the text. However, readers wishing a rapid overview can focus on the ***bold highlighted text.***

Stage 2. Pest risk assessment

1 Taxonomy

Taxonomic classification: Kingdom: Animalia / Phylum: Arthropoda / Subphylum: Chelicerata / Class: Arachnida / Subclass: Acari / Superorder: Acariformes / Order: Trombidiformes / Suborder: Prostigmata / Superfamily Tetranychoidea / Family: Tetranychidae / Genus: *Tetranychus* Dufour, 1832 / Species: *Tetranychus mexicanus* (McGregor, 1950).

Synonym: *Septanychus mexicanus* McGregor, 1950.

Common names:

English	Mexican spider mite
Spanish	ácaro mexicano (Bernal & Pineiro, 1982); arañita mexicana (sinavimo.gob.ar); ácaro rojo de la parchita (Dominguez Gil, 1998).
Portuguese	ácaro-mexicano (Chiaradia *et al.*, 2009; Sanches *et al.*, 2021).

In the literature, *T. mexicanus* is commonly named 'ácaro-vermelho' in Portuguese (Brazil) (Azevedo & Vieira, 2002; Teodoro *et al.*, 2015) and 'spider mite'/'red spider mite' in English, which are general names also used for other Tetranychidae.

EPPO code: TETRME

2 Pest overview

Tetranychus mexicanus has five life stages: egg, larva, protonymph, deutonymph and adult (Sousa *et al.*, 2010). The larva, protonymph and deutonymph stages each include a short quiescent (resting, non-feeding) period preceding the next life stage, respectively: protochrysalid (preceding protonymph), deutochrysalid (preceding deutonymph) and teliochrysalid (preceding adult).

2.1 Morphology

- **Eggs** are spherical, and measure 0.15 mm in diameter (Paschoal, 1968a). They are first transparent, becoming dark yellow close to hatching (Paschoal, 1968a; Stein and Daólio, 2012).
- **Larvae** are light yellow and have three pairs of legs. They gradually acquire dark spots in the podosoma (region of the idiosoma (body) bearing the legs) (Paschoal, 1968a; Stein & Daólio, 2012). Larvae measure 0.2-0.3 mm (Paschoal, 1968a).
- **Nymphs.** The colour of nymphs varies, from light to dark green, to yellow-greenish or red (Chiaradia *et al.* 2009 citing Chiavegato, 1991; Parra *et al.*, 2003, Paschoal, 1968a; Stein & Daólio, 2012) and they also carry dark spots that may reach the opisthosoma (posterior part of the body) (Stein & Daólio, 2012). Nymphs have four pairs of legs and measure 0.3-0.45 mm; deutonymphs are larger than protonymphs (Paschoal, 1968a).
- **Adults** also have four pairs of legs (Paschoal, 1968a). Females measure ca. 0.5 mm in length (Domínguez Gil, 1998 citing Oliveira, 1987; Paschoal, 1968a). Males have a more tapered posterior part than females and are smaller, measuring about 0.25 mm in length (Favero, 2016, citing Oliveira, 2014). The colour of males and females varies from yellowish or green to brownish, orange or red (Chiaradia *et al.*, 2009 citing Chiavegato, 1991; Feres, 2000; Flechtmann & Paschoal, 1967; Domínguez Gil, 1998 citing Oliveira 1987; Paschoal, 1968a*;* Andrade *et al.*, 2007; Moraes & Flechtmann 2008 cited in Andrade-Bertolo *et al.*, 2013). Adults have dark spots on the dorsum (Andrade *et al.*, 2007; Stein & Daólio, 2012). Adults may present different colours even when fed on the same host, as for red and yellow females found on *Paullinia cupana* plants (Vasconcelos *et al.*, 2022). Females have a specific number of tactile setae on Tarsus III, while for males the shape of the aedeagus can be used as a diagnostic character (Seeman & Beard, 2011).

Life stages measure from 0.15 mm diameter for eggs to 0.5 mm in length for adult females. Eggs are yellowish. Larvae, nymphs and adults have dark spots on the dorsum. Larvae are yellow, and the colour of nymphs and adults varies, generally from yellow or green to brownish, orange or red.

Photos of life stages of *T. mexicanus* and symptoms are provided in Annex 2.

2.2 Life cycle

***Tetranychus mexicanus* reproduces sexually (fertilized eggs develop into females) and by arrhenotokous parthenogenesis (unfertilized eggs develop into males) (Paschoal, 1968a).** Males are able to detect teliochrysalids (resting stage of female deutonymphs) and generally mate with them soon after adult emergence (Teodoro *et al.*, 2015). Eggs are laid on the plant leaves or in the webs produced by the mites (Andrade *et al.*, 2007 citing Rodrigues & Oliveira, 2005; Barroncas *et al.*, 2022; Favero, 2016 citing Oliveira, 2014).

Arrhenotokous parthenogenesis is also known for other Tetranychidae, such as the two-spotted spider mite *Tetranychus urticae*. With such parthenogenesis, when a single female colonizes a new host plant, it would be able to initiate a population by producing male offspring and mating with her sons when mature. The impact of this reproductive system, known as oedipal mating, on demography has been explored for the spider mite *T. urticae* (Bolland *et al.*, 1981; Helle & Pijnacker, 1985; Tuan *et al.*, 2016).

The biology of *T. mexicanus* has been documented mostly on cultivated hosts (hosts are dealt with in section 7, symptoms on some hosts in section 2.9). There is no information on its biology for many other plants recorded as hosts. At least four laboratory studies on the development of *T. mexicanus* are available: on *Citrus aurantifolia* (Paschoal, 1968a), on *Annona* (*A. muricata*, *A. squamosa*, *A. coriaceae* - Sousa *et al.*, 2010), on *Bactris gasipaes* (Stein & Daólio, 2012) and on *Carica papaya* and *Passiflora edulis* (Barroncas *et al.*, 2022). Some results are summarized below.

The duration from egg to adult was found to be, at 25°C, 10-13 days on the three *Annona* species, *B. gasipaes*, *C. papaya* and *P. edulis*, and the total generation time ca. 15-24 days (see Table 1). As a comparison, the developmental time of *T. urticae* from egg to adult at 25°C is about 10 days (Sabelis, 1985: in general 10 days; Ali *et al.*, 2013: 9 days on watermelon; Uddin *et al.*, 2015: 9-10 days on bean; Riahi *et al.*, 2013: ca. 12 days on peach leaves).

Neves *et al.* (2015) note that spider mites "have enormous capacity for population increase, reaching from 20 to 25 generations per year" when the environmental conditions are favourable. No species-specific estimate of the number of generations per year for *T. mexicanus* was found in the literature.

From the data related to the three *Annona* species, *B. gasipaes, C. papaya* and *P. edulis* (Barroncas *et al.*, 2022; Sousa *et al.*, 2010; Stein & Daólio, 2012), it can be concluded that the reproductive capacity and survival (i.e. the biotic potential) was higher on *A. muricata* and *C. papaya* than on the other hosts. *Tetranychus mexicanus* developed slower on *A. squamosa* than on the other two *Annona* species, and oviposition was much lower on *A. coriaceae* (Sousa *et al.*, 2010; Stein & Daólio, 2012). Comparing *C. papaya* and *P. edulis*, the mite generally developed faster and had a higher growth rate on the first (Barroncas *et al.*, 2022). Sousa *et al.* (2010) noted that the intrinsic growth rate[1] of *T. mexicanus* on *A. muricata* reported in their study (r_m = 0.24) is similar to that obtained for other spider mites with high biotic potential, such as *T. urticae*, *Tetranychus desertorum*, *Tetranychus neocaledonicus,* and *Tetranychus pacificus*.

Sousa *et al.* (2010) mention the possibility of host adaptation of *T. mexicanus* in the field based on laboratory tests where a population collected on *A. muricata* and reared for six months on *A. muricata*, *A. coriaceae* and *A. squamosa* showed a faster development and higher survival on the first two hosts and a higher reproduction on *A. muricata*. However, females often preferred to feed and lay eggs on the species on which they were reared, showing partial adaptation within a short period of time (Sousa *et al.*, 2010).

Table 1. Duration of life stages (in days) and other parameters of the life cycle. Unless otherwise stated, mean data are shown

Host	*Citrus aurantifolia*	*Annona muricata*	*A. squamosa*	*A. coriaceae*	*Bactris gasipaes*	*Carica papaya*	*Passiflora edulis*
Source	Paschoal (1968a)	Sousa *et al.* (2010)			Stein & Daólio (2012)	Barroncas *et al.* (2022)	
Conditions	19-25°C[2]	25°C±1°C RH 60%±10% photophase 14 hours			25°C±1°C RH 60% ± 10% photophase 14 hours	25°C±0,2°C RH 76%±3,6% photophase 12 hours	
Egg	6.5	3.4	3.4	2.4	5.2 ♀ 5.1 ♂	4.4 ♀ 4.5 ♂	4.5 ♀ 4.6 ♂
Larva	4-7	2.6	3.5	2.5	2.6 ♀ 2.4♂	2.3 ♀ 2.6 ♂	2.6 ♀ 2.7 ♂
Protonymph	4-5	1.9	2.4	2.4	2.9 ♀ 2.4 ♂	1.9 ♀ 1.9 ♂	1.9 ♀ 1.9 ♂
Deutonymph	2-4	2.3	2.7	2.5	3 ♀ 3.2 ♂	2.5 ♀ 2.7 ♂	2.9 ♀ 2.8 ♂
Egg to adult	18♂-20♀	10.1	12.1	9.9	13.6 ♀ 13 ♂	11.2 ♀ 11.3 ♂	11.9 ♀ 12 ♂
Sex ratio (females:males)	-	9:1	9:1	9:1	4:1	9:1	9:1
Pre-oviposition period	1 (egg to egg 20.5, minus cycle 19.5)	1.0	1.2	0.9	2	0.6	0.6
Oviposition period	21 (measured for 1 ♀)	21.2	22.7	16.9	12.1	19.4	19.2
Post-oviposition period	-	0.8	1.0	1.2	-	2.1	1.2
Number of eggs/female (rounded)	35 (measured for 1 ♀	99	65	39	9	106	82
Longevity of adults (rounded)	-	23 ♀ 47 ♂	25 ♀ 38 ♂	19 ♀ 30 ♂	17 ♀ 7 ♂	22 ♀ 60 ♂	21 ♀ 32 ♂
Overall survival from egg to adult in %	-	90	80	60	60	92	79
Generation time	-	19	21	16	22	24	24

[1] the intrinsic growth rate r_m is an estimate of the innate natural increase rate of a population based on fecundity, sex ratio and mortality.
[2] in this article, the RH was not controlled, and the photophase is not indicated

Host	*Citrus aurantifolia*	*Annona muricata*	*A. squamosa*	*A. coriaceae*	*Bactris gasipaes*	*Carica papaya*	*Passiflora edulis*
Estimated time to double the size of the population						3.7	4.2
intrinsic growth rate[3] - r_m	-	0.24	0.17	0.21	0.06	0.19	0.16

2.3 Dispersal capacity

Dispersal mechanisms

Natural dispersal mechanisms observed in species of Tetranychidae are:

- crawling (walking) within plants and to neighbouring plants of larvae, nymphs (protonymphs, deutonymphs) and adults of *T. mexicanus*, except during the quiescent periods of protochrysalids, deutochrysalids and teliochrysalids (Kennedy & Smitley, 1985; Teodoro *et al.*, 2015).
- drifting with air currents (which is the main mechanism of natural dispersal of spider mites over longer distances - Li & Margolies, 1994; Kennedy & Smitley, 1985).
    - spinning down on their silk threads, and thereby either reaching other leaves on the plant, or reaching another plant (Li & Margolies, 1994);
    - becoming airborne either passively or following a specific active behaviour (raising forebody and forelegs) (as known e.g. in *T. urticae*, Li & Margolies, 1994; Smitley & Kennedy, 1985);
    - ballooning, a collective dispersal mode (i.e. on silk balls formed by many individuals gathering and spinning web) described for *T. urticae* (Clotuche *et al.*, 2011, 2013), *Tetranychus ogmophallos* (Santos *et al.*, 2020), and *Tetranychus evansi* (Azandeme-Hounmalon *et al.*, 2014). No information is available on whether this dispersal mechanism is also used by *T. mexicanus*.
- passive transport, by using another organism (phoresy), of either individual mites (Kennedy & Smitley, 1985) or collectively through silk balls (Clotuche *et al.*, 2011), or possibly via various materials (e.g. wind-blown leaves). Note that passive transport through human activities is covered in section 11 (Spread).

Active dispersal in spider mites is usually induced by plant deterioration, as a result of overcrowding and/or predation risk posed by predatory mites and other natural enemies (Clotuche *et al.*, 2013; Otsuki & Yano, 2014; Yano, 2008).

***Tetranychus mexicanus* can disperse by crawling. Further, it is assumed that like other species of Tetranychidae, it can disperse by drifting with air currents and passive transport.**

Dispersal distances

No information on distances of dispersal was found in the literature for *T. mexicanus*, but some data are available for other species of Tetranychidae.

Fleschner *et al.* (1956) mention the aerial dispersal of mites at a few meters or few hundred meters (from older studies on red spider mites and their own observations on *Oligonychus punicae*, *Panonychus citri* (= *Metatetranychus citri*) and *Eotetranychus sexmaculatus* in orchards and in greenhouses). In a study measuring gene flow between populations of *T. urticae* in the field, it was shown that mites largely interbreed (which is a good estimator of mite exchanges and then of mite dispersion) in open-field areas of 50 m^2 or less, at least when mite population density is high (Tsagkarakou *et al.*, 1998). According to Jung & Croft (2001), *T. urticae* may be able to cover distances of 16-48 m from a falling height of 5 m and at a wind speed of 8 m/s (estimations based on a diffusion model of wind-blown mites, with body weight and falling speed of adult females as parameters). In general, aerial dispersal of *T. urticae* is reported to occur within a relatively short distance (< 100 meters) (Jung 2005). *Eutetranychus banksi* was wind-transported at least 54 m from a citrus grove in Texas (EFSA, 2014 citing Hoelscher, 1967). Hoy *et al.* (1984; cited in EFSA, 2014) showed that *T. urticae* from infested almond trees could disperse a distance of 200 m in the air, and aerial

[3] Sousa et al. (2010) and Stein & Daólio (2012) do not document the calculation method of the intrinsic growth rate, and Barroncas et al. (2022) calls it "Innate ability to increase in corrected number (r_m')". However, Barroncas compares the different publications and hosts, and it is therefore supposed all articles use the same parameter.

dispersal was greater when prevailing winds were stronger. In experiments in strawberry fields, one individual of *T. urticae* was found in an isolated site situated almost three kilometres from the closest known mite-infested vegetation (Miller *et al.*, 1985). Finally, during the preparation of an EPPO PRA on *T. evansi* (EPPO, 2008), Dr Margolies indicated that mites could spread slowly via winds, but their effective range is probably limited to a few kilometres per event. He gave an indication of a range "about five kilometres".
Santos *et al.* (2020) studied dispersal distances of *T. ogmophallos* in wind tunnels and found that wind speed was important for the proportion of mites taking off from an infested plant and how far they were displaced. For example, they observed that ca. 30–60% of the introduced mites were recovered in the wind tunnel after exposing the plant to a wind speed of 30 km/h and at an average distance of about 1 meter from the plant.

In the absence of specific information, aerial dispersal of *T. mexicanus* in one event is assumed to occur within a relatively short distance (< 100 meters), but a small proportion of a *T. mexicanus* population may aerially disperse over longer distances (up to several kilometers).

Regarding crawling, preliminary experiments to design a study on *T. urticae* movement did not find mites beyond 50 cm from the initial point after 24 h (Bitume *et al.*, 2011). In another study on the dispersal of *T. urticae* by crawling of adults (females and males), deutonymphs, protonymphs and larvae, mites were able to move to distances up to 4.8 m (Krainacker & Carey, 1990).

There is no information on the crawling distance of *T. mexicanus*, but spider mites are thought to disperse by walking for only a few meters from plant to plant (Yaninek, 1988 cited by Moraes & Flechtmann 2008). It is assumed that individuals walk mostly on the same plant or between plants that are close to each other to find a new feeding site, or if they have been blown to an unsuitable plant or substrate.

2.4 Location of the pest on the plants

Tetranychus mexicanus is mostly found on leaves:

- Colonies are generally on the lower surface of leaves (Azevedo & Vieira, 2002; Feres, 2000; Feres *et al.*, 2009; Moraes & Flechtmann, 1981; Ochoa *et al.*, 1994; Paschoal, 1968a; Silva *et al.*, 2016, 2019; Teodoro *et al.*, 2020). However, individual mites can be found on upper leaf surfaces (Ochoa *et al.*, 1994) especially at high population levels (Paschoal & Reis, 1968).
- On *Carica papaya*, *T. mexicanus* occurs on the lower leaf surface of the oldest leaves, between the veins, close to the petiole (Sanches *et al.*, 2000). It may also occur on the upper leaf surface, but to a lower extent than on the lower leaf surface (Santos *et al.*, 2018).
- On *Citrus latifolia*, *T. mexicanus* is mainly present on lower, old leaves, although it may also attack young leaves that emerge after pruning when irrigation is resumed (Quiros-Gonzalez, 2000). It is reported on the youngest *Citrus* leaves in Flechtmann & Paschoal (1967).
- There may be several mite species on the same leaf. *Tetranychus mexicanus* was, for example, found on the same leaf with *Tetranychus ludeni* on cotton (Mendonça *et al.*, 2011), and with *Brevipalpus californicus* on *Codiaeum variegatum* (Ochoa, 1994). On *Citrus* spp., *T. mexicanus* inhabits mainly the lower surface of leaves while *Eutetranychus banksi* is found on the upper leaf surfaces (Chiaradia *et al.*, 2009; A. Teodoro pers. comm.).

►This PRA considers that *T. mexicanus* is mostly associated with the lower leaf surface, but may also be found on the upper leaf surface. There may be several pest mite species on the same leaf.

Tetranychus mexicanus is occasionally found on twigs and on fruit:

- In Northeast Brazil (e.g. Sergipe state), *T. mexicanus* is not observed in association with citrus fruit in orchards (A. Teodoro, pers. comm.). In a survey in a commercial plantation of *Citrus sinensis* in Amazonas, 4 out of 319 immatures of *T. mexicanus* observed were on fruit, against 258 on leaves and 57 on twigs. *Tetranychus mexicanus* adults were recorded only on leaves (while adults of some other mite species were also recorded on twigs and fruit) (Bobot *et al.*, 2011). Nevertheless, Flechtmann & Baker (1975) note that *T. mexicanus* is attacking leaves and fruits of *Citrus*. Andrade *et al.* (2007 citing Flechtmann & Paschoal 1967) mention that on *Citrus*, in addition to the lower leaf surface, *T. mexicanus* can infest depressions in the fruits. In *C. sinensis* orchards in the north of São Paulo state (Brazil), in case of high infestation, *T. mexicanus* can be found infesting orange fruits, but it is not common. Eggs, larvae, nymphs and adults may be present, mainly in natural depressions in the skin of fruits (especially in the stylar region) or depressions caused by other pests (see symptoms in section 2.9). On young twigs of *C. sinensis*, *T. mexicanus* is usually observed only when populations are high (D. Andrade, pers. comm.). The reasons for the difference between São Paulo and Sergipe is not known, but it may be due to different environmental conditions, and difference of orchard management (e.g. intensive management in São Paulo) (A. Teodoro, D. Andrade, pers. comm.).

- On *Vitis vinifera*, no evidence of association with bunches was found. An Australian PRA (Australian Government, 2016) also found no evidence of association with bunches, and considers such association unlikely and incidental (e.g. individuals blown to fruit), but may occur if population density is high.
- On *A. muricata*, Sousa *et al.* (2015) appear to report the presence of colonies of *T. mexicanus* on fruit. However, the article is not clear because it treats *T. mexicanus* and *Brevipalpus phoenicis* in the same sentence, and *B. phoenicis* is known to be associated with fruit. In addition, the article refers to Moraes & Flechtmann (2008) in relation to fruit, but Moraes & Flechtmann (2008) reported *B. phoenicis*, not *T. mexicanus*, on fruit of *A. muricata.* Consequently, Sousa *et al.* (2015) is not considered as a valid record of association of *T. mexicanus* with *A. muricata* fruit.
- For all host plants, as for *V. vinifera* above, individuals may become incidentally associated with fruit or twigs when dispersing within the plant or landing on a plant by aerial dispersal.

►This PRA considers that association of *T. mexicanus* with fruit and twigs is not common although it has been occasionally been observed in São Paulo state (Brazil) on oranges. The presence of colonies containing all life stages on orange fruit suggests that the pest could complete its development on fruit, but this has not been verified.

2.5 Age of plants attacked and environments

Tetranychus mexicanus has been recorded on various ages and sizes of plants, from seedlings to mature plants, including fruiting trees.

- On *Citrus* in Brazil, *T. mexicanus* is more common in seedlings under nursery conditions (Andrade *et al.*, 2007), but it was also reported on fruiting trees (see above and Fundecitrus, 2002).
- On *A. muricata*, a high population was reported on seedlings (Silva *et al.*, 2019).

Tetranychus mexicanus has been found on cultivated plants as well as on plants in natural ecosystems In Brazil, it was found in remnant native vegetation (savanna-like 'Cerrado' and tropical dry forest) and forests (Araújo & Daud, 2017; Buosi *et al.*, 2006). This is presumably also the case in some other Central American and South American countries.

►*Tetranychus mexicanus* can be found on plants of all ages, from seedlings to mature plants, in crops (outdoors and in protected conditions) and in nature (including native vegetation). There are several examples in this PRA of cultivation in protected conditions favouring the development of high populations.

2.6 Host preference and resistance

It is not possible to identify preferred hosts of *T. mexicanus* from the literature (see section 7). Differences of development on various hosts have been documented in experiments on three *Annona* species, *B. gasipaes*, *C. papaya* and *P. edulis* (see section 2.2).

Regarding resistance, various studies have been conducted on *P. edulis* and *Citrus*:

- On *P. edulis*, some genotypes were found to be less susceptible than others (da Silva *et al.*, 2020; Neves *et al.*, 2015).
- On *Citrus*, different rootstocks were found to influence population densities of *T. mexicanus* on *C. sinensis* cv. Valencia Tuxpan in some periods of the year (Silva *et al.*, 2016), but not on *C. sinensis* cv. Jaffa (Teodoro *et al.*, 2020), nor *C. reticulata* cv. Piemonte (Teodoro *et al.*, 2020 citing others).
- In a study on different scion varieties of orange (*C. sinensis*), mandarins and Tahiti acid lime (*C. latifolia*) grafted on Rangpur lime (*C. limonia*) in a commercial orchard, the abundance of *T. mexicanus* was

influenced by scion varieties only in some periods, suggesting the presence of putative resistance mechanisms in some genotypes. Higher populations were found in sweet orange 'Lima' in January 2013 in comparison to 'Tahiti' acid limes IAC 5 and IAC 5-1, with 'Pêra CNPMF-D6' and the remaining varieties carrying intermediate population levels (Silva *et al.*, 2017). These studies should be replicated using longer periods in the field coupled with lab bioassays to address the possible resistance of some varieties to this mite.

► Less susceptible varieties have been investigated for *Passiflora edulis* and *Citrus*, as well as rootstocks for the latter but, to date, resistant or less susceptible varieties and rootstocks do not appear to be available.

2.7 Environmental requirements

***Tetranychus mexicanus* has been reported only in subtropical and tropical climates.** It has been found between 27°N in Florida and 31°S in Uruguay (see section 6), and the scarcity of publications and records at the most northern and southern latitudes indicates that conditions are probably not optimal in those areas.

Temperature

Most publications relate to tropical climates. For example, at one location where *T. mexicanus* is present (Cassilândia, Mato Grosso do Sul, Brazil), "the mean annual temperature is 24.1°C with a July minimum of 16.4°C and a January maximum of 28.6°C, and mean annual rainfall of 1240 to 1520 mm" (Silva *et al.*, 2019). On *Hevea brasiliensis*, there is an increase in *T. mexicanus* populations in July–August (cooler temperatures, dry season) until the start of rains in the municipalities of Itiquira and Pontes e Lacerda, Mato Grosso state, Brazil (Ferla & Moraes, 2002). In a laboratory experiment on strawberry leaves, Oliveira *et al.* (2008) found that *T. mexicanus* was able to complete its life cycle at 20, 25 and 30°C; 30°C was more favourable (shorter generation time, lower mortality). Laboratory experiments on the development of this species were conducted at 25°C (see section 2.2), which is presumably favourable for this species. No information was found on the lower or upper threshold for development and survival of *T. mexicanus*.

In an experiment in a *Citrus* orchard (municipality of Umbaúba, Sergipe state, Brazil), *T. mexicanus* was recorded at temperatures between ca. 22°C and 26.5°C (Silva *et al.*, 2017). Abundance and temperature were correlated with populations increasing with higher temperatures. Temperature explained over 75% of the variation in abundance, while relative humidity, rainfall, radiation and the predatory mite *Iphiseiodes zuluagai* explained less than 25% of the variation.

Generally for spider mites, low temperatures or sudden large variations of temperature can reduce populations (Carvalho *et al.*, 2018).

There is no information on the ability of *T. mexicanus* to adapt to a wide range of temperatures. However, some spider mites have been shown to develop in a wide range of temperatures, such as:

- The capacity of *T. urticae* to survive and develop over a broad temperature range from 10 to 40°C is one factor favouring its establishment (Tuan *et al.*, 2016 citing others).
- Bonato *et al.* (1995) showed that for *Mononychellus progresivus* and *Oligonychus gossypii*, tetranychids of cassava found in tropical conditions in Africa, development stopped at 16°C, but the lower threshold temperature (projected, graph is in the article) was close to 10°C, and the upper thermal threshold was close to ca. 36°C.
- *Tetranychus evansi* possibly originates from South America and has established in tropical climates of Africa as well as in the Mediterranean basin. *Tetranychus evansi* develops within a wide range of temperatures (12–45°C), with a high thermal optimum (~ 35 to 43°C) (Ghazy *et al.*, 2019, citing others). Mild winters are a key to survival of populations outdoors (Migeon *et al.*, 2009). *T. evansi* has spread to areas with different climatic gradients from those in its original distribution (Ghazy *et al.*, 2019). *T. evansi* was also found in a few locations predicted to be too dry (desert or semi-desert conditions). Cultivation system including artificial irrigation might account for localised occurrences of *T. evansi* in those areas (Migeon *et al.*, 2009). From experiments on the (sub)tropical species *T. evansi*, different lower temperature thresholds for development (egg to female adult) were reported, i.e. ca. 10 or 13°C,

and it was noted that it could survive at lower temperatures but no reproduction or development takes place (EPPO, 2008 citing Bonato, 1999 and Moraes & McMurtry, 1987; Gotoh *et al.*, 2010).

Some *Tetranychus* spp. have biological characteristics that allow them to survive in a wide range of conditions, such as harsh conditions or temporary absence of leaves on host plants, but this is not known for *T. mexicanus*:

- *Tetranychus urticae* can enter diapause to survive harsh conditions while diapause has not been observed for *T. evansi* (EPPO, 2008).
- Some Tetranychidae are able to overwinter as eggs or adults in plant buds, bark or in the ground cover, allowing them to develop on deciduous plants (e.g. adults of *T. urticae* on ground cover of apple orchards - Kim and Lee, 2003; eggs of *Panonychus ulmi* or *P. citri* on twigs - Broufas & Koveos, 2000; Takafuji & Kamekaze, 1984; *T. urticae* females on bark, Kroon *et al.*, 2008). There is no such information in the literature for *T. mexicanus*.

Relative humidity

In a study conducted in 2003–2006 in an orange orchard, hot and dry periods were found to favour the population increase of spider mites (incl. *T. mexicanus*), while there was a negative correlation between rainfall and mite populations (Chiaradia *et al.*, 2009). Similarly, in the *Citrus*-producing areas of São Paulo state (Brazil), *T. mexicanus* is more abundant in the dry months (winter) (Andrade *et al.*, 2007 citing Oliveira 1993). The relative humidity in São Paulo can be lower than 20% in the dry season (D. Andrade, pers. comm.). However, *T. mexicanus* is also present in Sergipe state where the relative humidity may be above 80% during part of the year (A. Teodoro, pers. comm.). *T. mexicanus* has also been collected in the wettest areas of Costa Rica, where it rains for most of the year (Ochoa *et al.*, 1994).

For spider mites generally, it is known that climatic factors affect population development. Among the main favourable climatic factors for development of mites are periods of drought, with low relative humidity, combined with a temperature of around 25°C (Carvalho *et al.*, 2018). Favourable temperatures are above 25°C for some species: a study on *T. ludeni* on *Gossypium hirsutum* leaves at temperatures ranging from 20 to 30°C (Silva, 2002) showed that the egg to adult and oviposition periods, and mites' longevity decreased with temperature, as well as the intrinsic growth rate and fecundity[4]. Egg-to-adult survival was lowest at 20°C (28%) and highest at 28°C (78%).

For *T. evansi*, dry seasons and winds favor population development whereas irrigated crops or rainy periods are detrimental (Cuane, 2008 cited in Carvalho *et al.*, 2018). Plant drought stress may favour outbreaks of spider mites (Quiros-Gonzalez, 2000; Ximénez-Embún *et al.*, 2018). Tetranychidae mites have high rates of reproduction during periods of low relative humidity and high temperature, while their populations are reduced during period of high relative humidity (because it negatively affects oviposition, hatching and survival of larvae, and is favourable to natural enemies). In addition, heavy rains cause an increase in relative humidity, and may wash mites off the leaves (Carvalho *et al.*, 2018).

► *T. mexicanus* is known to be favoured by temperatures above 20°C, possibly between 25-30°C (from one laboratory study and as inferred from other spider mite species). Its upper and lower temperature thresholds are not known, nor its adaptability to a wider range of temperatures. The species has never been found outdoors in conditions other than tropical and subtropical climates. A possible lower threshold of development of 10-13°C is mentioned in the literature for several (sub)tropical mites and this may also apply to *T. mexicanus* (with a high uncertainty). Survival below the development threshold is expected to be possible, but the lowest survival temperature of *T. mexicanus* is not known.
***Tetranychus mexicanus* is reported to be favoured by dry conditions. However, in its current distribution, it maintains populations under a wide range of relative humidities (at least below 20 % to above 80 %).**
► There is no information on whether *T. mexicanus* can enter diapause or overwinter as eggs or adults, and the literature does not provide evidence of its capability to adapt to new conditions. Given its tropical/subtropical origin, the EWG did not expect that *T. mexicanus* can enter diapause.

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[4] intrinsic growth rate, r_m= 0.41 at 30°C; 0.27 at 28°C; and 0.22 at 25°C
fecundity: eggs/female/day = 3.47 at 30°C; 2.49 and 2.97 at 28 and 25°C, respectively; and only 1.53 at 20°C).

Survival without food

There is no information in the literature on the survival of *T. mexicanus* without food. *Tetranychus evansi* could survive on non-host plants, but for a shorter period than on hosts (EPPO, 2008). *Tetranychus urticae* is known to survive at least two days at 24°C without food and resume feeding and reproduction afterwards; at lower temperatures, the survival times of *T. urticae* are assumed to be even longer (Krainacker & Carey, 1990). However, low temperatures appear to be unfavourable to the development of *T. mexicanus* and the effect of temperature on its survival remains uncertain.

►Similarly to other spider mites, *T. mexicanus* is expected to survive a few days (at least 2 days) without food, at conditions that are otherwise favourable for its development (e.g. temperature of 24°C), and resume feeding and reproduction. At lower temperatures, *T. mexicanus* might survive for a longer period, but there is uncertainty on how temperature and other environmental conditions affect *T. mexicanus* survival in the absence of food.

2.8 Nature of the damage

The damage described for *T. mexicanus* in the literature resembles that described by Carvalho *et al.* (2018) generally for spider mites (Tetranychidae). **Damage by *T. mexicanus* is mainly due to the feeding activity of immatures and adults on leaves** (Dominguez-Gil & McPheron, 1992). The mites feed on the cytoplasmic content of leaf cells, causing physiological disorder (Favero, 2016 citing Oliveira, 2014). Feeding leads to chlorosis, necrosis, deformation, and subsequently leaf drying and fall (Silva *et al.*, 2019 citing Moraes and Flechtmann, 2008; Favero, 2016 citing Oliveira, 2014). In high populations, entire leaves or plants may turn yellow and necrotic (Dominguez-Gil & McPheron, 1992 citing Oliveira, 1987). The reduction of the photosynthetic area of the foliage has impact on yield, plant growth and quality (da Silva *et al.*, 2020 citing Moraes and Flechtmann, 2008).

On *Citrus*, a slight discoloration of fruit has been reported (Andrade *et al.*, 2007 citing Flechtmann & Paschoal 1967; D. Andrade, pers. comm.). On *Citrus* in Venezuela, *T. mexicanus* does not damage fruits (Quiros Gonzalez, 2000). No damage has been reported on fruit of other plant species.

2.9 Natural enemies

Natural enemies are mentioned in the literature as important to control populations of *T. mexicanus* and prevent economic damage (e.g. Sousa *et al.*, 2010; Teodoro *et al.*, 2015). In particular, predatory mites have a direct influence on spider mite populations in citrus crops (Carvalho *et al.*, 2018; Chiaradia *et al.*, 2009). Natural enemies of *T. mexicanus* mentioned in the literature are listed in Annex 4.

Among all natural enemies, predatory mites of the family Phytoseiidae are the most important in controlling spider mites. *Neoseiulus californicus*, for instance, is associated with heavy-webbing spider mites and has the ability to cut strands of web with its chelicerae (McMurtry *et al.*, 2013; Shimoda *et al.*, 2009). *Neoseiulus fallacis* and *N. longispinosus* are also efficient natural enemies of spider mites like *T. urticae* (McMurtry *et al.*, 2013). ***Phytoseiulus persimilis* and *N. californicus*, among other species, are commercially available in many countries as biological control agents to control spider mites. However, no information was found on the efficacy of these species against *T. mexicanus*.**

2.10 Symptoms

Symptoms are similar to those caused by other spider mites (Ochoa *et al.*, 1994; Silva *et al.*, 2019 citing Moraes and Flechtmann, 2008). Carvalho *et al.* (2018, citing Moraes & Flechtmann, 2008) mention that damage might be confused with water stress. Symptoms occur on both sides of the leaves, but are more easily visible on the upper surface. In case of low infestation levels, small white spots are present, which may be easily overlooked. **Typical symptoms are chlorosis that may develop into necrosis, and deformation of leaves.** Symptoms are described in the literature in more details for some hosts (see Annex 3) and similar symptoms probably occur on others.

2.11 Detection

- Symptoms are not specific to *T. mexicanus* (section 2.10).
- Colonies of phytophagous mites may be visible to the naked eye, but at low infestation levels, individual mites and eggs may be easily overlooked. A hand-held lens with a 20x magnification or above or a microscope (A. Teodoro, pers. comm.) should be used to ensure that initial mite infestations are also detected (End *et al.*, 2021, A. Teodoro, pers. comm.). Colonies are mostly on the lower surface of the leaves, in some cases on the upper leaf surface or on fruit (see section 2.4).
- Webbing may be abundant, on which all life stages adhere (Aldana de La Torre *et al.*, 2010; Feres, 2000; Ochoa *et al.*, 1994; Teodoro *et al.*, 2015). *Tetranychus mexicanus* produces more webs than *Panonychus citri* and *Eutetranychus banksi*, which are the most common spider mite species on *Citrus* in Brazil (A. Teodoro, D. Andrade, pers. comm.).
- The mite can also be detected by the thin whitish layer corresponding to exuvia, as well as dust debris adhering to the web on the underside of the leaflets (described for coconut in Teodoro *et al.*, 2015).
- There might be mites of several species on the same plant and even leaf (see section 2.4).

2.12 Identification

Identification of *T. mexicanus* may be challenging as it may be confused with other *Tetranychus* spp. The mite colour is not sufficient for identification, as it varies widely, as for other *Tetranychus* species (section 2.1). For identification, collected specimens should be mounted on microscopic slides. Adults of both male and female mites can be used to identify at the genus level, however the identification at the species level is mostly based on the morphology of the male aedeagus shape as the principal diagnostic character (see Gutierrez, 1985 for a detailed description of morphological caracters used in morphologically-based systematics of Tetranychidae). Santos *et al.* (2018) mention that pregenital striae and tarsal chaetotaxy are useful to identify females. Descriptions and/or identification keys of males and females of *T. mexicanus* are provided in Seeman & Beard (2011), Ochoa *et al.* (1994) and Andrade-Bertolo *et al.* (2013, citing Vacante, 2010).

In the Netherlands (NL NPPO, 2018a), females and males were prepared in microscopic slides and studied with a magnification up to 1000x. The following keys and descriptions were used:

- McGregor EA (1950) Mites of the family Tetranychidae. *The American Midland Naturalist* 44(2), 257-420 [described as *Septanychus mexicanus*].
- Pritchard AE & Baker EW (1955) A revision of the spider mite family Tetranychidae. Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2, 472 pp.
- Seeman & Beard (2011) Identification of exotic pest and Australian native and naturalised species of *Tetranychus* (Acari: Tetranychidae). *Zootaxa* 2961, 1-72.[5]

No mention of molecular methods for the identification of *T. mexicanus* was found in the literature. However, genetic markers (e.g. a fragment of the Cytochrome oxidase subunit I gene (COI)) can be used to confirm spider mite species identity). In Belgium, ILVO used both an existing (Matsuda *et al.*, 2014) and an unpublished protocol to amplify/sequence COI gene fragments of two Brazilian populations of *T. mexicanus* on *Passiflora edulis* (2022, unpublished; W. Dermauw, pers. comm.).

Six COI sequences and one Internal Transcribed Spacer (ITS) sequence of *T. mexicanus* are available in GenBank to date (2022-09-29):

- specimens from *P. edulis*: two from Distrito Federal (Brazil) and one from Minas Gerais (Brazil), linked to ILVO, unpublished (provided by R. Santos de Mendonça and CEM dos Santos; OM765042.1, OK632064.1, OK598061.1);
- specimens from *Citrus* x *microcarpa*: four from Florida (USA) linked to Sharkey *et al.*, 2022 (MW326469.1, MW326468.1, MW326467.1, MW326466.1).

While the specimens from *P. edulis* and *C.* x *microcarpa* above were identified as *T. mexicanus* based on morphological characters, there was more than 10% nucleotide difference between the COI sequences of

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[5] It should be noted that "hourglass pattern" in the legend of figure 25B of Seeman & Beard (2011) should read "diamond pattern" (J. Witters and W. Dermauw, pers. comm.).

these specimens (W. Dermauw, pers. comm.). The EWG noted that this requires further investigation, as such a result may point towards COI sequences retrieved from different species.

3 Is the pest a vector?

Yes ☐ **No** ☒

4 Is a vector needed for pest entry or spread?

Yes ☐ **No** ☒

Passive transport on animals (phoresy) exists for other Tetranychidae species (Clotuche *et al.*, 2011). However, this is not a true vectoring, and it is covered as a case of contamination in the entry section (section 8.2).

5 Regulatory status of the pest

In the EPPO region, *T. mexicanus* is a quarantine pest for Morocco (EPPO, 2022b), and is being considered for the list of quarantine pests of Israel (T. Levi, pers. comm. 2022-12). Information about the regulatory status of *T. mexicanus* elsewhere in the world was sought (at 2022-02). *Tetranychus mexicanus* is regulated at least in South Africa (South Africa Government, 2009), Thailand (Thailand Government, 2006), Japan (MAFF, 2015), China (China Government, 2009), New Zealand (Biosecurity New Zealand, 2022), Guatemala (Gobierno de Guatemala, 2015) and Western Australia (WA Government, 2022). The information consulted is not exhaustive and *T. mexicanus* may thus be regulated in more countries.

6 Distribution

***Tetranychus mexicanus* is reported only from the Americas. Its known distribution extends from northern Argentina and Uruguay in the South, to southern Florida and Texas (USA) in the North, between the latitudes 31°S and 27°N, and it is reported from several Caribbean islands (Figure 1).**

In the South, the known distribution of *T. mexicanus* reaches the northern Argentinian provinces of Tucuman (Herrero, 1984) and Corrientes (Cáceres, 2006), located respectively at ca. 27°S and 28°S, and Salto Department in Uruguay (ca. 31°S) (Bernal & Pineiro, 1982).

The northernmost report available is from ca. 27°N, at Port Salerno, Martin county, in southern Florida (USA), where the mite was found in 1980 on one out of four *C. sinensis* trees (5-6 years old) at a street (Anonymous, 1980). There are a few recent sequences of *T. mexicanus* from Florida in Genbank, all from localities at lower latitudes. One record from southern Texas is from Monte Alto, at ca. 26°N (Beer & Lang, 1958). Anonymous (1980) mentions “records from Texas tentative until males confirmed”, but no details were found of precise location. In Mexico, the records found are alsofrom localities south of 27°N (San Luis Potosi - Beer & Lang, 1958, Veracruz - Ruíz-Montiel *et al.*, 2020; Tabasco - Otero-Colina, 1986).

A report in China is not confirmed (EPPO, 2019; NL NPPO, 2018b): the pest was reported in Hainan in 1994 on eggplant (Anonymous, 1980; Cheng, 1994). However, no other record of the pest was found since. China is not listed in Migeon & Dorkeld (2022) (a comprehensive database on Tetranychidae that includes distribution records).

Finally, at 2022-10, *T. mexicanus* is not known to be present in the EPPO region. An incursion occurred in the Netherlands in 2018 and was declared eradicated in 2019 (NL NPPO, 2018a, 2019). Approximately 25 out of 770 *Beaucarnea recurvata* plants, which were severely affected, were found infested in a retail company. These plants were in a greenhouse with other tropical plants, which were not affected. Official measures were taken.

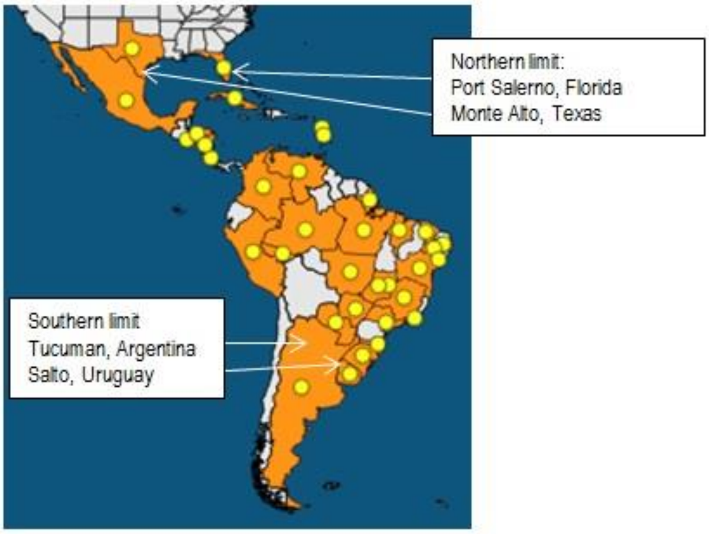


Fig. 1. Countries (and states for Brazil and the USA) where *Tetranychus mexicanus* has been reported (EPPO, 2022b)**.**

Table 2. All records are from EPPO Global Database (EPPO, 2022b, which provides original references)

	Countries (and states for Brazil and the USA)
North America	Mexico
	USA: Florida, Texas
South America	Argentina
	Brazil: Acre, Amapá, Amazonas, Bahia, Ceará, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo, Sergipe
	Colombia
	Paraguay
	Peru
	Uruguay
	Venezuela
Central America and Caribbean	Costa Rica
	Cuba
	El Salvador
	Guadeloupe
	Honduras
	Martinique
	Nicaragua

***Tetranychus mexicanus* may have a wider distribution in Central and South America and in particular it may also be present in countries and Brazilian states that border countries/states where the pest is known to be present, i.e.:**

- Belize, Panama, Guyana, Suriname, French Guiana, Ecuador, Bolivia (northern part).
- Brazilian states: Rondônia, Tocantins, Piauí, Rio Grande do Norte, Roraima, Espírito Santo, Alagoas, Paraná.

Regarding Guatemala, the quarantine list states that *T. mexicanus* is absent (Gobierno de Guatemala, 2015).

7 Host plants and their distribution in the PRA area

***Tetranychus mexicanus* has been reported on over 150 plant species and genera belonging to 50 families (Annex 5). However, the host status of some plants was considered as uncertain by the EWG (see below).**

Tetranychus mexicanus was first described on *Citrus* from Mexico (McGregor, 1950[6]) and Argentina (Flechtmann & Baker 1970 cited in Favero, 2016), and *C. sinensis* appears to be a major host. On cultivated plants, *T. mexicanus* has been more frequently reported on *Citrus*, *Annona* and *C. papaya*, as well as on various palms and ornamental plants. Rutaceae is the family with the highest number of hosts, and there are also many host species amongst Annonaceae, Arecaceae (palms), Euphorbiaceae, Fabaceae and Malvaceae. This does not necessarily reflect host preference for these plant families, but could rather result from the prevalence of these families where the mite occurs, or their economic importance.

Tetranychus mexicanus is mostly recorded from trees and bushes, but there are also some records on herbaceous plants. For example Bernal & Pineiro (1982) mention that *Citrus* is the main host of *T. mexicanus*, but it sometimes attacks peanut (*Arachis hypogea*) plantations. It is not specified if this happens only when populations are high. Many host plants are present in the EPPO region, as crops, as ornamentals in gardens, parks and public areas, and in the natural environment (see Annex 5).

The host range of *T. mexicanus* is likely to be wider than known. For example, *B. recurvata* was not a known host until heavily infested plants were found after import into the Netherlands and was the first host species recorded in the Asparagaceae family (NL NPPO, 2018a). Also *Paullinia cupana* was recently reported as a new host plant (Vasconcelos *et al.*, 2022).

Plants on which *T. mexicanus* have been recorded in the literature were separated into 'hosts and likely hosts' (category 1) and 'uncertain hosts' (category 2) (see descriptions below). This separation is done because findings of a mite on a plant is not sufficient to determine its host status. Flechtmann & Moraes (2017) note that "*several host plant records are based on the finding of a single specimen, almost always a female, therefore, require confirmation of host plant status. Even when rather large numbers of spider mites are seen on plants in the vicinity of a highly infested crop, their populations can be only temporarily due to dispersion by wind from the neighbouring crop*".

Many hosts of *T. mexicanus* in the literature were recorded during faunistic studies on mites in Brazil, where collection place, date and number of individuals are reported. The presence of colonies with immature stages is a solid criterion to indicate the development of the mite on a plant species. However, the presence of colonies is normally not recorded in faunistic studies, and the EWG decided to consider a plant species as a likely host when at least two different life stages (immatures and adults) have been reported on that plant, or when the number of specimens reported indicated the presence of a colony.

Category 1 – Hosts and likely hosts. Plants in this category fulfil at least one of the following criteria:
- there is evidence that the plant is suitable to complete the life cycle (in particular, specific studies conducted on the life cycle, colonies observed on the plant in the field); or
- report of *T. mexicanus* as a pest; or
- from faunistic studies on mites, at least two different life stages (immatures[7] and adults) found on the plant species, or the numbers of specimen reported indicate a colony. The EWG decided to apply a threshold of 10 adults (in one observation or in total over several observations) as an indicator of the possible presence of a colony of *T. mexicanus*. When another species in the same genus is a 'host or likely host', a threshold of 5 adults was applied.

All species within the genera of *Citrus* and *Annona* are considered category 1 hosts because there are many known host species within these genera.

Category 2 – Uncertain hosts. All other plants on which *T. mexicanus* was recorded, including plants listed as hosts in the databases Flechtmann & Moraes (2017) or Migeon & Dorkeld (2022) but for which the original publications could not be checked in detail.
In the rest of this PRA, when the information provided or assessment relates to an uncertain host, this is indicated between brackets.

[6] Unlike mentioned in some sources, McGregor (1950) did not report the pest in the USA, only in Mexico.
[7] in studies when adults and nymphs were reported together, nymphs were assumed to be *T. mexicanus* (even if only adults may be identified by morphological characters).

Records at the family level (especially from Migeon & Dorkeld, 2022) are not included in Annex 5.

Summary of hosts **(extract from Annex 5 –details on hosts are in Annex 5)**
# indicates species or genera categorised based only on the threshold of adults (see thresholds in the description of Category 1 above)

Host scientific name	Family	Cat.
Abelmoschus esculentus	Malvaceae	1
Acalypha diversifolia#	Euphorbiaceae	1
Acrocomia aculeata	Arecaceae	1
Alchornea glandulosa	Euphorbiaceae	1
Annona	Annonaceae	1
Annona coriacea	Annonaceae	1
Annona crassiflora	Annonaceae	1
Annona muricata	Annonaceae	1
Annona squamosa	Annonaceae	1
Annona x atemoya	Annonaceae	1
Arachis hypogaea	Fabaceae	1
Bactris gasipaes	Arecaceae	1
Beaucarnea recurvata	Asparagaceae	1
Bougainvillea sp.	Nyctaginaceae	1
Canavalia ensiformis	Fabaceae	1
Carica papaya	Caricaceae	1
Carya illinoinensis	Juglandaceae	1
Cedrela fissilis	Meliaceae	1
Cedrela odorata	Meliaceae	1
Celtis iguanaea	Cannabaceae	1
Celtis sp. #	Cannabaceae	1
Centrosema pubescens	Fabaceae	1
Citrus	Rutaceae	1
Citrus aurantifolia	Rutaceae	1
Citrus latifolia	Rutaceae	1
Citrus limon	Rutaceae	1
Citrus paradisi	Rutaceae	1
Citrus reticulata	Rutaceae	1
Citrus sinensis	Rutaceae	1
Citrus sunki	Rutaceae	1
Cocos nucifera	Arecaceae	1
Codiaeum variegatum	Euphorbiaceae	1
Elaeis guineensis	Arecaceae	1
Erythrina poeppigiana	Fabaceae	1
Fortunella sp.	Rutaceae	1
Fragaria chiloensis	Rosaceae	1
Fragaria x ananassa	Rosaceae	1
Gossypium	Malvaceae	1
Gossypium herbaceum	Malvaceae	1
Gossypium hirsutum	Malvaceae	1
Guettarda uruguensis#	Rubiaceae	1
Hancornia speciosa	Apocynaceae	1
Hevea brasiliensis	Euphorbiaceae	1
Ilex paraguariensis	Aquifoliaceae	1
Litchi chinensis	Sapindaceae	1
Manihot esculenta	Euphorbiaceae	1
Murraya paniculata	Rutaceae	1
Musa	Musaceae	1
Passiflora edulis	Passifloraceae	1
Passiflora ligularis	Passifloraceae	1
Passiflora membranacea	Passifloraceae	1
Paullinia cupana	Spindaceae	1
Persea americana	Lauraceae	1
Phaseolus vulgaris	Fabaceae	1

Host scientific name	Family	Cat.
Poncirus trifoliata	Rutaceae	1
Prunus persica	Rosaceae	1
Prunus salicina	Rosaceae	1
Pyrus communis	Rosaceae	1
Ricinus communis#	Euphorbiaceae	1
Rollinia mucosa	Annonaceae	1
Syagrus#	Arecaceae	1
Tecoma stans	Bignoniaceae	1
Theobroma cacao	Malvaceae	1
Theobroma grandiflorum#	Malvaceae	1
Trichilia casarettoi#	Meliaceae	1
Vitis labrusca	Vitaceae	1
Vitis vinifera	Vitaceae	1
Xylopia aromatica#	Annonaceae	1
Zingiber zerumbet#	Zingiberaceae	1
Allium sativum	Amaryllidaceae	2
Alocasia	Araceae	2
Aloysia virgata	Verbenaceae	2
Anacardium occidentale	Anacardiaceae	2
Andropogon#	Poaceae	2
Annona purpurea	Annonaceae	2
Annona reticulata	Annonaceae	2
Attalea speciosa	Arecaceae	2
Averrhoa carambola	Oxalidaceae	2
Azadirachta indica	Meliaceae	2
Bauhinia sp.	Fabaceae	2
Bixa orellana#	Bixaceae	2
Cariniana estrellensis	Lecythidaceae	2
Cariniana legalis	Lecythidaceae	2
Caryocar brasiliense	Caryocaraceae	2
Caryota mitis	Arecaceae	2
Casearia sylvestris	Salicaceae	2
Catasetum macrocarpum	Orchidaceae	2
Citrus limetta	Rutaceae	2
Codiaeum	Euphorbiaceae	2
Cordiera sessilis	Rubiaceae	2
Couroupita guianensis	Lecythidaceae	2
Crotalaria retusa	Fabaceae	2
Cupressus sp.	Cupressaceae	2
Cymbopogon schoenanthus	Poaceae	2
Dioscorea alata	Dioscoreaceae	2
Doliocarpus dentatus#	Dilleniaceae	2
Elaeis oleifera	Arecaceae	2
Erythrina variegata	Fabaceae	2
Esenbeckia leiocarpa	Rutaceae	2
Euterpe edulis	Arecaceae	2
Euterpe oleracea	Arecaceae	2
Fortunella japonica	Rutaceae	2
Genipa americana	Rubiaceae	2
Glycine max	Fabaceae	2
Gossypium barbadense	Malvaceae	2
Heliconia sp. #	Heliconiaceae	2
Heliconia wagneriana	Heliconiaceae	2
Hevea benthamiana	Euphorbiaceae	2

Host scientific name	Family	Cat.
Hevea pauciflora	Euphorbiaceae	2
Hovenia dulcis	Rhamnaceae	2
Livistona sp.	Arecaceae	2
Luehea	Malvaceae	2
Luehea speciosa#	Malvaceae	2
Maclura tinctoria	Moraceae	2
Magnolia grandiflora	Magnoliaceae	2
Malpighia	Malpighiaceae	2
Malpighia glabra	Malpighiaceae	2
Malus sylvestris or *domestica*	Rosaceae	2
Melicoccus bijugatus	Sapindaceae	2
Micropholis gardneriana	Sapotaceae	2
Morus alba#	Moraceae	2
Morus nigra	Moraceae	2
Myrtus communis	Myrtaceae	2
Passiflora	Passifloraceae	2
Petiveria alliacea	Phytolaccaceae	2
Phaseolus lunatus	Fabaceae	2
Philodendron sp.	Araceae	2
Phyllanthus	Phyllanthaceae	2
Pittosporum tobira	Pittosporaceae	2
Plumeria alba	Apocynaceae	2
Podranea ricasoliana	Bignoniaceae	2
Polyscias balfouriana	Araliaceae	2
Populus tremuloides	Salicaceae	2
Portulaca oleracea	Portulacaceae	2
Psidium guajava	Myrtaceae	2
Psychotria sp. #	Rubiaceae	2
Ptychosperma macarthurii	Arecaceae	2
Rosa	Rosaceae	2
Roystonea regia	Arecaceae	2
Saccharum officinarum	Poaceae	2
Sapindus saponaria	Sapindaceae	2
Schefflera vinosa	Araliaceae	2
Sida	Malvaceae	2
Sida cf glutinosa	Malvaceae	2
Smilax fluminensis	Smilacaceae	2
Sorghum halepense	Poaceae	2
Stryphnodendron adstringens#	Fabaceae	2
Tabernaemontana catharinensis#	Apocynaceae	2
Thaumatophyllum bipinnatifidum	Araceae	2
x Citrofortunella microcarpa	Rutaceae	2
Zanthoxylum coco#	Rutaceae	2
Zanthoxylum monogynum#	Rutaceae	2

8 Pathways for entry

Tetranychus mexicanus is mentioned as intercepted in Texas, USA (Beer and Lang, 1958 from Mexico) but the commodity is not clearly specified (‘host (orange) shipment’). The incursion in the Netherlands was linked to imported pot plants of *B. recurvata*, which was not known to be a host at the time and was the first host species recorded from the family Asparagaceae (NL NPPO, 2018a)

The following pathways for entry of *T. mexicanus* are discussed in this PRA:
- **Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material (Table 3 in section 8.1)**
- **Above-ground fresh cut plant parts of hosts (cut flowers, cut foliage, cut branches (incl. trees), leaf vegetables (incl. herbs)) and associated packaging material (Table 4 in section 8.1)**
- **Host fruit and associated packaging material (Table 5 in section 8.1)**
- Non-host plants for planting, above-ground fresh cut plant parts and fruit
- Seeds, bulbs, corms, tubers, rhizomes for planting (hosts and non-hosts)
- Pollen, tissue cultures (hosts and non-hosts)
- Underground plant parts (hosts and non-hosts)
- Wood (round wood, sawn wood, wood chips, processing wood residues, hogwood), bark, wood packaging material, furniture and articles made of wood (hosts and non-hosts)
- Stored products/dried plant parts (hosts and non-hosts)
- Manufactured/processed commodities (other than wood) made of hosts or non-hosts
- Natural spread
- Hitchhiking, conveyances etc.

Pathways in bold are described and evaluated in detail in section 8.1. These are commodities of hosts that contain fresh leaves, twigs or fruit. Pathways that are considered ‘unlikely pathways’ (not in bold) are briefly discussed in section 8.2. In each pathway, all plant species in the host categories 1 and 2 that are relevant for the commodity are covered. The search for data focused on ‘hosts and likely hosts’ (category 1).

8.1 Pathways investigated in detail

Note: Examples of import prohibitions and phytosanitary measures are given only for some EPPO countries (in this express PRA the regulations of all EPPO countries are not fully analysed).

Table 3. Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material

Pathway	**Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material**
Coverage	• The pathway covers plants for planting with root ball (with soil or growing medium; including bonsais), plants with bare roots, cuttings, scions of host plants. • It covers commercial trade, including Internet trade by private persons (although there are no specific data on the latter). • It also covers packaging used for plants for planting. • Seeds, bulbs, corms, tubers, rhizomes, tissue cultures and pollen are excluded (covered in section 8.2). This pathway also includes travellers carrying in their luggage plants for planting from areas where the pest occurs. However, little data are available for travellers' luggage, which is therefore not assessed separately.
Plants concerned	Plant species in categories 1 and 2 (see section 7 and Annex 5)
Pathway prohibited in the PRA area?	Partly, at least in some EPPO countries. For example, in the EU, import of some host plants intended for planting, other than fruit or seeds, is prohibited in relation to other quarantine organisms according to Annex VI of EU Implementing Regulation 2019/2072 (EU, 2019). These prohibitions cover countries where *T. mexicanus* occurs and include the following genera: - *Citrus*, *Fortunella*, *Poncirus* and their hybrids - *Malus* (uncertain host), *Prunus*, *Pyrus*, and *Rosa* (uncertain host), other than dormant plants free from leaves, flowers, and fruits - *Malus* (uncertain host), *Prunus*, *Pyrus*, and their hybrids, and *Fragaria* (allowed from the USA except Hawaii) - *Vitis* - *Populus* (uncertain host), with leaves, from Mexico and the USA. In the EU, there is also a prohibition of introduction into the EU of 'high risk plants' pending a risk assessment according to EU Implementing Regulation 2018/2019 (EU, 2022a). This prohibition covers several host genera, including three that are not mentioned above: *Annona*, *Bauhinia* (uncertain host) and *Persea*. In Israel, plants for planting from the genera *Citrus*, *Malus*, *Vitis*, *Annona* and *Carica* are prohibited. They may be imported for research or breeding purposes under post-entry quarantine under a special permit (T. Levi, pers. comm.).
Pathway subject to a plant health inspection at import?	Yes, at least in some EPPO countries. For example, in the EU, plants for planting other than seeds should be accompanied with a phytosanitary certificate and should be inspected at import. Plants for planting of specific species/genera are also covered by various pest-specific phytosanitary requirements (EU, 2019; EEC, 2016). These requirements are likely to reduce the likelihood of association of the pest with the commodity as they imply inspection before export and at import, which increases the likelihood of detection. However, low populations are difficult to detect. In addition, as *T. mexicanus* is not a quarantine pest in most EPPO countries (e.g. in EU and EAEU countries), presence of the pest on an intercepted commodity may not result in its rejection.
Pest already intercepted?	Yes. In the Netherlands, *T. mexicanus* was found on imported pot plants of *Beaucarnea recurvata* (NL NPPO, 2018a, 2019).

Pathway	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material
Most likely stages that may be associated	All life stages may be present. Packaging may carry immatures and adults, if these crawl from the plants or are carried through aerial dispersal.
Important factors for association with the pathway	*Tetranychus mexicanus* is present all year-round. *Tetranychus mexicanus* can be associated with young or mature leaves and has been observed on seedlings and mature plants (see section 2.4). If there are no leaves, association is less likely, but it cannot be ruled out that eggs and other live stages are present (e.g. on dormant plants or cuttings without leaves). The pest is normally located on leaves, but there is one mention of association with twigs and orange fruit in the literature (see section 2.4). The pest has been found in nurseries in several countries where it is present. There is no information on how common the pest is in nurseries that export plants to the EPPO region, nor on the effect of management practices already applied in nurseries. Highly infested units are likely to be removed during quality checks.
Survival during transport and storage	*T. mexicanus* is expected to survive on its hosts. The life cycle is short and the mite may even reproduce during transport and storage if the conditions are appropriate. The survival of mites present on the packaging may be limited to a few days if they do not find a suitable host (see section 2.4). Transport in cool conditions was studied in the PRA for *T. evansi*. It was considered that if plants are transported in cool conditions, any mite infesting the plants will become quiescent if cooled and thus transport or storage conditions will not affect the mite too negatively (EPPO, 2008). Cuttings may be transported at fairly low temperatures (e.g. 3-4°C). Survival of *T. mexicanus* below the lower development threshold might be possible. However, there is a high uncertainty on the development threshold of *T. mexicanus* (it may be 10-13°C as inferred from other (sub)tropical species). The lowest survival temperature of *T. mexicanus* is not known (see section 2.7). The PRA for *T. evansi* mentions that, in cool conditions, females are unlikely to produce males parthenogenetically (EPPO, 2008). It is assumed that this would be the same for *T. mexicanus*, and thus reproduction during transport is less likely.
Trade	Plants for which no data were found on their presence in the EPPO region (this includes a number of wild plants) are unlikely to be traded as plants for planting (see Annex 5, 'no data found', or 'not known', such as *Alchornea glandulosa*, *Cedrela fissilis*). However, trade patterns change, and it cannot be excluded that some of them may be traded in the future. Regarding 'hosts and likely hosts' (Category 1), data for the period 2000–2011 (ISEFOR data regarding imports from non-EU countries into seven EU countries – Eschen *et al.*, 2017) show import of some host species or genera (see Annex 6). These data are old and incomplete and there is a high uncertainty concerning the import volumes of plants for planting of host plants of *T. mexicanus* into the EPPO region. The origin of such trade may also change. However, they show: • a large diversity of hosts (or their genera) coming from many countries where the pest occurs (or countries where its presence is uncertain - section 6)), especially ornamentals, mainly *Codiaeum* and *Beaucarnea*. • fruit host species are less traded. • import was registered for some plants for planting of fruit species that are prohibited in the EU from such origins. It is supposed that such consignments were rejected (e.g. *Citrus*) or only allowed under derogation (in the EU, such plants may be imported for research or breeding

Pathway	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material
	purposes under strict conditions and only with a special permit (Regulation (EU) 2019/829)). In 2021 in the Netherlands, approximately 1.2 million *Beaucarnea* plants were imported from Guatemala (where there is no confirmed record of *T. mexicanus* to date – see section 6), and 900 from Costa Rica, where the pest is present (178 lots in total) (DJ van der Gaag, pers. comm.).
Transfer to a host	*Factors favourable to transfer:* The pest is already on a suitable host. In nurseries, infested plants for planting are likely to be grouped close to other suitable (or the same) hosts to which *T. mexicanus* could spread (as for *T. evansi*, EPPO, 2008). The pest is highly polyphagous. One single surviving female either fertilized or unfertilized, has the potential to start a population. *Factors unfavourable to transfer:* Transfer from infested packaging would require that the mites find a suitable host by crawling or other dispersal mechanism. This is not likely, unless the packaging is reused for packing host plants.
Likelihood of entry and uncertainty	The EWG decided to rate separately plants for planting with leaves and plants for planting without leaves. ***Host plants for planting (except tissue cultures) with leaves and associated packaging material:*** **High likelihood, moderate uncertainty** Host plants for planting with leaves are imported in large quantities, especially ornamentals; pest found associated with traded plants once (*B. recurvata*); polyphagous, facilitating transfer. *Uncertainty*: only one documented interception but possibly the mite may have been overlooked; no information on how common the pest is in nurseries that export plants to the EPPO region, and effect of the management practices already applied in nurseries. ***Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen) without leaves and associated packaging material:*** **Low likelihood, moderate uncertainty** The likelihood of association is lower than for plants with leaves, but association is not excluded; less possibility to survive; low import volume because relates to species subject to prohibitions in many EPPO countries. *Uncertainty*: association with cuttings; which species imported without leaves from countries where *T. mexicanus* is present and what is the extent of import volumes; how well the pest survives on plants without leaves.

Table 4. Above-ground fresh cut plant parts of hosts (cut flowers, cut foliage, cut branches (incl. trees), leaf vegetables (incl. herbs)) and associated packaging material

Pathway	**Above-ground fresh cut plant parts of hosts (cut flowers, cut foliage, cut branches (incl. trees), leaf vegetables (incl. herbs)) and associated packaging material**
Coverage	This pathway covers all commodities composed of fresh parts of plants that include leaves. It covers: - cut flowers, cut foliage, cut branches, and leaf vegetables (incl. herbs), as well as other leaves traded on their own for various purposes, such as medicinal. It also covers packaging used for packing such commodities. This pathway also includes travellers carrying in their luggage such commodities from areas where the pest occurs. However, limited data are available for such commodities in travellers' luggage, which are therefore not assessed separately. Some host plants are used as animal feed such as *Centrosema pubescens*, *Esenbeckia leiocarpa* (uncertain host), *Morus alba* (uncertain host), *M. nigra* (uncertain host), *Tecoma stans*, but the EWG considered that they are unlikely to be imported fresh from the Americas, and they are therefore not covered further in this pathway.
Plants concerned	Plant species in categories 1 and 2 (see Annex 5), such ascut flowers, cut foliage, cut branches of for example *Pittosporum tobira* (uncertain host) and *Rosa* (uncertain host); leaf vegetables (incl. herbs) and other leaves of for example *Casearia sylvestris* (uncertain host) (herb, medicinal plant), *Portulaca oleracea* (uncertain host) (leaf vegetable). Note that the EWG did not know if all leaves used as herb or for medicinal purposes would be traded fresh, or fresh enough to allow survival of the pest.
Pathway prohibited in the PRA area?	Yes, at least in some EPPO countries. In the EU, *Citrus*, *Fortunella*, *Poncirus* and *Vitis*; *Populus* (uncertain host) with leaves (EU, 2019).
Pathway subject to a plant health inspection at import?	Yes, at least in some EPPO countries. In the EU (Commission Implementing Regulation 2019/2072), the following commodities are inspected due to regulation of other quarantine organisms. In Part A of Annex XI: - Leaves of *Manihot esculenta* - Foliage and branches of *Populus* (uncertain host), without flowers and flower buds, fresh - *Zanthoxylum* (uncertain host), *Murraya*, cut fresh plant parts (e.g. flowers, foliage, branches) - Cut flowers of Orchidaceae (*Catasetum macrocarpum* (uncertain host)) and *Rosa* (uncertain host)
Pest already intercepted?	No information found.
Most likely stages that may be associated	All life stages may be present. Packaging may carry immatures and adults, if these crawl from the plant material or are carried through aerial dispersal.

Pathway	Above-ground fresh cut plant parts of hosts (cut flowers, cut foliage, cut branches (incl. trees), leaf vegetables (incl. herbs)) and associated packaging material
Important factors for association with the pathway	*Tetranychus mexicanus* is present on hosts all year-round. *Tetranychus mexicanus* can be associated with young or mature leaves, and has been observed on seedlings and mature plants (see section 2.4). If there are no leaves, association is less likely, but it cannot be ruled out that eggs and other live stages are present. The pest is normally located on leaves, but there is one mention of association with twigs in the literature. Highly infested units are likely to be removed during quality checks. There is no information on the presence of the pest with production of host cut flowers or other cut plant parts. In particular, *Rosa* (uncertain host) in Ecuador, and most likely also Colombia, are cultivated at high altitude (between 2800 and 3000 m) (Financial Times, 2015), where the pest is assessed as unlikely to be present).
Survival during transport and storage	The commodities concerned are likely to be transported under cool conditions to keep them fresh. Cut flowers and cut branches with leaves are normally stored and transported at low temperatures (often between 0 and 4°C). Leaf vegetables may be stored at higher temperatures but which are still low for development of the mite (e.g. 12°C). Because of their short shelf lifes these commodities are usually transported by plane (short transport time). Survival of *T. mexicanus* below the lower development threshold might be possible. However, there is a high uncertainty on the development threshold of *T. mexicanus* (it may be 10-13°C as inferred from other (sub)tropical species). The lowest survival temperature of *T. mexicanus* is not known (see section 2.7). The survival of mites present on the packaging may be limited to a few days if they do not find a suitable host (see section 2.4).
Trade	*Rosa* (uncertain host) are traded as cut flowers from Colombia to the EPPO region (Annex 7 – data for other countries where *T. mexicanus* occurs were not extracted). No information was sought for other host species.
Transfer to a host	*Factors favourable for transfer:* One single surviving female either fertilized or unfertilized, has the potential to start a population. The pest is highly polyphagous. *Factors unfavourable for tranfer:* Cut plant parts are mostly used indoors where there may not be other suitable plants to transfer to. The temperatures may be suitable for the pest, but the material will progressively degrade, and become unsuitable. Mites are therefore not likely to survive and be able to transfer to a host. Leaf vegetables have a short shelf life and are intended for consumption, which both lower the likelihood of transfer. If leaves are used by the medicinal industry, they would be processed (incl. washing, extraction, drying), and the mite is unlikely to survive such processes. Transfer from infested packaging would require that the mites find a suitable host by crawling or other dispersal mechanism.

Pathway	Above-ground fresh cut plant parts of hosts (cut flowers, cut foliage, cut branches (incl. trees), leaf vegetables (incl. herbs)) and associated packaging material
Likelihood of entry and uncertainty	**Low likelihood, moderate uncertainty** The likelihood is lower than for plants for planting with leaves; several factors are unfavourable for transfer (indoors use, short shelf-life or processing for some hosts); no interceptions; there is a large import volume of *Rosa* (uncertain host) cut flowers from South America but these are likely produced at high altitude where the pest is unlikely to be present. *Uncertainty*: likelihood of association (presence of the pest in facilities producing such commodities for export); effect of low temperature in transport/storage; trade; whether hosts are traded in this form; possibility that the mite might have been overlooked on commodities at export and import.

Table 5. Host fruit and associated packaging material

Pathway	**Host fruit and associated packaging material**
Coverage	This pathway includes fruit in the botanical sense with or without green parts (leaves and peduncles) associated, as well as nuts and pods. It also covers packaging used for packing fruit. The pathway focuses on commercial trade, but fruit carried by travellers are also covered. Airline luggage is a known pathway for introduction of alien insect species in the USA (Liebhold *et al.*, 2006, fruit presumed to be largely represented because to be consumed during the journey or brought as gifts).
Plants concerned	Plant species in categories 1 and 2 (see Annex 5). The following hosts have edible fruits (incl. nuts) that may be traded: *Abelmoschus esculentus*, *Annona coriacea*, *A. muricata*, *A. purpurea* (uncertain host), *A. squamosa*, *A.* x *atemoya*, *Averrhoa carambola* (uncertain host), *Carica papaya*, all *Citrus* hosts, *Euterpe oleracea* (uncertain host), *Fortunella japonica* (uncertain host), *Fragaria* x *ananassa*, *Litchi chinensis*, *Malpighia glabra* (uncertain host), *Malus domestica* (uncertain host), *Melicoccus bijugatus* (uncertain host), *Musa*, *Passiflora edulis*, *P. ligularis*, *P. membranacea*, *Persea americana*, *Phaseolus vulgaris* (pods, e.g. green beans or other types traded fresh and shelled), *Prunus persica*, *P. salicina*, *Psidium guajava* (uncertain host), *Pyrus communis*, *Rollinia mucosa*, *Vitis vinifera*, x *Citrofortunella microcarpa* (uncertain host). The pathway also covers plants whose fruit are reported as being consumed mostly locally at origin (travellers may carry such fruits, and it is not excluded that there is a small commercial production and trade): *Annona crassiflora*, *Caryocar brasiliense* (uncertain host), *Cordiera sessilis* (uncertain host), *Fragaria chiloensis*, *Hancornia speciosa* (although highly perishable and unlikely to be transported in luggage – A. Teodoro, pers. comm.), *Morus alba* (uncertain host), *M. nigra* (uncertain host), *Poncirus trifoliata*, *Theobroma grandiflorum.* Nuts: *Anacardium occidentale* (uncertain host), *Carya illinoinensis*, *Cocos nucifera* (if traded fresh and with outer envelope). Pods: *Phaseolus vulgaris* (if traded whole, e.g. green beans). The analysis of edible fruits from hosts was made based on a general search and may have missed some hosts in Annex 5. *Theobroma cacao* is most likely to be traded dry and is covered in section 8.2.
Pathway prohibited in the PRA area?	Partly, at least in some EPPO countries. In the EU, imports of citrus fruit with peduncles or leaves from countries where the pest is present are prohibited (EU, 2019).
Pathway subject to a plant health inspection at import?	Yes, at least in some EPPO countries. e.g. in the EU (in relation to other quarantine pests): *Citrus*, *Fortunella*, *Poncirus*, *Annona*, *Carica papaya*, *Fragaria*, *Malus* (uncertain host), *Passiflora*, *Persea americana*, *Prunus*, *Psidium* (uncertain host), *Pyrus*, *Vitis* (EU; 2019). Cashew nuts (*Anacardium occidentale* – uncertain host), fresh, whole, not shelled, not peeled. Other nuts, fresh, whole not shelled, not peeled, also for sowing. A phytosanitary certificate is required for all fruit (including for fruit transported by passengers in luggage) except a few species that include the hosts *Cocos nucifera* and *Musa.*

Pathway	Host fruit and associated packaging material
Pest already intercepted?	No information found.
Most likely stages that may be associated	All life stages may be associated with the green parts of the host fruit. For host fruit without leaves association is less likely; association of all life stages with fruit without leaves has only been reported for *Citrus sinensis* from São Paulo state. Packaging may carry mites (immatures and adults), if these crawl from the fruit or are carried through aerial dispersal.
Important factors for association with the pathway	Association with fruit is mentioned only for *Citrus sinensis*. Such association does not seem to be observed throughout the distribution of the pest. Where import of citrus fruits with leaves and peduncles is prohibited from countries where *T. mexicanus* occurs (e.g. in the EU), this would lower the likelihood of association. Association is more likely if green parts are present. For example litchis on branches are traded from the USA to Australia (https://micor.agriculture.gov.au/Plants/Pages/United_States_of_America_US/Lychee.aspx), and this may happen in the EPPO region. Although *Citrus* may be traded with leaves within the EPPO region, it is unlikely from the Americas. Nuts traded without their outer green envelope would not be a pathway, nor beans if traded without pods (e.g. *P. vulgaris* as Kidney beans). If the fruit originates from commercial orchards, operations at harvest and post-harvest (such as washing) may reduce the likelihood of association with mites of different life stages. However, fruit transported by passengers may also originate from local production, gardens or the wild, where the pest may not be controlled, and the fruit may also not be washed. Travellers may not notice infestations (especially because there may not be many mites). Aerially dispersing individuals of *T. mexicanus* may contaminate fruit or packaging at harvest/packing. Information was not sought on whether measures are applied at origin to prevent the association with fruit, but orchards that have high populations of the pest would probably be treated, lowering the likelihood of association with fruit.
Survival during transport and storage	There is no evidence that *T. mexicanus* can develop on fruit without leaves, except C*itrus sinensis* (see section 2.4). Fruit in international trade is commonly transported under controlled conditions (lower temperature and/or controlled atmosphere), and this is the case in particular for *Citrus* fruit. For example, oranges are transported at 3-10°C, depending on cultivars, with temperatures down to 1°C possible for some varieties in combination with controlled conditions (GDV, 2022). Oranges may be stored for a duration of 4-16 weeks in suitable temperature/humidity conditions, and longer in controlled atmosphere (GDV, 2022). Survival of *T. mexicanus* below the lower development threshold might be possible.However, there is a high uncertainty on the development threshold of *T. mexicanus* (it may be 10-13°C as inferred from other (sub)tropical species). The lowest survival temperature of *T. mexicanus* is not known (see section 2.7). Many tropical fruits other than citrus are more sensitive to long storage and low temperatures, and storage and transport conditions for these fruits would probably be more favourable to the pest (e.g. transportation by plane). The mite is more likely to survive if fresh green parts are present; fruit with green parts are expected to be transported by plane (to ensure that the green parts remain fresh). In travellers' luggage, travel time by plane is unlikely to affect survival at least for cabin luggage. Luggage in the baggage hold may be transported in cool conditions (from a general search, the minimum temperature can be 5-10°C, there is no standard).

Pathway	Host fruit and associated packaging material
	The survival of mites present on the packaging may be limited to a few days if they do not find a suitable host (see section 2.4).
Trade	Trade of *Citrus sinensis* was analysed in the EPPO PRA for *G. aurantianum* (EPPO, 2020), and data from this PRA is used here (extracted from FAOStat for 2016). The pests do not have exactly the same distribution, but the data for *G. aurantianum* provide an indication that oranges are traded from some countries where *T. mexicanus* occurs. In 2016, imports of oranges (over 140000 t) from 10 countries where *T. mexicanus* is known to occur were recorded by 24 EPPO countries, incl. ca. 55000 t from Argentina, 38000 t from Uruguay, 24000 t from Brazil, 10000 t from Peru. For *Citrus*, the trading period depends on the varieties, but oranges mature in autumn to spring where they grow. Oranges from the Southern hemisphere would generally reach the EU in June-November, oranges from the Northern hemisphere generally from November to June. Tropical fruits such as *Annona*, *Averrhoa carambola* (uncertain host), *Carica papaya,* various *Citrus, Persea americana* or *Passiflora edulis* are also imported from the Americas. No data was sought. There is no data on whether host fruit with leaves are imported from the Americas. Travellers may carry host fruit, which is likely to be intended for consumption (similar to studies in South Africa, own consumption or for friends (Ramasodi, 2008)). Fruit that are normally not traded in the EPPO region may be transported by travellers. For example, some host fruit is consumed only locally in South America, and would not be available for sale to consumers in the EPPO region.
Transfer to a host	Even if fruit arrives at packing or storage facilities that are situated close to growing plants in the EPPO region, transfer to a living host would be difficult as it would require either aerial dispersal, crawling, or accidental human-assisted transfer. This would have to happen when the conditions are favourable to mites, and in facilities where the fruit is repackaged close to host crops. Transfer is more likely in companies that combine production of fruit and packaging of imported fruit. In the PRA on *Thaumatotibia leucotreta* (EPPO, 2013), it was mentioned that in the Mediterranean part of the PRA area, part of citrus consignments from countries where [*T. leucotreta*] is present are imported for sorting, re-packing and further distribution. Sorting and packing facilities are located in the vicinity of *Citrus* fruit production areas thus ensuring host availability. During the sorting/repacking process, culled infested fruit may be discarded outdoors on compost piles. If the fruit is peeled to be processed (e.g. to produce *Citrus* juice) or consumed, infested peels are discarded. The mites present on the fruit may be able to crawl or disperse aerially and find a host; this is more likely to happen where there are many host plants nearby. Transfer from infested packaging would require that the mites find a suitable host by crawling or other dispersal mechanism.
Likelihood of entry and uncertainty	***Host fruit with green parts and associated packaging material:*** **Low likelihood, moderate uncertainty** The EWG considered that the likelihood and uncertainty are the same as for above-ground fresh cut plant parts, because the risk is linked to individuals present on the leaves associated with fruit. ***Host fruit without green parts and associated packaging material:*** **Very low likelihood, moderate uncertainty** The likelihood of entry is lower than for fruit with green parts. There is evidence only for association and survival on *C. sinensis*, and the association is occasional. Post-harvest treatments (such as washing and waxing) are generally applied to *Citrus* fruit, and may eliminate most individuals. As for fruit with green parts, transfer would be difficult. There are no known interceptions on fruit. *Uncertainty*: little information about infestation of host fruits (except *C. sinensis* in São Paulo state); whether post-harvest processes are effective to remove the mite; possibility that the mite might have been overlooked on commodities at import; survival during transport/storage.

Overall rating of the likelihood of entry

Rating of the overall likelihood of entry	*Very low* ☐	*Low* ☐	*Moderate* ☐	*High* X	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* X	*High* ☐

This rating is based on the worst-case scenario from the individual pathways considered.

8.2 Unlikely pathways (very low likelihood of entry)

Host fruits without green parts and associated packaging material. Details in Table 5 in section 8.1.

Uncertainty: moderate.

Non-host plants for planting, above-ground cut fresh plant parts and fruit
Association with the commodity, survival during transport and storage, and transfer to a host plant are less likely for all life stages on non-host plants than on hosts.
Association:

- Life stages that crawl or move through aerial dispersal may become associated with such commodities. There would be fewer individuals on non-host plants than on host plants.
- If the plant is not a host, *T. mexicanus* is not likely to remain on the plant. For *T. evansi*, it was noted that although the pest could land on non-host plants, it was not likely to remain there for very long (EPPO, 2008 citing Palevsky, pers. com. 2007).
- Only mites landing on non-host plants immediately prior to their packing and shipping remains on the plant, but they would not multiply on such non-host plants (EPPO, 2008).

Survival:

- *Tetranychus mexicanus* much likely does not survive without food for more than a few days (at conditions favourable for its development; however, it may survive for a longer period at lower temperatures) (see section 2.3). The lowest survival temperature of *T. mexicanus* is not known (see section 2.7).
- On non-host plants, the mite would not multiply.

Transfer:

- If *T. mexicanus* has survived transport on a plant/plant part that does not allow its development, transfer would require crawling or aerial dispersal to a host.
- As for *T. evansi* (EPPO, 2008), because any initial population on non-host plants are assumed to be present in low numbers and [following transport] in weak condition, the probability that any surviving mite will find a suitable host is considered very low. Similar considerations apply to cut plant parts and to fruit.

Uncertainty: low

Seeds, bulbs, corms, tubers, rhizomes for planting (hosts and non-hosts): T. mexicanus is not associated with such plant parts.
Uncertainty: low

Pollen, tissue cultures (hosts and non-hosts): T. mexicanus is not associated with these. Spider mites do not feed on pollen..

Uncertainty: low.

Underground plant parts (hosts and non-hosts). Hosts include some species whose bulbs, tubers or rhizomes are used for consumption (e.g. *Arachis hypogaea* (uncertain host), *Manihot esculenta*, *Allium sativum* (uncertain host), *Dioscorea alata* (uncertain host)). Green parts (leaves) are not associated to those. *T. mexicanus* is not associated with underground parts of plants.
Uncertainty: low.

Wood (round wood, sawn wood, wood chips, processing wood residues, hogwood), bark, wood packaging material, furniture and articles made of wood (hosts and non-hosts): *T. mexicanus* may become associated with bark or wood by aerial dispersal to the trunk or branches of living trees, or to cut wood and wood products. Bark and wood would not sustain survival and development, and transfer to a living host is also unlikely.

Uncertainty: low.

Stored products/dried plant parts (hosts and non-hosts): *T. mexicanus* is unlikely to be associated with plant parts other than leaves, and if it became associated, it would not survive in stored products or dried plant parts (e.g. *Arachis hypogaea; Gossypium, Theobroma cacao, Vitis* raisins, *Phaseolus vulgaris* without pod).

Uncertainty: low.

Manufactured/processed commodities (other than wood) made of hosts or non-hosts. Tetranychus mexicanus is not associated with these. The processes involved will destroy live stages (e.g. grain of *Sorghum halepense* (uncertain host), beans of *Ricinus communis*, rubber from *Hevea brasiliensis* or others; *Theobroma cacao* powder/chocolate, *Glycine max* (uncertain host) meal or oil, *Arachis hypogea* foods; *Maclura tinctoria* (uncertain host) dyes). Where manufactured items are made of parts of plants, these would dry and would not allow the survival and development of the mite (e.g., palms may be used for various objects – *Euterpe oleracea* (uncertain host), possibly other hosts).

Uncertainty: low.

Natural spread. Tetranychus mexicanus is present only in the Americas. Although the mite may be carried upwards in air currents or by phoresy on animals, it is unlikely to be transported all the way into the EPPO region.

Uncertainty: low.

Hitchhiking, *conveyances* etc. Although *T. mexicanus* may become associated as a contaminant of other commodities and substrates by aerial dispersal (e.g. non-host seeds, bulbs or tubers, conveyances, soil and growing medium, cattle, workers' clothing and tools, packaging material not carrying hosts etc.), such substrates would not sustain survival and development. Hitchhiking may be more important for spread locally, especially on worker's clothes or tools.

Uncertainty: low.

9 Likelihood of establishment outdoors in the PRA area

9.1 Host plants

Host plants are grown outdoors and indoors throughout the EPPO region. *Citrus* (especially *C. sinensis*), as well as peach (*Prunus persica*), are cultivated commercially outdoors from the Mediterranean area to the Black Sea. Grapevine (*Vitis vinifera*) and strawberry (*Fragaria* x *ananassa*) are widely cultivated in a wider part of the EPPO region northwards to the UK and Scandinavian countries. Tropical hosts, such as *Persea americana*, *Carica papaya, Passiflora edulis* or *Annona squamosa* are cultivated to a limited extent in the south of the EPPO region (e.g. coast of Granada in Spain, Israel). Palms are widely cultivated as ornamentals in the southern part of the EPPO region. Hosts are also grown in gardens.

Establishment in areas where only deciduous hosts are grown (e.g. peach, apple (uncertain host), grapevine) would depend on whether the pest is able to overwinter on the plant (see section 2) or to find suitable hosts during the winter period until the following growing season. No report has been found of *T. mexicanus* infesting weeds (except for *Sorghum halepense* which is considered a weed in some areas (Annex 5)). However this may not have been studied, but *T. mexicanus* is very polyphagous and other *Tetranychus* spp. are commonly found infesting weeds.

***Tetranychus mexicanus* is very polyphagous and may find new hosts in the EPPO region.**

9.2 Climatic suitability

Considering the environmental requirements of *T. mexicanus* (see section 2.7), it is considered that the mite would be able to establish outdoors in the southernmost part of the EPPO region (where winters are mild), such as the Mediterranean coast, southern Portugal, coastal areas of the Black Sea. In other parts of the EPPO region, while it could develop and reproduce outdoors during the summer, it would probably not be able to overwinter. There is an uncertainty on the northern and eastern limits of the potential area of establishment.

Other alien spider mites were able to establish in the EPPO region. For example, the (sub)tropical spider mite *T. evansi* has expanded its distribution to many tropical and temperate areas (Ghazy *et al.*, 2019), and it is now established outdoors in several countries around the Mediterranean Basin, as well as in Portugal and Israel (EPPO, 2022b; Naves *et al.*, 2021). Similarly, *Eotetranychus lewisi* was originally present in tropical or subtropical areas, but according to EFSA (2017), the climatic conditions in the EU would allow *E. lewisi* to establish in large parts of this territory.

9.3 Other factors

- One single female, fertilized or even unfertilized, has the potential to start a population.
- The reproductive capacity of *T. mexicanus* is high.
- Competition will probably not prevent establishment. *T. mexicanus* is commonly found with other spider mite species on plants in its current area of distribution. In Spain, studies have shown that *T. evansi* has established on weed hosts despite competition with *T. urticae* (EPPO, 2008 with references).
- Existing management practices have not prevented establishment of the (sub)tropical spider mite *T. evansi* (EPPO, 2008).

Rating of the likelihood of establishment outdoors	*Very low* ☐	*Low* ☐	*Moderate* ☐	*High* ☐	*Very high* X
Rating of uncertainty			*Low* X	*Moderate* ☐	*High* ☐

10 Likelihood of establishment in protected conditions in the PRA area

Several hosts are grown under protected conditions in the EPPO region, such as strawberry, *Citrus* and *B. recurvata*. In Spain, there are many nurseries producing *Citrus* seedlings in protected conditions all-year round. Several other tropical fruit crops that are hosts for *T. mexicanus* may also be grown under greenhouse conditions all-year round.

There are several reports of *T. mexicanus* being a pest under protected conditions and protected conditions are favourable for pest development. *Tetranychus mexicanus* was reported as a pest of strawberry under protected cultivation (Argolo, 2008 citing others). On *A. muricata*, in the rainy season, protected environment (screenhouse) is thought to have favoured the pest's development on seedlings, while seedlings cultivated outdoors were not attacked (Cassilandia, Mato Grosso do Sul) (Silva *et al.*, 2019). In Corrientes, Argentina, the mite is a pest of *Citrus* especially in nurseries under plastic greenhouse (Cáceres, 2006). The cultivation of seedlings in protected environments generally favours the population development of phytophagous mites, such as *T. urticae* (Silva *et al.*, 2019 citing Vieira *et al.*, 2004).

To maintain populations in protected conditions throughout the year, *T. mexicanus* should find suitable host leaves all year round indoors, or be able to establish outdoors and re-enter the greenhouse. For these reasons, establishment under protected conditions is assessed to be more likely in areas where it can also establish outdoors (under protected conditions there may be periods without any host or without any plant).

In areas where it can establish outdoors, the likelihood of establishment under protected conditions is as for establishment outdoors (very high) due to possible reintroduction from outside.

In areas where it cannot establish outdoors, the likelihood is assessed to be moderate in greenhouses where host plants are present year-round. Current crop protection measures, especially those applied against spider mites that are already present, may also have an effect on *T. mexicanus*, and possibly prevent establishment, but no data is available.

In greenhouses or greenhouse areas where host plants are only present part of the year, establishment is unlikely.

In the area where* T. mexicanus *can establish outdoors

Rating of the likelihood of establishment in protected conditions	*Very low* ☐	*Low* ☐	*Moderate* ☐	*High* ☐	*Very high* X
Rating of uncertainty			*Low* X	*Moderate* ☐	*High* ☐

In the area where* T. mexicanus *cannot establish outdoors, in greenhouses where host plants are present year-round

Uncertainty: how many greenhouses grow host plants year-round; to which extent current crop protection measures, especially those applied against spider mites present will prevent establishment of *T. mexicanus*.

Rating of the likelihood of establishment in protected conditions	*Very low* ☐	*Low* ☐	*Moderate* X	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* X	*High* ☐

11 Spread in the PRA area

Natural spread would occur through crawling, phoresy and aerial dispersal. In the absence of specific information, aerial dispersal of *T. mexicanus* in one event is assumed to occur mostly within a relatively short distance (< 100 meters), but a small proportion of a *T. mexicanus* population may aerially disperse over longer distances (up to several kilometers) (see section 2.3).

Human-assisted spread would be the main spread mode over long distances, especially through the trade of plants for planting. The large diversity of ornamental plants grown in nurseries may ensure a continuous presence of suitable hosts, and continuous source of mites to be carried in trade. There are mites on many ornamental plant species in the EPPO region, and monitoring and treatments is probably conducted to control the mites species present to lower infestation levels. Plants carrying low levels of infestation may not be noticed in trade. On a local scale, *T. mexicanus* may be transported on workers' clothing and tools (EPPO, 2008), as well as agricultural machinery or harvesting crates used in several orchards.

There is a large trade of fresh cut plant parts and fruit with green parts (e.g. *Citrus*) of hosts within the EPPO region, and this may also contribute to spread to areas suitable for establishment (see sections 9 and 10). The pest may also be spread with packaging material associated to host commodities (with the same uncertainties related to transfer as for entry).

As populations build up in an area, *T. mexicanus* may contaminate various non-host commodities, which may contribute to spread (with the same uncertainties related to transfer as for entry).

The magnitude of spread of *T. mexicanus* was estimated based on observations for *T. evansi*, which was first reported in North Africa in the 1980s-90s, in 1995 in Spain, and it has since been reported in many countries of the Mediterranean area (e.g. first records in mainland Portugal in 2000, France in 2004, Italy 2005, Greece [Kriti] 2006, Turkey 2017). *T. evansi* records have been linked to two separate introductions from Brazil (Boubou *et al.*, 2011). *T. mexicanus* is more polyphagous than *T. evansi*, and may therefore spread faster.

Uncertainty: scarcity of specific data on *T. mexicanus;* It is not known if it will spread in the same way as *T. evansi*; host range of *T. mexicanus* may be wider than currently known, which would facilitate spread.

Rating of the magnitude of spread	Very low ☐	Low ☐	Moderate X	High ☐	Very high ☐
Rating of uncertainty			*Low* ☐	*Moderate* X	*High* ☐

12 Impact in the current area of distribution

Amongst the hosts for which there is evidence of impact in the literature, *Citrus* are economically important in the EPPO region. There is no indication of impacts in other host crops that have high economic value in the EPPO region, such as *Pyrus communis*, *Vitis vinifera*, *Malus* (uncertain host), *Saccharum officinarum* (uncertain host), *Rosa* (uncertain host), *Fragaria*, nor on tropical fruits such as *Litchi sinensis*, *Annona cherimola*, *Psidium guajava* (uncertain host). According to Seeman & Beard (2011), *T. mexicanus* does not appear to be a species of great importance. Sporadic outbreaks of *T. mexicanus* may occur when populations of natural enemies populations are disturbed, for example by use of pesticides (coconut, Teodoro *et al.*, 2015; annona Sousa *et al.*, 2010). Chemical control against *T. mexicanus* has been investigated at least on cocoa in Brazil (Nakayama *et al.*, 1987), *Citrus* in Brazil (Andrade *et al.*, 2007, 2008; Fundecitrus, 2022) and passionfruit in Colombia (Hernández *et al.*, 1988) suggesting that the pest must have had some importance. Information found in the literature are listed by country below. Most data come from Brazil.

Brazil. **In the past, *T. mexicanus* was considered as a potential pest of many fruit trees in São Paulo and Bahia states (Flechtmann & Abreu, 1973). In more recent literature, *T. mexicanus* appears to have minor importance (Vacante, 2010; Moraes & Flechtmann, 2008).** Information available by host is provided below.

- **On *Citrus*, *T. mexicanus* is overall a common species, but a sporadic and secondary pest in Brazil (Andrade-Bertolo *et al.*, 2013, Chiaradia *et al.*, 2009, citing others; Horn *et al.*, 2011; A. Teodoro and D. Andrade, pers. comm.).** Alerts on pest spider mites, with the main three spider mites being *P. citri*, *E. banksi* and *T. mexicanus*, are provided to growers in the dry season in São Paulo state (Fundecitrus, 2022). It is noted that other mites are more important on *Citrus* in Brazil, such as *Brevipalpus phoenicis* and *Phyllocoptruta oleivora* (A. Teodoro, pers. comm.; Bobot *et al.*, 2011). *Tetranychus mexicanus* represented 0.2% of the total mite population on *Citrus sinensis* surveyed in a commercial plantation of Amazonas (Bobot *et al.*, 2011). Nevertheless, it is reported to cause damage in some conditions. In *Citrus*, it can cause intense defoliation, harming the development of plants, which is why its control has been commonly carried out (Andrade *et al.*, 2007). In Manaus municipality (Amazonas), high populations of *T. mexicanus* were observed and damage to *Citrus* spp. is reported (Vasconcelos, 2011; Vasconcelos & Silva, 2015). In Northeast Brazil, *T. mexicanus* is a minor citrus pest in orchards, even in the dry season, and treatments in orchards are normally not needed. In that area, *T. mexicanus* is a more important pest of *Citrus* in nurseries, where it can reach high populations (A. Teodoro, pers. comm.). In São Paulo State, *T. mexicanus* is present all year-round in many greenhouses on citrus plants seedlings, and control is often necessary (D. Andrade, pers. comm.). Except during heavy infestations, the pest does not directly and noticeably affect fruit quality. It is noted that in Brazil, citrus fruits are intended both for fresh consumption and for processing as juice (main export commodity - A. Teodoro, pers. comm.).
- On *Passiflora edulis*, *T. mexicanus* is a major pest in Brazil and in other countries in the Americas in general according to da Silva *et al.* (2020) and Favero (2016). It has caused severe yield losses in commercial cultivation in Brazil, possibly due to the intensive use of pesticides and elimination of natural enemies (da Silva *et al.*, 2020 citing Croft, 1990 and Desneux *et al.*, 2007). In Manaus municipality (Amazonas), high populations of *T. mexicanus* can be observed and damage to *P. edulis* is reported (Vasconcelos, 2011; Vasconcelos & Silva, 2015).
- On *Carica papaya*, Santos *et al.* (2018) in Acre state found *T. mexicanus* on several isolated plants but not in a commercial production area. *T. mexicanus* is mentioned amongst mite pests of papaya (Barroncas *et al.*, 2022 citing others; Sanches *et al.*, 2021). Damage occurs in Manaus municipality (Amazonas) where high populations are observed (Vasconcelos, 2011; Vasconcelos & Silva, 2015).
- On *Annona muricata*, *T. mexicanus* only causes occasional damage in Pernambuco state (Brazil) although it is frequently found on Annonaceae (Sousa *et al.*, 2010 citing others). This is probably due to the fact that *T. mexicanus* is under an effective control by its natural enemies, since producers normally grow the

crop without pesticides. However, *A. muricata* is suitable for development of *T. mexicanus,* and it may reach the economic damage threshold when its natural enemies are eliminated by pesticides (Sousa *et al.*, 2010). In Manaus municipality (Amazonas), high populations of *T. mexicanus* can be observed and damage to another Annonaceae, *Rollinia mucosa*, is reported (Vasconcelos, 2011; Vasconcelos & Silva, 2015).

- On *Gossypium hirsutum*, *T. mexicanus* maintained regular and persistent population in cotton agrosystems in Ceara State, close to the threshold of economic damage, making it a potential risk (Azevedo & Vieira, 2002).
- On *Fragaria* x *ananassa*, *T. mexicanus* is mentioned as a secondary pest, based on one record of high populations in a greenhouse (Argolo, 2008).
- On *Theobroma cacao*, *T. mexicanus* was recorded to be harmful to seedlings in nurseries (Costa, 1977; Flechtmann & Abreu, 1973). Control measures on cacao are listed in Nakayama *et al.* (1987). In Bahia state, it is mostly a pest in nurseries, but mature trees can also be attacked (Sodré, 2017).
- On palms (Arecaceae), Vasconcelos (2011) and Vasconcelos & Silva (2015) report damage on *Bactris gasipaes* in Manaus municipality (Amazonas), where high populations of *T. mexicanus* can be observed. Based on the results of experiments on leaves, *T. mexicanus* did not express a high reproductive potential on *Bactris gasipaes,* suggesting that *T. mexicanus* cannot cause economic damage to *B. gasipaes* except when natural enemies are eliminated (Stein & Daólio, 2012). *T. mexicanus* is occasionally found on coconut palm leaves, however it does not appear to cause economic damage (Michereff & Barros, 2001). On coconut, it is more common on seedling nurseries and young plants in the field (A. Teodoro, pers. comm.). On palms, its damage is less serious than on other hosts (Howard *et al.*, 2001 citing Ferreira *et al.*, 1994). However, the ornamental value of palms is presumably affected when heavily attacked.
- On *Paullinia cupana* (guarana), 90% of 250 plants in a greenhouse in Amazonas were infested, and some drying and necrosis of leaves was observed (Vasconcelos *et al.*, 2022). Vasconcelos & Silva, (2015) report damage on *Abelmoschus esculentus* in Amazonas.
- Finally, it is present on a wide range of forest plants (e.g. Demite *et al.*, 2016), but no environmental damage is reported in the literature.

Paraguay. *Citrus*, *Carica papaya*, *Gossypium*, *Ilex paraguariensis*, *Persea americana*, *Prunus persica* are mentioned as being “the more important hosts” in this country (Aranda & Flechtman, 1971).

Colombia. Two reports of damage were found, both on oil palm *Elaeis guineensis*. Urueta (1975) reported ‘some damage’ at the beginning of 1975 in Santander Department. More recently, young or nursery *E. guineensis* are reported to be exposed to greater populations in summer. Sprinkler irrigation normally helps reduce mite populations. The application of acaricides is rarely necessary; the application of sulfur (wettable powder) significantly reduces populations (Aldana de La Torre *et al.*, 2010).

Mexico. *T. mexicanus* is mentioned amongst mites that have been reported on *Cocos nucifera*, but no damage has been documented and no control measures are applied against the mites concerned (Estrada-Venegas *et al.*, 2013).

Venezuela. *T. mexicanus* is a minor pest in Venezuela, although one of the common plant-feeding mites on Persian lime (*C. latifolia)*, and should be covered by IPM programmes on this crop (Quiros-Gonzalez, 2000). It can be a serious pest during periods of low precipitations (January-February) (Dominguez-Gil & McPheron, 1992 citing Haddad & Millán, 1975, Oliveira, 1987).

Argentina. *T. mexicanus* is mentioned as a *Citrus* pest especially in nurseries under plastic greenhouse (Cáceres, 2006).

Central America. *T. mexicanus* is mentioned in a guide of phytophagous mites of Central America, with details regarding several crops. Ochoa *et al.* (1994) note that crops such as the ornamental species *Codiaeum variegatum* are often attacked by different Tetranychidae at different seasons, which complicates control.

Cuba. In Guantanamo, *T. mexicanus* is one of the most significant mite pests on *Theobroma cacao* (Suarez 1991).

Uruguay. In Uruguay, it was recorded to attack orange (*C. sinensis)* and sometimes peanut (*A. hypogea*) plantations (Bernal & Pineiro, 1982).

Control measures

The control of *Tetranychus* spp. generally relies on chemical control (including application of plant extracts) or biological control. Numerous reports exist in the literature on cases of development of resistance in spider mites due to the use of chemicals, for example in *T. urticae* (Neves *et al.*, 2015; Van Leeuwen *et al.*, 2010).

In *Citrus*, lime sulfur controls all life stages (A. Teodoro, pers. comm.) and was found to provide a long lasting control when applied on eggs of *T. mexicanus*, with better results than abamectin with oil (Andrade *et al.*, 2007). In Brazil acaricides are registered against *T. mexicanus*, only on *Citrus*, with five commercial products based on three active substances: spirodiclofen, fenpyroximate, pyridaben (AGROFIT, 2022).

In trials, essential oil of *Derris floribunda* caused mortality and affected fecundity of *T. mexicanus* (Amaral *et al.*, 2017).

For coconut, the following measures are listed (Teodoro *et al.*, 2015):

- Monitoring all plants in the nursery or coconut plantations with up to two years of age, observing the presence of *T. mexicanus* attack symptoms.
- Control measures are taken to prevent spread of the pest, such as pruning and burning of infested leaves, at the beginning of attacks, and sprays with alternative products, as there are no registered pesticides for the control of this pest in coconut trees in Brazil.
- Crude (fixed) vegetable oils such as cottonseed can also be used to control *T. mexicanus* with sprays targeting the underside of the coconut leaflets.

For *Tetranychus* species on *C. papaya*: Removal and destruction of older leaves (base leaves). Sprays of acaricides targeting the underside of leaves (and in high infestations trunks and vegetation under the canopy) can be applied in the dry period over an infestation threshold (average of 30 evaluated plants with 6 or more mites on one leaf per plant). Acaricide applications can result in the emergence of resistant populations, in addition to the negative effect on non-target organisms, including predators (Sanches *et al.*, 2021 citing various sources).

No information was found on biological control specifically against *T. mexicanus* (apart from the general opinion that control measures should not have a negative impact on natural enemies). In Brazil, *P. persimilis*, *P. macropilis* and *N. californicus* are registered for use on *Tetranychus* spp. such as *T. urticae* and they have been used against spider mites in general in greenhouses, but their efficiency against *T. mexicanus* is yet to be determined (A. Teodoro, pers. comm.).

The resistance/tolerance of *P. edulis* and of *Citrus* varieties and rootstocks has been investigated, but this does not appear to be a part of control strategies to date (see section 2.6). Neves *et al.* (2015) studied the selection of *P. edulis* for resistance to *T. mexicanus* (Neves *et al.*, 2015). On *P. edulis*, it is noted that genotypes resistant to *T. mexicanus* need to be integrated in a programme for genetic improvement because there are no registered pesticides on this crop in Brazil (Favero, 2016).

Overall, the impact of *T. mexicanus* appears to be low in its current area of distribution. *T. mexicanus* is considered overall as a minor pest and it causes economic damage in some crops only in favourable conditions. Especially *Citrus*, *Passiflora edulis*, *Annona muricata* and *Theobroma cacao* are mentioned in the literature. Normally no treatments are applied, but sometimes outbreaks occur that require treatments. In areas where it occurs, it may be controlled by natural enemies or by acaricides or alternatives that are used against spider mites in general. There are more important mite pests on many of the host crops of *T. mexicanus*.

Uncertainty: lack of quantitative data; damage caused by *T. mexicanus* may be attributed to other spider mites, and *T. mexicanus* may in fact cause impact in more crops than reported (e.g. possibly leguminous crops – A. Teodoro, pers. comm.).

Rating of the magnitude of impact in the current area of distribution	Very low ☐	Low X	Moderate ☐	High ☐	Very high ☐
Rating of uncertainty			*Low* ☐	*Moderate* X	*High* ☐

13 Potential impact in the PRA area

Will impacts be largely the same as in the current area of distribution? **Yes** / No

Although the EWG considered that the overall potential impact would also be low in the EPPO region, impacts may be higher locally or on specific species. The uncertainty is high because of differences in cropping practices and hosts plants available as compared to the current area of distribution (see below for more details). The PPM noted that the major uncertainty for this rating is how the pest will affect varieties of orange, as well as other species of *Citrus* and ornamental species, that are grown in the EPPO region. If those varieties and species prove to be susceptible to the pest, the overall potential impact may be higher.

Regarding cultivated host species:

- For *Citrus*, impact in Brazil is reported on orange (*C. sinensis*), although the pest has also been reported on other *Citrus* species. There is an uncertainty on how *T. mexicanus* will affect varieties of orange and other *Citrus* species that are cultivated in the EPPO region.
- In the EPPO region, *Citrus* fruits are mainly intended for direct consumption, and consequently would be discarded if found infested or with symptom; in Brazil, part of the fruits is also used for consumption (see section 12).
- Tropical fruit crops are produced in a limited part of the EPPO region (such as *C. papaya*, *P. edulis*, *A. squamosa*), but varieties different from those in the current area of distribution may be used.
- In relation to ornamental plants: *B. recurvata* was not reported as a host before *T. mexicanus* was found in the Netherlands on this species. In addition, *T. mexicanus* is highly polyphagous and may find new hosts in the EPPO region. There are many ornamental species cultivated, and some species may be highly susceptible. The pest may affect the quality of ornamental plants. In the Dutch quick scan, *T. mexicanus* was assessed as a potential greenhouse pest for Europe because the *Beaucarnea* pot plants in the Dutch greenhouse were heavily infested. Ornamentals should be visibly free of pests. Any cosmetic damage or presence of a pest can lower the value of the plant or even make it unmarketable. Thus, if effective control measures are not applied, *T. mexicanus* may be able to cause significant economic damage on ornamental hosts.

Regarding cropping practices and control methods:

- There may be differences in cropping practices in the EPPO region, which would affect impact. Good cultural practices might aid in controlling and reducing populations (e.g. some described in Smith, 2013, Dara & Soto, 2017).
- Spider mites are controlled in the EPPO region, and currently used acaricides are expected to be effective against *T. mexicanus*. However, because of their biology (short life cycle, high fecundity, arrhenotokous reproduction), spider mites can quickly become resistant to acaricides as documented for several *Tetranychus* species (APRD, 2022; Sanches *et al.*, 2021 citing others), lowering the efficacy of acaricides. In addition, at least in the EU, there may be fewer and fewer registered chemical pesticides in the future. For example spirodiclofen's approval expired in July 2020 (EU, 2022b). The possible development of resistance (although apparently not yet reported in the current distribution of *T. mexicanus*) and a lower number of available acaricides might lead to an increased impact.
- *Tetranychus mexicanus* may attack plant species that are not susceptible to other spider mites (and therefore not already subject to acaricide treatments).
- Several biological control agents are available in the EPPO region, for example against *T. urticae* such as *Phytoseiulus persimilis, Feltiella acarisuga*, *Macrolophus pygmaeus*, *Neoseiulus californicus*, *Galendromus occidentalis* and *Stethorus punctillum* (EPPO, 2021). Their efficacy against *T. mexicanus* would need to be investigated. For *T. evansi*, the EPPO PRA (EPPO; 2008) noted that commercially available biological control agents available at the time, such as the predatory mites (e.g. *P. persimilis* and *N. californicus*) were not effective against that species but it might be related to the unsuitability of the

solanaceous hosts of *T. evansi* (Koller *et al.*, 2007). The costs of development and constraints for authorization will complicate the development of non-native natural enemies as commercial biological control agents.

Regarding environmental conditions:

- Natural enemies are identified as an important factor allowing a balance in its native range. It is not known if the natural enemies of *Tetranychus* species present in the EPPO region would ensure the same control.
- The (sub)tropical spider mite *T. evansi* is also not a serious pest in its native range but can cause severe impact in solanaceous crops in invaded areas (such as in the EPPO region), in particular because it has a high intrinsic rate of increase (Ghazy *et al.*, 2019) in optimal environmental conditions also present in the EPPO region (Gotoh *et al.* 2010). A similar situation may occur with *T. mexicanus*. The conditions in the Mediterranean area, where *Citrus* are grown, are expected to be favourable to the pest.
- Plant stress associated with drought, which favours populations of *T. mexicanus*, also occurs in the EPPO region, and models (Litskas *et al.*, 2019) predict that it will occur more often in part of the region in the future due to climate change.
- It can be expected that climate change will favour the establishment, spread and abundance of pests from subtropical origin in regions which are currently more temperate, as modelling predicts for *T. evansi* in Europe (Migeon et al, 2009; Maynard et al, 2013). This may increase impact.

Rating of the magnitude of potential impact in the PRA area	*Very low* ☐	*Low* X	*Moderate* ☐	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	*High* X

14 Identification of the endangered area

In this case, the endangered area corresponds roughly to the area of potential establishment. Details are provided in sections 9 and 10, and the area is described below in section 15. More impact is expected in areas with low rainfall and warm climate and where host plants are present all year-round. In areas where the pest cannot establish outdoors, management will probably be easier.

15 Overall assessment of risk

Summary of ratings**:**

	Likelihood	**Uncertainty**
Entry (overall)	**high**	**moderate**
Host plants for planting (except tissue cultures) with leaves and associated packaging material	high	moderate
Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen) without leaves and associated packaging material	low	moderate
Above ground fresh cut plant parts of hosts (cut flowers, cut foliage, cut branches (incl. trees), leaf vegetables (incl. herbs)) and associated packaging material	low	moderate
Host fruit with green parts and associated packaging material	low	moderate
Host fruits without green parts and associated packaging material	very low	moderate
Establishment outdoors	**very high**	**low**
Establishment in protected conditions		
- in areas where *T. mexicanus* can establish outdoors	very high	low
- in areas where *T. mexicanus* cannot establish outdoors	moderate	moderate
Spread	**moderate**	**moderate**
Magnitude of impact in the current area of distribution	**low**	**moderate**
Magnitude of potential impact in the PRA area	**low**	**high**

The likelihood of entry on host plants for planting with leaves was considered as high, with a moderate uncertainty. All other pathways assessed (see table above) had a low or very low likelihood and moderate uncertainty.

Climatic conditions were considered as a limiting factor for the establishment of *T. mexicanus*. Outdoors, *T. mexicanus* could establish in the southernmost part of the EPPO region (where winters are mild), such as the Mediterranean coast, southern Portugal, coastal areas of the Black Sea. Hosts occur throughout that area. In other parts of the EPPO region, while it could develop and reproduce during the summer, it would probably not be able to overwinter outdoors. There is an uncertainty on the northern and eastern limits of the potential area of establishment. In areas where it can establish outdoors, the likelihood of establishment under protected conditions is as for establishment outdoors.

In areas where it cannot establish outdoors, the likelihood of establishment is assessed to be moderate with a moderate uncertainty in greenhouses where host plants are present year-round. In greenhouses or greenhouse areas where host plants are only present part of the year, establishment is unlikely.

Mainly based on the spread of *T. evansi* in the Mediterranean area, the magnitude of spread was rated as moderate with a moderate uncertainty. *T. mexicanus* could spread locally by natural dispersal, and at long distance through human-assisted pathways.

Impact in the current distribution of the mite was rated as low overall, with a moderate uncertainty. *T. mexicanus* is generally considered a secondary pest in Brazil and it causes economic damage in some crops only in favourable conditions, especially in nurseries, such as *Citrus* or *Carica papaya*.

In the EPPO region, the potential impact was rated as low. However, there is a high uncertainty linked to the differences between the EPPO region and the current area of distribution of *T. mexicanus*, in relation to cultivated host plants, cropping practices and environmental conditions. In particular, at least in the EU, the number of registered pesticides may decrease in the future. In addition, the efficacy of natural enemies and commercially available biological control agents that are present in the EPPO region against *T. mexicanus* is not known. Further, the pest may attack plant species in the EPPO region that are currently not damaged by other spider mites and introduction of *T. mexicanus* may especially on these plants lead to an increased impact by spider mites. The PPM further noted that the major uncertainty relating to potential impact is how the pest will affect varieties of orange, as well as other species of *Citrus* and ornamental species, that are grown in the EPPO region. If those varieties and species prove to be susceptible to the pest, the overall potential impact may be higher.

The phytosanitary risk for the endangered area was assessed to be low with a high uncertainty.

Based on all the information in this PRA, the EWG identified management options for *T. mexicanus*.

The EWG noted that the potential impact and the area of potential establishment may increase with climate change as summers are expected to become drier and warmer, and winters milder in the EPPO region, and this will make environmental conditions more favourable for *T. mexicanus*.

Stage 3. Pest risk management

16 Phytosanitary measures

The EWG identified phytosanitary measures for ‘host plants for planting with leaves (except tissue cultures)’ (see detailed measures in Annex 1). The measures should apply at least to all ‘hosts and likely hosts’ (category 1). For *Annona*, *Passiflora*, *Citrus*, *Fortunella*, and *Poncirus*, measures should apply to the whole genus, including hybrids, since several species are reported as host plants and/or hybrids are used.

Possible pathway	Measures identified for the exporting country (see Annex 1 for details)
Plants for planting with leaves (except tissue cultures) of 'hosts and likely hosts' (category 1)	Pest free area (PFA) (ISPM 4, ISPM 29) (see requirements below) or Pest free production site for *T. mexicanus* established according to EPPO Standard PM 5/8 '*Guidelines on the phytosanitary measure 'Plants grown under physical isolation'* or Systems approach: Pest free place of production/pest free production site[1] for *T. mexicanus* (see requirements below) + Inspection of the consignment prior to export with no *T. mexicanus* observed or Systems approach: Inspection of the consignment prior to export with no *T. mexicanus* observed, followed by treatment(s) of the consignment which is (are) effective against all life stages of *T. mexicanus* [*Remark: The Panel on Phytosanitary Measures considered that this option provides a lower protection than previous options*] or Post-entry quarantine for 4 weeks in conditions suitable for the development of the mite (at 25°C or more) (in the framework of a bilateral agreement)

[1] The choice between pest free place of production and pest free production site is a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements.

Requirements for establishing a pest-free area (PFA):
PFAs could be established in areas where the pest has not been recorded. Even within the current area of distribution of *T. mexicanus* in America, the EWG considered that the concept of PFA may be applicable to some areas such as at high altitude, close to its limits of current distribution, or islands.
Ascertaining the free status of the area may be complicated by the large number of host plants, the presence of the mite in the wider environment and the many other spider mites *T. mexicanus* could be confused with.
Aerial dispersal is the main mode of natural dispersal at distances longer than a few metres. There are not sufficient data to specify the necessary distance between a PFA and the closest area where the pest is known to be present. However, mites may be incidentally dispersed over distances of several kilometers (see section 2.3). Based on data in section 2.3, the EWG considered that 2 km was an appropriate distance; but the PFA may also be limited by specific natural barriers or defined for areas where conditions affect survival of the pest, for example areas above a certain altitude with lower temperatures.
To establish and maintain a PFA, detailed surveys (using visual inspection) should be conducted in the area and continued every year. Similar surveys should also be carried out in the buffer zone to demonstrate pest freedom.
There should be restrictions on the movement of plant material from areas where the pest is known to be present into the PFA, and into the area surrounding the PFA. Movement of material and equipment potentially contaminated should also be regulated.

Requirements for establishing a pest free place of production/pest free production site outdoors (PFPP/PFPS):

- Inspections at the production site(s), including at least once within the last two weeks prior to export
- Isolation: no other host plants in the immediate vicinity of the place of production/production site (minimum 100 m, based on data in section 2.3).
- Treatments of the crop during production (including close to harvest)
- Measures to prevent entry of the pest at the place of production/production site as contaminant (on clothes, machinery, crates etc.) or on plants (if plant material is being introduced from another location).

Containment and eradication:
One outbreak was eradicated in a greenhouse in The Netherlands (NL NPPO, 2018a, 2019).

The EWG considered that the assessment in the PRA on *T. evansi* (EPPO, 2008) applied to *T. mexicanus*, i.e. that containment and eradication were possible under protected conditions, in places where the pest cannot establish outdoors. Measures for eradication are mentioned such as chemical treatment, destruction of infested crops, heating of the greenhouse to 50°C for two to three days, implementing a crop break for at least 4 weeks whilst ensuring no host-weeds were present to act as a “bridge”. This would be more difficult if potential hosts are present in the greenhouse all year round. Structures should also be treated as the mite may have been carried by air currents to the sides of the greenhouse (citing Fleschner *et al.*, 1956). In the Netherlands the outbreak in pot plants of *Beaucarnea recurvata* was eradicated by applications of pesticides (pers. comm. D. J. van der Gaag, NVWA, the Netherlands).

Among factors that would complicate containment and eradication, EPPO (2008) for *T. evansi* mentions factors that would also apply to *T. mexicanus*, such as the minute size of the pest, the large number of hosts, and the fact that it may be confused with other widespread spider mites. It is noted that where *T. evansi* was detected, there had been no success in containment. Containment outdoors of *T. mexicanus* is unlikely to be feasible.

17 Uncertainty

Main sources of uncertainty within the risk assessment are linked to:

- Host range (specifically in relation to new hosts and possible additional pathways)
- Lower temperature threshold for survival
- Susceptibility and potential impact on *Citrus* species and varieties, as well as on ornamentals grown in the EPPO region
- Association of *T. mexicanus* with *Citrus* fruit, and whether it can complete its life cycle on fruit
- Efficiency of natural enemies and commercialized biological control agents present/available in the EPPO region for controlling *T. mexicanus*
- Future availability of effective pesticides in the EPPO region (e.g. spirodiclofen’s approval expired in 2020, see section 13)
- Distance for natural dispersal capacity.

18 Remarks

More research will be needed to reduce the main sources of uncertainty noted under Section 17.

It is also recommended to further investigate whether the currently available COI sequences attributed to *T. mexicanus*, but differing by more than 10%, actually correspond to different species (see section 2.12).

19 References

All URLs were accessed between 09-2022 and 02-2023.

AGROFIT (2022) Sistemas de Agrotóxicos Fitossanitários. Brasília, DF: Ministério da Agricultura, Pecuária e Abastecimento. https://agrofit.agricultura.gov.br/agrofit_cons/principal_agrofit_cons

Aldana de La Torre RC, Aldana de La Torre J, Calvache Guerrero H & Franco Bautista PN (2010) Manual de plagas de la palma de aceite en Colombia. 4th edition, Cenipalma, 9–11.

Ali F, Afifi A, El-Saiedy E & Ahmed M (2013) Biology and Life Table Parameters of *Tetranychus urticae* Koch (Acari: Tetranychidae) and Two Phytoseiid Predatory Mites on Two Watermelon Cultivars. *Acarines: Journal of the Egyptian Society of Acarology*, *7*(1), 25–30.

Amaral ACF, Ramos A de S, Pena MR, Ferreira JLP, Menezes JMS, Vasconcelos GJN, da Silva NM & Silva JR de A (2017) Acaricidal activity of Derris floribunda essential oil and its main constituent. *Asian Pacific Journal of Tropical Biomedicine*, *7*(9), 791–796.

Andrade-Bertolo F de O de, De Moura RB, Matioli AL & Ott AP (2013) New records of mites (Acari: Prostigmata) on *Vitis* sp. (L.) in Brazil. *Comunicata Scientiae*, *4*(4), 414–418.

Andrade DJ de, Oliveira CAL de, Romani GDN & Pattaro FC (2007) Efeito da calda sulfocálcica sobre o ácaro *Tetranychus mexicanus* (McGregor, 1950) em citros. *Revista de Agricultura*, *82*(2), 161–169.

Andrews K & Poe S (1980) Spider Mites of El Salvador, Central America (Acari: Tetranychidae). *The Florida Entomologist*, *63*(4), 502–505.
Anonymous (1980) A tetranychid mite (*Tetranychus mexicanus* (McGregor)) - Florida - new United States record. *Cooperative Plant Pest Report*, *5*(1), 11.
APRD (2022) Arthropod Pesticide Resistance Database. https://www.pesticideresistance.org/
Aranda B & Flechtman C (1971) A report on the Tetranychidae of Paraguay. *Proceedings of the Entomological Society of Washington*, *73*, 29–33.
Araújo WS de & Daud RD (2017) Insights on plant mite occurrence in natural vegetation remnants from Brazil. *Systematic and Applied Acarology*, *22*(2), 302–322.
Argolo P (2008) Resistência induzida ao ácaro rajado *Tetranychus urticae* Koch (Acari: Tetranychidae) em morangueiro. Mestrado em Entomologia. Universidade Federal de Viçosa., 65 pp.
Australian Government (2016) *Final report for the non-regulated analysis of existing policy for table grapes from Sonora, Mexico*.
Azandeme-Hounmalon GY, Fellous S, Kreiter S, Fiaboe KKM, Subramanian S, Kungu M & Martin T (2014) Dispersal behavior of *Tetranychus evansi* and *T. urticae* on tomato at several spatial scales and densities: Implications for integrated pest management. *PLoS ONE*, *9*(4, e95071).
Azevedo FR de & Vieira FV (2002) Levantamento populacional de pragas do algodoeiro em condições de sequeiro Cotton insect pests population in rain fed crop., *33*(1), 15–19.
Barroncas SF, da Silva NM & de Vasconcelos GJN (2022) Biological parameters of *Tetranychus mexicanus* (McGregor) (Acari: Tetranychidae) in papaya and passion fruit. *Pesquisa Agropecuaria Tropical, Goiânia*, *52*(e72154), 1–7.
Beer RE & Lang DS (1958) The Tetranychidae of Mexico. *The University of Kansas Science Bulletin*. [Lawrence], University of Kansas, [1926-1996].
Bernal R & Pineiro C (1982) *Nuevos acaros encontrados sobre citrus en la zona de salto*.
Biosecurity New Zealand (2022) Official New Zealand Pest Register. https://pierpestregister.mpi.govt.nz/pests-of-concern/pest-details?id=Tetranychus mexicanus
Bitume EV, Bonte D, Magalhães S, Martin GS, van Dongen S, Bach F, Anderson JM, Olivieri I & Nieberding CM (2011) Heritability and artificial selection on ambulatory dispersal distance in *Tetranychus urticae*: Effects of density and maternal effects. *PLoS ONE*, *6*(10).
Bobot T da E, Franklin E, Navia D, Gasnier TRJ, Lofego AC & Oliveira BM de (2011) Mites (Arachnida, Acari) on *Citrus sinensis* L. Osbeck orange trees in the state of Amazonas, Northern Brazil. *Acta Amazonica*, *41*(4), 557–566.
Bolland H, Gutierrez I, Hele W (1981) Chromosomes in spider mites (Tetranychidae – Acari). Acarologia 22, 271-275.
Bonato O, Baumgärtner J & Gutierrez J (1995) Comparison of biological and demographic parameters for *Mononychellus progresivus* and *Oligonychus gossypii* on cassava : influence of temperature. *Entomologia Experimentalis et Applicata*, *75*(1990), 119–125.
Boubou A, Migeon A, Roderick G & Navajas M (2011) Recent emergence and worldwide spread of the red tomato spider mite, *Tetranychus evansi*: genetic variation and multiple cryptic invasions. *Biological Invasions*, *13*, 81–92.
Broufas GD, Koveos DS (2000) Threshold Temperature for Post-Diapause Development and Degree-Days to Hatching of Winter Eggs of the European Red Mite (Acari: Tetranychidae) in Northern Greece. *Environmental Entomology* 29(4), 710-713.
Buosi R, Feres RJF, Oliveira AR, Lofego AC & Hernandes FA (2006) Ácaros Plantícolas (Acari) da “Estação Ecológica de Paulo de Faria”, Estado de São Paulo, Brasil. *Biota Neotropica*, *6*(1), 1–20.
Cáceres S (2006) *Guía Práctica Para la Identificación y el Manejo de las Plagas de Citrus*. edición literaria a cargo de Andrés Alberto Zárate. - 1a ed. - Buenos Aires : Ediciones INTA, 2013 (digital edition).
Carvalho NL de, Barcellos AL de, Bubans VE & Pietczk LJ (2018) Àcaros fitófagos em plantas cultivadas e os fatores que interferem em sua dinâmica populacional. In *[title not found]* (pp. 4–17).
Cheng L (1994) A new record of Chinese Tetranychidae [in Chinese]. *Zoological Research*, *15*, 20.
Chiaradia LA, Maria J & Nunes C (2009) Influência de fatores climáticos e de ácaros predadores na população de ácaros tetraniquídeos em citros. *Agropecuária Catarinense*, *22*(2), 52–56.
China Government (2009) Quarantine Requirements for The Importation of Plants or Plant Products into The Republic of China (English translation).
CIAT (2011) *The Cassava Handbook. A Reference Manual based on the Asian Regional Cassava Training Course, held in Thailand* (R. Howeler, Ed.). Centro Internacional de Agricultura Tropical.
Clotuche G, Mailleux AC, Fernández Astudillo A, Deneubourg JL, Detrain C & Hance T (2011) The

formation of collective silk balls in the spider mite *Tetranychus urticae* Koch. *PLoS ONE*, *6*(4).
Clotuche G, Navajas M, Mailleux AC & Hance T (2013) Reaching the Ball or Missing the Flight? Collective Dispersal in the Two-Spotted Spider Mite *Tetranychus urticae*. *PLoS ONE*, *8*(10, e77573).
Costa A da S (1977) Principais pragas do cacaueiro no Estado do Para. *Cacau Atualidades*, *14*(4), 13–22.
da Silva PR, dos Santos CEM, da Silva RS, da Silva ÉM, Lopes MC, da Silva Paes J & Picanço MC (2020) Assessing the resistance of passion fruit genotypes as control method to *Tetranychus mexicanus*. *Crop Protection*, *128*, 6–11.
Dara K, Soto F (2017) Biology and Management of Spider Mites in Strawberry. University of California Cooperative Extension. Pages 1-17.
De Maria M, Robinson E, Kangile J, Kadigi R, Dreoni I, Couto M, Howai N, Peci J & Fiennes S (2020) *Global Soybean Trade. The Geopolitics of a Bean*.
Demite PR & Feres RJF (2005) Influência de Vegetação Vizinha na Distribuição de Ácaros em Seringal (*Hevea brasiliensis* Muell. Arg., Euphorbiaceae) em São José do Rio Preto, SP. *Neotropical Entomology*, *34*(5), 829–836.
Demite PR, Flechtmann CHW & Feres RJF (2016) Tetranychidae (acari) in forest fragments in the state of São Paulo, Brazil. *Acarologia*, *56*(4), 435–449.
Díaz-Tejeda YE, Beltrán-Castillo PA & Hernández-Espinosa, D., Rodríguez-Tapia, J. L. Rodríguez-Morell, H., Pérez-Madruga Y (2010) Acarofauna asociada a frutales, plantas ornamentales y arvenses presentes en localidades de la región occidental y central de Cuba. *CitriFrut*, *27*(2).
Dominguez-Gil O & McPheron B (1992) Arthropods Associated with Passion Fruit in Western Venezuela. *The Florida Entomologist*, *75*(4), 607–612.
Domínguez Caises DL & Mateo Arce A (2008) Inventario de los ácaros en la provincia de Holguín. *Fitosanidad*, *12*(1), 9–14.
Domínguez Gil OE (1998) Fauna fitófaga de parchita maracuyá (*Passiflora edulis* f. *flavicarpa*) en las regiones oriental y suroriental de la Cuenca del Lago de Maracaibo, Venezuela: daños e importancia económica. *Boletín Del Centro de Investigaciones Biológicas*, *32*(2), 13–44.
EC (2021) *The citrus market in the EU. European Commission - DG Agri G2. 26 pp.*
EFSA (2014) Scientific Opinion on the pest categorisation of *Eotetranychus lewisi*. EFSA Journal 12(7), 3776.
EFSA (2017) Scientific Opinion on the pest risk assessment of *Eotetranychus lewisi* for the EU territory. EFSA Panel on Plant Health, Jeger M *et al*. *EFSA Journal*, *15*(10:4878), 1–122.
End M, Daymond A & Hadley P (2021) *Technical Guidelines for the Safe Movement of Cacao Germplasm. Revised from the FAO/IPGRI Technical Guidelines No. 20 (Fourth Update 2021).* Rome, Italy.
EPPO (2004) *PRA on Rhynchophorus palmarum*.
EPPO (2008) *Pest risk analysis for Tetranychus evansi Baker & Pritchard. PRA record 08-14559*.
EPPO (2013) Document 13-19032 *Pest risk analysis for Thaumatotibia leucotreta*. www.eppo.int
EPPO (2016) Standard PM 5/8 (1) Guidelines on the phytosanitary measure 'Plants grown under complete physical isolation'. *OEPP/EPPO, Bulletin OEPP/EPPO Bulletin*, (46), 421–423. https://gd.eppo.int/download/standard/682/pm5-008-1-en.pdf
EPPO (2019) EPPO Alert List: *Tetranychus mexicanus* (Acari: Tetranychidae). www.eppo.int
EPPO (2020) *EPPO PRA on Gymnandrosoma aurantianum (Lepidoptera: Tortricidae) - 20-25860*.
EPPO (2021) PM 6/3 (5) Biological control agents safely used in the EPPO region. *EPPO Bulletin*, *51*(3), 452–454.
EPPO (2022a) *22-27547 Guidance for Pest free production site, pest free place of production and pest freedom of the crop in the risk management options in EPPO recommendations*.
EPPO (2022b) EPPO Global Database. gd.eppo.int
Eschen R, Douma JC, Grégoire JC, Mayer F, Rigaux L & Potting RPJ (2017) A risk categorisation and analysis of the geographic and temporal dynamics of the European import of plants for planting. *Biological Invasions*, *19*(11), 3243–3257.
Estrada-Venegas E, Acuña-Soto J, Chaires-Grijalva M & A E-M (2013) Ácaros Asociados y de Importancia Económica a los "Sistemas Producto" en México, y la Relevancia de Algunas Especies que Afectan Estos Cultivos con Importancia Cuarentenaria. In *Ácaros de Importancia Cuarentenaria en Latinoamérica – sus efectos y su relevancia (Eds. Estrada-Venegas EG, Acuña-Soto JA, Chaires-Grijalva MP, Equihua-Martínez A). Sociedad Mexicana de Entomología. 354 pp.* (pp. 155–236).
EU (2019) Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, a. *Official Journal of the*

European Union, *L319*(10.12.2019), 1–279. https://eur-lex.europa.eu/eli/reg_impl/2019/2072/oj
EU (2022a) 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 phytos., (323), 10 pp.
EU (2022b) EU Pesticides Database. https://food.ec.europa.eu/plants/pesticides/eu-pesticides-database_en
Favero F (2016) *Seleção de Genótipos de Maracujazeiro Azedo Resistentes ao Ácaro Vermelho*. Universidade Federal De Viçosa, Minas Gerais, Brazil.
Feres RJ. (2000) Levantamento e observações naturalísticas da acarofauna (Acari, Arachnida) de seringueiras cultivadas (*Hevea* spp., Euphorbiaceae) no Brasil. *Revista Brasileira de Zoologia*, *17*(1), 157–173.
Feres RJF, Buosi R, Daud RD & Demite PR (2007) Padrões ecológicos da comunidade de ácaros em euforbiáceas de um fragmento de mata estacional semidecidual, no Estado de São Paulo. *Biota Neotropica*, *7*(2), 185–194.
Feres RJF, Lofego AC & Oliveira AR (2005) Ácaros plantícolas (Acari) da "Estação Ecológica do Noroeste Paulista", Estado de São Paulo, Brasil. *Biota Neotropica*, *5*(1), 43–56.
Feres RJF, Vieira MR, Daud RD, Pereira Jr. EG, Oliveira GF & Dourado CL (2009) Ácaros (Arachnida, Acari) de plantas ornamentais na região noroeste do estado de São Paulo, Brasil: inventário e descrição dos sintomas causados pelos fitófagos. *Revista Brasileira de Entomologia*, *53*(3), 466–474.
Ferla NJ & Moraes GJ de (2002) Ácaros (Arachnida, Acari) da seringueira (*Hevea brasiliensis* Muell. Arg.) no Estado do Mato Grosso, Brasil. *Revista Brasileira de Zoologia*, *19*(3), 867–888.
Financial Times (2015) Roses with altitude: why Ecuador's flower industry stands out. Conefrey M, 10 April 2015. https://www.ft.com/content/eb5114d6-d846-11e4-ba53-00144feab7de.
Flechtmann C (1966) Ácaros encontrados em algumas plantas do Estado de São Paulo. *Revista de Agricultura, Piracicaba*, *41*(4), 161–162.
Flechtmann C (1967a) *Contribuição para o conhecimento dos ácaros de plantas de algumas regiões do Estado de São Paulo*. Universidade de Sao Paulo.
Flechtmann C (1996) Rediscovery of *Tetranychus abacae* Baker & Pritchard, additional description and notes on South American spider mites (Acari, Prostigmata, Tetranychidae). *Revista Brasileira de Zoologia*, *13*, 569–578.
Flechtmann C & Abreu J (1973) Ácaros Fitófagos do Estado da Bahia, Brasil (Notas preliminares). *Ciência e Cultura*, *25*(3), 244–251.
Flechtmann C & Bastos J (1972) Ácaros Tetranychoidea do Estado do Ceará, Brasil. *Ciência Agronômica, Fortaleza*, *2*(2), 83–90.
Flechtmann C, Kreiter S, Etienne J & Moraes Gj (1999) Plant mites (Acari) of the French Antilles. 1. Tetranychoidea (Prostigmata). *Acarologia*, *40*, 137–144.
Flechtmann C & Paschoal A (1967) Os ácaros dos citrus. *O Solo*, *2*, 53–56.
Flechtmann CH & Baker EW (1975) A report on the Tetranychidae (Acari) of Brazil. *Revista Brasileira de Entomologia*, *19*(3), 111–112.
Flechtmann CHW (1967b) Ácaros De Plantas Do Cerrado. *Anais Da Escola Superior de Agricultura Luiz de Queiroz*, *24*(0), 315–316.
Flechtmann CHW (2020) Spider mites, host plants and new records for Brazil (Acari: Tetranychidae). *Entomological Communications*, *2*, 2 pp.
Flechtmann CHW & Baker EW (1970) A Preliminary Report on the Tetranychidae (Acarina) of Brazil. *Annals of the Entomological Society of America*, *63*(1), 156–163.
Flechtmann CHW & Moraes RCB (2017) Tetranychidae Database. http://www.lea.esalq.usp.br/tetranychidae/
Frizzas MR, Dianese AC, Oliveira CM & Junqueira NTV (2020) *Aspectos Fitossanitários da Macaúba [Acrocomia aculeata (Jacq.) Lodd ex. Martius]: principais pragas e doenças. Documentos 363*. Embrapa Cerrados, Planaltina, DF.
Fundecitrus (2022) Fundecitrus alerta para a ocorrência de ácaros desfolhadores em citros no período de outono-inverno. https://www.fundecitrus.com.br/comunicacao/noticias/integra/fundecitrus-alerta-para-a-ocorrencia-de-acaros- defoliators-on-citrus-in-autumn-winter/1196
GDV (2022) Transport Information Service. Cargo Information for oranges. Gesamtverbandes der Deutschen Versicherungswirtschaft e.V. https://www.tis-gdv.de/tis_e/ware/obst/orangen/orangen.htm/
Ghazy NA, Gotoh T & Suzuki T (2019) Impact of global warming scenarios on life-history traits of *Tetranychus evansi* (Acari: Tetranychidae). *BMC Ecology*, *19*(1), 1–12.
Gobierno de Guatemala (2015) *Acuerdo Ministerial No. 491-2015 [establishing the list of regulated pests]*.

Ministerio de Agricultura, Ganadería y Alimentación.
Gotoh T, Sugimoto N, Pallini A, Knapp M, Hernandez-Suarez E, Ferragut F, Ho CC, Migeon A, Navajas M & Nachman G (2010) Reproductive performance of seven strains of the tomato red spider mite *Tetranychus evansi* (Acari: Tetranychidae) at five temperatures. *Experimental and Applied Acarology*, *52*(3), 239–259.
Guanilo AD, De Moraes GJ, Flechtmann CHW & Knapp M (2012) Phytophagous and fungivorous mites (Acari: Prostigmata, Astigmata) from Peru. *International Journal of Acarology*, *38*(2), 120–134.
Gutierrez J (1985) Systematics. In Spider mites, their biology, natural enemies and control. Volume 1A. Vol. Helle W, Sabelis MW. Elsevier. pp. 75-90.
Halbert S (2008) Entomology section. *Tri-Ology*, *47*(1), 4–8.
Helle W, Pijnacker LP (1985) Parthenogenesis, chromosomes and sex. In Helle W, Sabelis MW. Spider mites their biology, natural enemies and control, Amsterdam, Netherlands, Elsevier Science Publisher BV, Volume 1A, 129-139.
Hernandes FA & Feres RJF (2006) Review about mites (Acari) of rubber trees (*Hevea* spp., Euphorbiaceae) in Brazil. *Biota Neotropica*, *6*(1).
Hernández E, Vargas H & Zuluaga J (1988) Efecto de algunos insecticidas sobre el comportamiento de dispersión de *Tetranychusmexicanus* (Acari: Tetranychidae) y observaciones sobre la acción de varios acaricidas para su control. *Revista Colombiana de Entomologia*, *14*(2), 15–24.
Herrero J de (1984) *Phytoseiulus macropilis* (Banks) (Acarina-Phytoseiidae) a new beneficial mite on Citrus in Tucumán. *Revista de Investigación CIRPON*, *2*(1/2), 27–35. (abstract)
Honoré MN, Belmonte-Ureña LJ, Navarro-Velasco A & Camacho-Ferre F (2019) The production and quality of different varieties of papaya grown under greenhouse in short cycle in continental Europe. *International Journal of Environmental Research and Public Health*, *16*(10), 1–14.
Horn TB, Johann L & Ferla NJ (2011) Ecological interactions between phytophagous and predaceous mites in citrus agroecosystems in Taquari Valley, Rio Grande do Sul, Brazil. *Systematic and Applied Acarology*, *16*(2), 133–144.
Howard FW, Moore D, Giblin-Davis RM & Abad RG (2001) *Insects of palm*.
IPPC (2017) *ISPM 29. Recognition of pest free areas and areas of low pest prevalence. Rome, IPPC, FAO.*
Jung C (1995) Some Evidences of Aerial Dispersal of Twospotted Spider Mites from an Apple Orchard into a Soybean Field. *Journal of Asia-Pacific Entomology* 8(3), 279-283.
Jung C, Croft BA (2001) Aerial dispersal of phytoseiid mites (Acari: Phytoseiidae): estimating falling speed and dispersal distance of adult female. Oikos 94, 182–190.
Kennedy G & Smitley D (1985) *Dispersal. In: Spider mites their biology, natural enemies and control. Eds Helle W and Sabelis MW. Vol. 1A. Elsevier Science, Amsterdam, The Netherlands.* pp. 233-242.
Kim DS, Lee JH (2003) Oviposition model of overwintered adult *Tetranychus urticae* (Acari: Tetranychidae) and mite phenology on the ground cover in apple orchards. Experimental and Applied Acarology 31(3-4), 191-208.
Koller M, Knapp M & Schausberger P (2007) Direct and indirect adverse effects of tomato on the predatory mite *Neoseiulus californicus* feeding on the spider mite Tetranychus evansi. *Entomologia Experimentalis et Applicata*, *125*(3), 297–305.
Krainacker DA & Carey JR (1990) Ambulatory dispersal and life history response to food deprivation in twospotted spider mites. *Entomologia Experimentalis et Applicata*, *56*(2), 139–144.
Kroon A, Veenendaal RL, Bruin J, Egas M, Sabelis MW (2008) "Sleeping with the enemy"--predator-induced diapause in a mite. Naturwissenschaften 95(12), 1195-1198.
Lawson D, Nyrop J & Dennehy T (1996) Aerial dispersal of european red mites (Acari: Tetranychidae) in commercial apple orchards. *Experimental & Applied Acarology*, *20*(4), 193–202.
Li J & Margolies DC (1994) Responses to direct and indirect selection on aerial dispersal behaviour in *Tetranychus urticae*. *Heredity*, *72*, 10–22.
Liebhold AM, Work TT, McCullough DG & Cavey JF (2006) Airline baggage as a pathway for alien insect species invading the United States. *American Entomologist*, *52*(1), 48–54.
Litskas V, Migeon A, Navajas M, Tixier M-S & MC S (2019) Impacts of climate change on tomato, a notorious pest and its natural enemy: small scale agriculture at higher risk. *Environmental Research Letters*, *14*(084041), 10.
MAFF (2015) Proposed revision of Quarantine Pest List (Annexed Table 1 of the Ordinance for Enforcement of the Plant Protection Act). https://www.maff.go.jp/j/syouan/keneki/kikaku/pdf/01_at1_qualant_pest_list.pdf
Mark J, Newton AC, Oldfield S & Rivers M (2014) *The international timber trade: a working list of*

commercial timber tree species. Richmond, UK.
Matsuda T, Morishita M, Hinomoto N & Gotoh T (2014) Phylogenetic analysis of the spider mite sub-family Tetranychinae (Acari: Tetranychidae) based on the mitochondrial COI gene and the 18S and the 59 end of the 28S rRNA genes indicates that several genera are polyphyletic. *PLoS ONE*, *9*(10).
McGregor E (1950) Mites of the family Tetranychidae. *American Midland Naturalist*, *44*, 257–420.
McMurtry JA, De Moraes GJ & Sourassou NF (2013) Revision of the lifestyles of phytoseiid mites (Acari: Phytoseiidae) and implications for biological control strategies. *Systematic and Applied Acarology*, *18*(4), 297–320.
Mendonça RS (2009) *Estudos taxonômicos de Ácaros Tetranychidae no Brasil e Filogenia e estrutura genética do Àcaro rajado, Tetranychus urticae Koch, inferidas a partir de sequências do DNA Ribossômico e Mitocondrial*. Universidade de Brasília.
Mendonça RS, Navia D, Diniz IR & Flechtmann CHW (2011) South American spider mites: New hosts and localities. *Journal of Insect Science*, *11*(121), 1–18.
Michereff SJ & Barros R (2001) *Proteção De Plantas Na Agricultura Sustentável*. Recife : UFRPE, Imprensa Universitária.
Migeon A & Dorkeld F (2022) Spider Mites Web. A comprehensive database for the Tetranychidae. http://www1.montpellier.inra.fr/CBGP/spmweb
Miller RW, Croft BA & Nelson RD (1985) Effects of Early Season Immigration on Cyhexatin and Formetanate Resistance of Tetranychus urticae (Acari: Tetranychidae) on Strawberry in Central California. *Journal of Economic Entomology*, *78*(6), 1379–1388.
Mineiro JL de C, Silva WR da & Silva RA da (2009) Ácaros em fruteiras e outras plantas no Estado de Amapá. *Biota Neotropica*, *9*(2), 103–106.
Moraes GJ de & Flechtmann CHW (1981) Ácaros fitófagos do Nordeste do Brasil. *Pesquisa Agropecuária Brasileira*, *16*(2), 177–186.
Nakayama K, Abreu J de & Ferraz E de A (1987) Controle químico do ácaro mexicano *Tetranychus mexicanus* (McGregor, 1950) em mudasde cacaueiro. *Revista Theobroma*, *17*(1), 9–16.
NAPPO (2014) DP 03: Morphological Identification of Spider Mites (Tetranychidae) Affecting Imported Fruits., 34 pp. www.nappo.org
Neves LG, Bruckner CH, Picanço MC, Araújo KL, Da Luz PB & Serafim ME (2015) Selection of full and half brothers families of yellow passionfruit resistant to Tetranychus mexicanus. *Semina:Ciencias Agrarias*, *36*(4), 2507–2514.
NL NPPO (2018a) *First outbreak of Tetranychus mexicanus (spider mite) on ornamental plants of Beaucarnea recurvata in a professional greenhouse (Municipality Drimmelen)*.
NL NPPO (2018b) *Quick Scan on Tetranychus mexicanus (QS-ENT-2018-007)*.
NL NPPO (2019) Update: Eradication confirmed of the first outbreak (October 2018) of *Tetranychus mexicanus* (spider mite) on ornamental plants of *Beaucarnea recurvata* in a professional greenhouse (Municipality Drimmelen)., 1–5.
Ochoa R (1991) *Acaros Fitofagos de America Central - Guia Illustrada*. CATIE.
Ochoa R, Aguilar H & Vargas C (1994) *Phytophagous mites of America Central: an illustrated guide*. CATIE.
Oliveira C & Frizzas M (2014) *Principais Pragas do Maracujazeiro Amarelo (Passiflora edulis f. flavicarpa Degener) e seu Manejo. Documentos 323*.
Oliveira EF, Argolo PS, Oliveira CM, Oliveira H, Fadinia MAM, Pallini A (2008) Efeitos da temperature na biologia de *Tetranychus mexicanus* em morangueiro. In Anais do simpósio (eds. Barros-Battesti *et al.*). II Simpósio Brasileiro de Acarologia, 16-18 April 2008, Poços de Caldas, MG, Brazil.
Otero-Colina G (1986) Notas sobre la importancia agrícola de los ácaros en el estado de Tabasco, México. *Folia Entomológica Mexicana*, *68*, 67–73.
Otsuki H & Yano S (2014) Predation risk increases dispersal distance in prey. *Naturwissenschaften*, *101*(6), 513–516.
Paschoal A (1968a) Sobre a biologia do ácaro Tetranychus mexicanus (Acarina Tetranychidae) - Notas prévias. *Solo, Piracicaba*, *40*(1), 67–70.
Paschoal A (1968b) Um ácaro parasita de plantas frutíferas: Tetranychus mexicanus (Acarina: Tetranychidae). *Solo, Piracicaba*, *60*(2), 75–77.
Paschoal A (1970) Revisão da família Tetranychidae no Brasil (Arachnida: Acarina). *Anais Da Escola Superior de Agricultura Luiz de Queiroz, XXVII*, 457–483.
Paschoal A (1971) Nova relação de ácaros de plantas do Brasil. Anales 1er. Congreso Latinoamericano de Entomologia. *Revista Peruana de Entomologia*, *14*(1), 174–176.

Paschoal A & Bleicher E (1973) Alguns Ácaros Fitófagos de estado de Santa Catarina. *Revista de Agricultura, Piracicaba*, *48*(2–3), 107–108.
Paschoal A & Reis P (1968) Relaçao de ácaros encontrados em plantas. *Revista de Agricultura*, 137–139.
Pinto A, Cordeiro M, De Andrade S, Ferreira F, Filgueiras H, Alves R & Kinpara D (2005) *Annona species*. International Center for Underutilised Crops, Southampton, UK. http://www.icuc-iwmi.org/files/Publications/Annona_Monograph.pdf
Pritchard A & Baker E (1955) *A revision of the spider mite family Tetranychidae*. Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2.
Quiros-Gonzalez M (2000) Phytophagous mite populations on Tahiti lime, Citrus latifolia, under induced drought conditions. *Experimental and Applied Acarology*, *24*, 897–904.
Ramasodi RM (2008) *Pest Risk Analysis on hand luggage at OR Tambo International Airport: A case study of flights from Cameroon, India and Kenya*. University of Pretoria.
Riahi E, Shishehbor P, Nemati AR & Saeidi Z (2013) Temperature effects on development and life table parameters of Tetranychus urticae (Acari: Tetranychidae). *Journal of Agricultural Science and Technology*, *15*(4), 661–672.
Ruíz-Montiel C, Reyes-Pérez N, Abato-Zárate M, Domínguez-González N & Anastacio-Lino C (2020) *Tetranychus mexicanus* Associated with Soursop (*Annona muricata* L.) in Veracruz, Mexico. *Southwestern Entomologist*, *45*(3), 815–818.
Sabelis M (1985) Chapter 1.4.5 Reproductive strategies/Life history evolution. *In: Spider Mites: their Biology, Natural Enemies and Control* (Elsevier, Ed.) (1A ed.).
Sanches NF, Nascimento AS do, Martins D dos S & Marin SLD (2000) Pragas. In C. Ritzinger & J. Souza (Eds.), *Mamao - Fitossanidade* (p. 91). Embrapa Comunicação para Transferência de Tecnologia - Brasília - DF.
Sanches NF, Noronha AC da S, Fancelli M & Do NAS (2021) A cultura do mamoeiro. In *Capítulo 11. Manejo de insetos e ácaros* (pp. 307–337).
Santana DLQ & Flechtmann CHW (1998) Mite (Arthropoda, Acari) associates of palms (Arecaceae) in Brazil I: present status and new records. *Revista Brasileira de Zoologia*, *15*(4), 959–963.
Santos FA, Rolim GS, Nachman GS & Andrade DJ (2020) Using mathematical models to describe aerial dispersal and silk ball formation of peanut red spider mite, *Tetranychus ogmophallos* (Acari: Tetranychidae). *Experimental and Applied Acarology*, *81*(1), 85–102.
Santos RS, Ferla NJ, Ferla JJ & Da Silva W (2018) Registro de *Tetranychus mexicanus* (McGregor) (Acari: Tetranychidae) em mamoeiro (*Carica papaya* L.) no estado do Acre, Brasil. *EntomoBrasilis*, *11*(2), 147–150.
Schrader G, MacLeod A, Mittinty M, Brunel S, Kaminski K, Kehlenbeck H, Petter F & Baker R (2010) Enhancements of pest risk analysis techniques: Contribution to Work Package 3: enhancing techniques for standardising and summarising pest risk assessments–review of best practice in enhancing consistency. *EPPO Bulletin*, *40*, 107–120.
Seeman OD & Beard JJ (2011) *Identification of exotic pest and Australian native and naturalised species of Tetranychus (Acari: Tetranychidae) Zootaxa* (Vol. 2961).
Sharkey E, Beaulieu F, Moore M & Bolton S (2022) Morphological and molecular data reveal the conspecificity of the spider mites *Tetranychus gloveri* and *T. okinawanus* (Acari: Trombidiformes: Tetranychidae). *Systematic and Applied Acarology*, *27*(2), 250–268.
Shimoda T, Kishimoto H, Takabayashi J, Amano H & Dicke M (2009) Comparison of thread-cutting behavior in three specialist predatory mites to cope with complex webs of *Tetranychus* spider mites. *Experimental and Applied Acarology*, *47*(2), 111–120.
Silva CD da (2002) Biology and thermal requirement of *Tetranychus ludeni* Zacher on cotton leaves. *Pesquisa Agropecuaria Brasileira*, *37*(5), 573–580.
Silva RR da, Teodoro AV, Martins CR, De Carvalho HWL, Silva SS, Farias AP & Guzzo EC (2017) Seasonal variation of pest mite populations in relation to citrus scion cultivars in northeastern Brazil. *Acta Agronomica*, *66*(2), 290–295.
Silva RR da, Teodoro AV, Vasconcelos JF, Martins CR, Soares Filho WDS, de Carvalho HWL & Guzzo EC (2016) Porta-enxertos cítricos influenciam a densidade populacional de ácaros fitófagos. *Ciencia Rural*, *46*(1), 1–6.
Silva EM, Toscano LC, Steiner F & Maruyama WI (2019) *Tetranychus mexicanus* (Acari: Tetranychidae) in soursop seedlings in the State of Mato Grosso do Sul, Brazil. *Revista De Agricultura Neotropical*, *6*(4), 75–78.
SmithT (2013) Two spotted Spider Mites. University of Massachusetts, Amherst.Extension Greenhouse

Crops and Floriculture Program. https://ag.umass.edu/greenhouse-floriculture/fact-sheets/twospotted-spider-mites

Smitley DR & Kennedy GG (1985) Photo-oriented Aerial-dispersal Behavior of *Tetranychus urticae* (Acari: Tetranychidae) Enhances Escape from the Leaf Surface. *Annals of the Entomological Society of America*, *78*(5), 609–614.

Sodré G (ed.) (2017) *Cultivo do Cacaueiro no Estado da Bahia*. Ilhéus, BA, MAPA/Ceplac/Cepec.

Sousa J de, Gondim Jr G & Lofego A (2010) Biologia de *Tetranychus mexicanus* (McGregor) (Acari: Tetranychidae) em Três Espécies de Annonaceae. *Neotropical Entomology*, *39*(3), 319–323.

Sousa JM de, Gondim MGC, Lofego AC & Moraes GJ de (2015) Mites on annonaceae species in northeast Brazil and in the state of Para. *Acarologia*, *55*(1), 5–18.

South Africa Government (2009) List 2: List of prohibited Alien species in terms of section 67. National environmental management: Biodiversity Act 2004. Notice 349 of 2009, Department of Environmental Affairs and Tourism. *Government Gazette*, *32090*, 76–99.

Stein CP & Daólio N (2012) Biologia de *Tetranychus mexicanus* (McGregor) (Acari : Tetranychidae) em folhas de Pupunha (Bactris gasipaes Kunth). *Bioikos, Campinas*, *26*(1), 23–28.

Suárez A (1991) Ácaros detectados sobre el cultivo del cacaotero (*Theobroma cacao*) en la provincia de Guantánamo. *Proteccíon de Plantas*, *1*(1), 59–65.

Suárez A (2004) Catálogo de ácaros de la provincia de Guantánamo. *Fitosanidad*, *8*(1), 23–31.

Takafuji A, Kamekaze H (1984) Diapausing incidence in eggs of the citrus red mite, *Panonychus citri* (M.) on pear twigs. Applied Entomology and Zoology 19(2), 270-271.

Teodoro AV, de Carvalho HWL, de Barros I, de Carvalho LM, Martins CR, dos Santos Soares Filho W, Girardi EA & Passos OS (2020) Performance of "jaffa" sweet orange on different rootstocks for orchards in the Brazilian Northeast. *Pesquisa Agropecuaria Brasileira*, *55*(e01665), 1–7.

Teodoro A V, Ferreira JMS, Navia D & SILVA SS (2015) Bioecologia e manejo dos principais ácaros-praga do coqueiro no Brasil. *Comunicado Técnico*, *169*(ISSN 1678-1937), 12. https://www.infoteca.cnptia.embrapa.br/handle/doc/1042136

Thailand Government (2006) G/SPS/N/THA/151/Rev. 1 List of plant pests attached to the Notification of Ministry of Agriculture and Cooperatives Re : Specification of plant pests as prohibited articles, under the Plant Quarantine Act B.E. 2507 (No. 6) B.E. 2550.

Tsagkarakou A, Navajas M, Papaioannou-Souliotis P & Pasteur N (1998) Gene flow among *Tetranychus urticae* (Acari: Tetranychidae) populations in Greece. *Molecular Ecology*, *7*, 71–79.

Tuan SJ, Lin YH, Yang CM, Atlihan R, Saska P & Chi H (2016) Survival and reproductive strategies in two-spotted spider mites: Demographic analysis of arrhenotokous parthenogenesis of tetranychus urticae (Acari: Tetranychidae). *Journal of Economic Entomology*, *109*(2), 502–509.

Uddin MN, Alam MZ, Miah MRU, Mian MIH & Mustarin KE (2015) Life table parameters of *Tetranychus urticae* koch (Acari: Tetranychidae) on different bean varieties. *African Entomology*, *23*(2), 418–426.

Urueta E (1975) Aranas rojas (Acarina: Tetranychidae) del Departamento de Antioquia. *Revista Colombiana de Entomologia*, *1*, 1–14.

Van Leeuwen T, Vontas J, Tsagkarakou A, Dermauw W & Tirry L (2010) Acaricide resistance mechanisms in the two-spotted spider mite *Tetranychus urticae* and other important Acari: A review. *Insect Biochemistry and Molecular Biology*, *40*(8), 563–572.

Vasconcelos G (2011) *Diversidade de ácaros em agroecossistemas e testes para o controle alternativo do ácaro branco, Polyphagotarsonemus latus (Acari, Tarsonemidae) na região de Manaus*. Universidade de Sao Paulo.

Vasconcelos G & Silva N (2015) Plant-inhabiting mites (Arachnida: Acari) in Amazonian Agrosystems. Chapter 7. In: Amazonian resources : microbiota, fauna, and flora (eds: BS Sant'Anna, R Takeara, MA Abegg. Nova Science Publishers, New York.

Vasconcelos G, Silva N, Almeida L, Lopes Casas L & Neto P (2022) First record of the occurrence and description of damage caused by *Tetranychus mexicanus* in guarana plants. *Revista de Ciências Agrárias - Amazonian Journal of Agricultural and Environmental Sciences*, *65*, 1–4.

WA Government (2022) *Tetranychus mexicanus*. https://www.agric.wa.gov.au/organisms/129704

Ximénez-Embún M, González-Guzmán M, Arbona V, Gómez-Cadenas A, Ortego F & Castañera P (2018) Plant-Mediated Effects of Water Deficit on the Performance of *Tetranychus evansi* on Tomato Drought-Adapted Accessions. *Frontiers in Plant Science*, *9*(1490), 15.

Yano S (2008) Collective and solitary behaviors of twospotted spider mite (Acari: Tetranychidae) are induced by trail following. *Annals of the Entomological Society of America*, *101*(1), 247–252.

Yassine F (2014) *State of annona cultivation in Lebanon*. Lebanese University.

ANNEX 1. Evaluation of possible phytosanitary measures for the main identified pathways

The table below summarizes the consideration of possible measures for the pathway 'host plants for planting with leaves' using the options described in EPPO Standard PM 5/3 (www.eppo.int).

When a measure is considered appropriate, it is noted "yes", or "yes, in combination" if it should be combined with other measures in a systems approach. "No" indicates that a measure is not considered appropriate. A short justification is included. Risk management options identified in the EPPO PRA on *T. evansi* (EPPO, 2008) are mentioned.

Option	**Host plants for planting with leaves (except tissue cultures) and associated packaging material**
Existing measures in the PRA area	Partly, see section 8.1, Table 3
Options at the place of production	
Visual inspection at place of production	Yes, in combination* Visual detection of mites is possible (EPPO, 2008), but is not considered effective on its own. All life stages are very small, and are difficult to detect, especially at low population levels.
Testing at place of production	No. Not relevant.
Treatment of crop	Yes, in combination* Acaricide treatments are available and can be very effective as all stages of mites can be controlled by pesticides. However, as the crop may be reinfested from the environment or surrounding crops (common and polyphagous mite, aerially dispersed), treatments should be repeated and the last treatment done close to harvest/delivery of the plants. Treatments may be more difficult on large plants or plants with dense foliage (difficult to cover all surfaces on which the species may be present). Treatments can be used to maintain a crop pest free (EPPO, 2022a).
Resistant cultivars	No. Commercial resistant cultivars are currently not known.
Growing under physical isolation	Yes. Plants for planting could be grown under protected conditions with sufficient measures to exclude the pest, following EPPO Standard PM5/8(1) *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'* (EPPO, 2016). Life stages of *T. mexicanus* are very small and may be carried by air currents. In addition, the pest may enter as a contaminant on various materials and equipments. Consequently, this option would require a high level of isolation, which is probably not feasible in most cases (only for very high value material).
Specified age of plant, growth stage or time of year of harvest	No. Life stages can be present on all sizes of plants, all year round.
Produced in a certification scheme	No. Not relevant.
Pest freedom of the crop	Yes, in combination*. See 'Treatment of crop' (no other measures were identified to guarantee pest freedom of the crop).
Pest free production site	Yes, growing under physical isolation (see above). Yes, in combination*. Outdoors or in greenhouses (that are not completely physically isolated).

Option	Host plants for planting with leaves (except tissue cultures) and associated packaging material
	Introductions from the surroundings may take place as the pest is common and highly polyphagous in the areas where it is currently present. A buffer zone with no host plants would decrease the likelihood of such introductions. As in the PRA on *T. evansi,* it is considered that a buffer zone of several km with no host plants is not a realistic option. The following measures should be combined to reduce significantly pest presence: • Inspections at the production site, including at least one within the last two weeks prior to export, with no *T. mexicanus* observed • Isolation: no other host plants in the immediate vicinity of the place of production (minimum 100 m; based on data in section 2.3). • Treatments of the crop during production (including close to harvest/delivery of the plants) • Measures to prevent entry of the pest at the production site as contaminant (on clothes, machinery, crates etc.) or on plants (if plant material is being introduced from another location).
Pest free place of production	As for a pest free production site. The choice between pest free production site and pest free place of production is a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements.
Pest free area	Yes. PFAs could be established in areas where the pest has not been recorded. Even within its current area of distribution in America, the EWG considered that the concept of PFA may be applicable to some areas such as at high altitude, close to its limits of current distribution, or islands. Ascertaining the free status of the area may be complicated by the large number of host plants, the presence of the mite in the wider environment and the many other spider mites *T. mexicanus* could be confused with. Aerial dispersal is the main mode of natural dispersal at distances longer than a few metres. There are not sufficient data to specify the distance between a PFA and the closest area where the pest is known to be present. However, mites may be incidentally dispersed over distances of several kilometers (see section 2.3). Based on the elements provided in the PRA, the EWG considered that 2 km was an appropriate distance; but the PFA may also be limited by specific natural barriers or defined for areas where conditions affect survival of the pest, for example areas above a certain altitude with lower temperatures. To establish and maintain a PFA, detailed surveys (using visual inspection) should be conducted in the area and continued every year. Similar surveys should also be carried out in the buffer zone to demonstrate pest freedom. There should be restrictions on the movement of plant material from areas where the pest is known to be present into the PFA, and into the area surrounding the PFA. Movement of material and equipment potentially contaminated should also be regulated.
Options after harvest, at pre-clearance or during transport	
Visual inspection of consignment	Yes, in combination* Visual inspection is unlikely to be completely effective on its own, especially at low levels of infestation and on large plants with many leaves. In the Netherlands, the mite was not detected at import inspection, but after the consignment was delivered to retail greenhouses (i.e. after population build-up).
Testing of commodity	No. Not relevant.
Treatment of the	Yes, in combination*

Option	Host plants for planting with leaves (except tissue cultures) and associated packaging material
consignment	Chemical treatments can be very effective against all life stages, but eradication may not be achieved if all surfaces are not covered by spraying. One single female either fertilized or unfertilized, is able to start a new population.
Pest only on certain parts of plant/plant product, which can be removed	No. The commodity concerns plants with leaves.
Prevention of infestation by packing/handling method	No, in most situations. Plants can become infested during packing, transportation or storage if those take place in an area where mites are dispersed aerially. However, the likelihood of plants being reinfested during packing, transportation or storage is very low. The EWG considered that prevention of infestation by packing was not necessary.
Options that can be implemented after entry of consignments	
Post-entry quarantine	Yes. The EWG recommended four weeks of post-entry quarantine (with weekly inspections) in conditions suitable for the development of the mite (at 25°C or more): this would ensure that any population develops to a size large enough to be detected. This may not be feasible for all plants. The Panel on Phytosanitary Measures considers that this measure should only be proposed in the framework of a bilateral agreement between the exporting and the importing NPPOs.
Limited distribution of consignments in time and/or space or limited use	No. EPPO countries may analyse more specifically whether the conditions are suitable for establishment in their country. However, if the plants for planting are to be used in greenhouses where host plants are present year round, conditions are considered suitable for establishment in the whole EPPO region. Most often, the final destination of plants for planting that are being imported is not known.
Surveillance and eradication in the importing country	No Eradication can likely be achieved under protected conditions in areas where the pest cannot establish outdoors. Eradication will be more difficult outdoors. The pest can be present without causing much damage and it may, therefore, be present in an area for several years before being detected. In the meantime, it can already have spread over larger areas (including private gardens, natural areas) due to aerial dispersal and human assisted spread (movement of infested plants), making eradication nearly impossible.

*The individual measures identified above as ‘Yes in combination’ were:

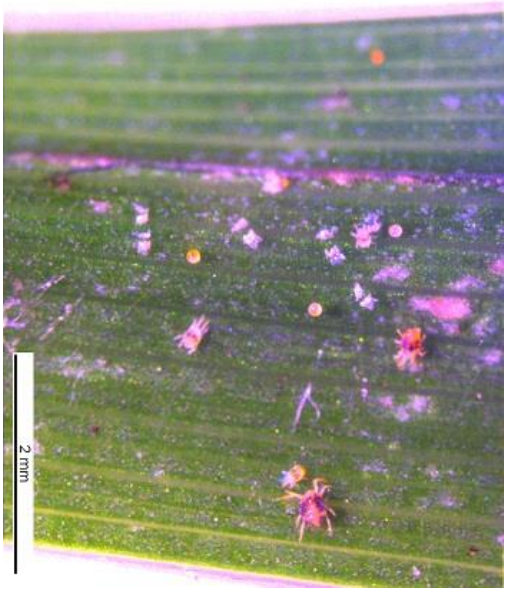
Host plants for planting with leaves (except tissue cultures) and associated packaging material
Visual inspection at place of production
Treatment of the crop
Pest free production site, Pest free place of production
Visual inspection of the consignment
Treatment of the consignment

The EWG considered whether these measures could be combined to achieve a suitable level of protection. This was considered possible for plants for planting with leaves when:
- produced in a pest free production site (or a pest free place of production, see details above), with an inspection of the consignment prior to export.
or

- inspection of the consignment prior to export with no *T. mexicanus* observed, followed by treatment of the consignment effective against all life stages.
The inspection guarantees that the level of infestation is low (or the pest is absent), and the treatment ensures that all life stages that may be present are eliminated. Together, the EWG considered that this option provides a sufficient level of protection.

Visual inspection at the place of production and treatment of the crop were not combined with other measures.

ANNEX 2. Pictures of different life stages and symptoms of *Tetranychus mexicanus*



T. mexicanus female and juvenile stages (Bert Vierbergen, NVWA, NL)

T. mexicanus egg and female. (Bert Vierbergen, NVWA, NL)

Note that, on both pictures, the reddish colour does not represent the real colour of the mite; individuals were greenish yellow/black

T. mexicanus female in microscopic slide (Bert Vierbergen, NVWA, NL)

T. mexicanus feeding damage on *Beaucarnea* (Bert Vierbergen, NVWA, NL)

T. mexicanus discoloration on an orange
(yellow area around the remnant of the style)
(D. Andrade, UNESP, Brazil)

Colonies of *T. mexicanus* on the underside of sweet orange leaves. The size of different life stages is as indicated in section 2.1. For example females (bigger and darker mites on the lower picture) are about 0.5 mm in length (Adenir V. Teodoro, Embrapa, Brazil).

ANNEX 3. Symptoms of *Tetranychus mexicanus* on various host plants

This Annex lists symptoms of *T. mexicanus* on some hosts as described in the literature (see Annex 2 for pictures).

- On *Citrus*, infested leaves become light green, with edges slightly curved downwards. There is often silk webbing at the lower leaf surface, and chlorotic areas at the upper surface, later developing into coloured/necrotic spots (De Andrade-Bertolo *et al*., 2013 citing Moraes & Flechtmann 2008, Parra *et al.* 2003; Ochoa *et al.*, 1994). In high infestations and under plant stress (such as drought), necrosis and defoliation may be observed (De Andrade-Bertolo *et al*., 2013 citing Parra *et al.*, 2003; Silva *et al*., 2017). Symptoms start with whitish mottling of the lower leaf surface, which may turn brownish yellow, and show cracking at the site of colonies. New leaves present leaf roll and deformation (Ochoa *et al*., 1994). On *C. latifolia*, attacked leaves turn yellow at feeding sites (Quiros-Gonzalez, 2000; Silva *et al*., 2017). On fruit, slight discoloration is mentioned (Andrade *et al*., 2007 citing Flechtmann & Paschoal 1967). In Salto (Uruguay) on citrus, the attacked leaves are curved where there are silk webs in which the mites are housed. On the opposite side of the colonies there are often chlorotic spots that turn tan and can cause defoliation (Bernal & Pineiro, 1982).
- On *Annona muricata*, yellowing leaves with curled edges, followed by leaf fall. On seedlings, symptoms always began in the lower third of the canopy then spreading upwards (Silva *et al.*, 2019).
- On *Carica papaya*, chlorotic areas on leaves, progressing to leaf necrosis, dryingand death of leaves (Santos *et al*., 2018).
- On *Elaeis guineensis*, discoloration of leaves with spots becoming orange (Aldana de La Torre *et al*., 2010).
- On *Bougainvillea*, *Erythrina poeppigiana*, *Passiflora membranacea*: yellowish irregular patches on the upper side of leaves (Ochoa, 1991; Ochoa *et al*., 1994).
- On *Centrosema pubescens*, *Passiflora edulis* and *P. ligularis*, yellow spots and deformation of leaf edges (Ochoa *et al*., 1994).
- On *Paullinia cupana*, chlorotic patches followed by drying and necrotic spots(Vasconcelos *et al*., 2022).
- On *Codiaeum variegatum* yellow wrinkled leaves (Feres *et al*., 2009).
- On *Murraya paniculata* and *Tecoma stans*, yellowing of the leaf (Feres *et al*., 2009).
- On *Populus tremuloides*, depressions of ashy appearance with smooth and shiny areas on the lower surface, with chlorosis at the corresponding areas of the upper leaf surface (Ochoa, 1991).
- On *Cocos nucifera*, browning of the leaves (“bronzeamento”) (Teodoro *et al*., 2015).

ANNEX 4. Natural enemies of *Tetranychus mexicanus*

The following natural enemies are mentioned in the literature in the current area of distribution of *T. mexicanus* (note that this list is not exhaustive):

- In *Citrus*: ladybugs (Coccinellidae); predatory mites *Iphiseiodes* spp., *Amblyseius* spp. and *Euseius* spp. (all Acari: Phytoseiidae), *Agistemus* spp. (Acari: Stigmaeidae), in addition to other mites belonging to the families Ascidae, Trombidiidae, Cheyletidae, Cunaxidae, Tydeidae, and Anystidae (Chiaradia *et al.*, 2009 citing others).
- *Neoseiulus idaeus* and *Phytoseiulus macropilis* (Acari: Phytoseiidae) (Cáceres, 2006; Herrero, 1984).
- In *Citrus sinensis*, the following predatory mites had a higher association level with *T. mexicanus*: *Agistemus floridanus*, *Euseius ho*, *Homeopronematus* sp., and *Parapronematus anconai* (Horn *et al.*, 2011).
- *Stethorus* (Coccinellidae) larvae and adults as predators (Dominguez-Gil & McPheron, 1992).
- Phytoseiidae, incl. *Phytoseiulus* spp. (Aldana de La Torre *et al.*, 2010; Teodoro *et al.*, 2015).
- In Cassava (CIAT, 2011), *Euseius casaeriae, Galendromus annectens, Neoseiulus anonymus, Phytoseiulus macropilis, Typhlodromalus peregrinus.*

ANNEX 5. Host plants of *Tetranychus mexicanus*

Category 1 – Hosts and likely hosts. Plants in this category fulfil at least one of the following criteria:

- there is evidence that the plant is suitable to complete the life cycle (in particular, specific studies conducted on the life cycle or colonies observed on the plant in the field); or
- report of *T. mexicanus* as a pest; or
- from faunistic studies on mites, at least two different life stages (immatures[8] and adults) found on the plant species, or the numbers of specimen reported indicate a colony. The EWG decided to apply a threshold of 10 adults (in one observation or in total over several observations) as an indicator of the possible presence of a colony of *T. mexicanus*. When another species in the same genus is a 'host or likely host', a threshold of 5 adults was applied.

Category 2 – Uncertain hosts. All other plants on which *T. mexicanus* was recorded, including plants listed as hosts in the databases Flechtmann & Moraes (2017) or Migeon & Dorkeld (2022) but for which the original publications could not be checked in detail.

Notes on the content of columns

Species. # indicates species or genera categorised based only on the threshold of adults (see thresholds in the description of Category 1 above).

Presence in the PRA area. From other PRAs or from an Internet search, especially to verify if the plant is sold in nurseries in the EPPO region (or as seeds on the Internet).

Comments. Used to classify the plants in the different categories.
Abbreviations used for life stages: n = nymph, f = female, m = male
Note that data for Mendonça *et al.* (2011) includes abbreviations of Brazilian states. These are not relevant to classify the plant, and are not explained in the table.

References. In relation with databases on Tetranychidae (Flechtmann & Moraes, 2017; Migeon & Dorkeld, 2022):

- if the reference(s) they cite is already in the table (because reviewed in details for the PRA), the databases are not mentioned
- if not, the database is mentioned, with the source they indicate between [ ]
- if both databases cite the same reference(s), only one of them is cited in the table (in general Flechtmann & Moraes).
- in some cases, Migeon & Dorkeld (2022) do not indicate a reference for the plant, and a general reference to Migeon & Dorkeld was kept with a note. It is noted however, that they may have used a reference already mentioned in the table.
- records at the family level (especially from Migeon & Dorkeld, 2022) are not in the host list.

Possible commodities from the plant. This column was developed at an early drafting stage to understand the parts of plants that are used, and therefore may become traded commodities in relation to the different pathways in section 8. Relevant commodities are studied in section 8.1. Commodities that correspond to pathways in section 8.2 (unlikely pathways) are in grey.

- Plants for planting with roots (pots, bare-rooted etc.) are considered a possible commodity for all host plants. It is noted however that some plants are more likely to be traded in the form of seeds, bulbs, tubers or rhizomes (which fall under section 8.2).
- EU Regulation 2019/2072 includes requirements for foliage or branches of a number of hosts or genera (no further information was found), and trade in this form is therefore assumed possible.

[8] in studies when adults and nymphs were reported together, nymphs were assumed to be *T. mexicanus* (even if only adults may be identified by morphological characters).

- Wood: based on the working list of commercial timber trees (Mark *et al*., 2014).
- Others are based on a general search.

Host scientific name (common name)	**Family**	**Cat.**	**Presence in PRA area**	**Comments** Abbreviations: n = nymph, f = female, m = male	**References**	**Possible commodities from the plant**
Abelmoschus esculentus	Malvaceae	1	No data searched. Possibly limited cultivation as vegetable or other uses	"severe damage"	Vasconcelos & Silva, 2015	Pfp? Fruit (vegetable)
Acalypha diversifolia[#]	Euphorbiaceae	1	No data found	Buosi *et al.* Studies in native forest, up to 36 specimens at different times of the year. V-03 (2), VI-03 (1), VII-03 (2), VIII-03 (20), IX-03 (36), X-03 (19), XI-03 (4), II-04 (1), III-04 (1) Feres *et al.*, 2007. In surveys in forest remnants, 05-2003 to 04-2004 in one locality, 86 specimens on this plant	Buosi *et al.*, 2006 Feres *et al.*, 2007	Pfp with roots?
Acrocomia aculeata	Arecaceae	1	Yes. Ornamental, possibly limited. Seed available on the Internet	Frizzas *et al.* deals with the pests of *A. aculeata*, and list *T. mexicanus*. Recorded in 2016 in DF. «No Distrito Federal, em coletas realizadas em 2016, foram identificadas as espécies *Tetranychus mexicanus* (McGregor) e *Brevipalpus* grupo phoenicis em folhas de macaúba»	Frizzas *et al.*, 2020	Pfp with roots?
Alchornea glandulosa	Euphorbiaceae	1	No data found	Studies in native forest Buosi *et al.* recorded up to specimens at different times of the year V-03 (7), VI-03 (1), VIII-03 (3),IX-03 (1), X-03 (7), XII-03 (1), II-04 (3), III-04 (2), IV-04 (3) Feres *et al.* 2005 1n V-92, 1f & 1m VII-92 Feres *et al.*, 2007. In surveys in forest remnants ; 05-2003to 04-2004 in one locality, 28 specimens on this plant	Buosi *et al.*, 2006 Feres *et al.*, 2005 Feres *et al.*, 2007	Pfp with roots?
Allium sativum (garlic)	Amaryllidaceae	2	Yes. Cultivated for its bulbs	No details. Relates to findings of mites in samples from crops (two locations, 1981 & 1885)	Caises & Arce, 2008	Pfp = Bulbs Underground plant parts (bulbs for consumption)
Alocasia	Araceae	2	Yes. Many species available as ornamentals, such as *A. x amazonica, A. cucullata, A. zebrina*. Native to India and SE Asia	One finding reported (Antilles), no details	Flechtmann *et al.*, 1999	Pfp with roots
Aloysia virgata	Verbenaceae	2	Yes. Ornamental	Demite & Feres, 2005 (amongst records on native plants in a forest fragment close to a rubber plantation). no details	Demite & Feres, 2005	Pfp with roots
Anacardium occidentale (cashew)	Anacardiaceae	2	Yes. Ornamental, probably limited	No details in the article	Paschoal, 1970	Pfp with roots Fruit Wood

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Andropogon#	Poaceae	2	Yes. Includes species native to Southern Europe (e.g. *A. distachyos*) and others, non-native (e.g. *A. gerardii*, N America) grown as ornamentals. *A. virginicus* (native to N America) was introduced intentionally to Russia, and considered invasive where introduced in France.	1f VII-92	Feres *et al.*, 2005	Pfp with roots
Annona	Annonaceae	1	Annona cherimola: Yes. Cultivated for fruit production, including commercial, in a limited part of the region (incl. Spain, Israel, Portugal (Madeira), Italy (Pinto *et al.*, 2005)).Available as ornamental/fruit plant in nurseries (EPPO, 2020)	many species as confirmed hosts below Demite *et al.* Surveys in natural forest fragments. *Annona* sp. one location, XII-2007 (1f and 2m), III-2008 (2f and 1m)	Sousa *et al.*, 2010 Demite *et al.*, 2016 Flechtmann & Baker, 1975	Pfp with roots
Annona coriacea	Annonaceae	1	Yes. Ornamental, probably limited. Seeds available on the Internet	Sousa *et al.* 2010 studied life cycle on this plant Flechtmann, 1967b: finding in the savanna-like vegetation 'cerrado'	Sousa *et al.*, 2010 Sousa *et al.*, 2015 Flechtmann, 1967b Paschoal, 1970	Pfp with roots Fruit (not domesticated, harvested locally in the 'Cerrado' of Brazil's Northeast)
Annona crassiflora	Annonaceae	1	Yes. Ornamental, probably limited. Seeds available on the Internet	Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:" No details in other articles	Sousa *et al.*, 2010 citing Bolland *et al.*, 1998 Paschoal & Reis, 1968 Paschoal, 1970, 1968b	Pfp with roots? Fruit (in South America, not domesticated, harvested locally)
Annona muricata	Annonaceae	1	Yes. Available as ornamental/fruit plant in nurseries. No evidence found of commercial cultivation. Commercial varieties for fruit production are only mentioned outside EPPO in Yassine (2014)). Adaptation to Malaga conditions is being researched (https://www.diariosur.es/economia/agroalimentacion/guanabana-sello-producido-20200129180400-nt.html?ref=https%3A%2F%2Fwww.google.com%2F)	Sousa *et al.* 2010 studied life cycle on this plant Ruíz-Montiel *et al.*, 2020 sampling in commercial and backyard orchards in Mexico, damage observed Urueta, 1975 as guanábana Silva *et al.* 2019 amongst pests responsible for economic damage	Sousa *et al.*, 2015 Moraes & Flechtmann, 1981 Ruíz-Montiel *et al.*, 2020 Sousa *et al.*, 2010 Vasconcelos, 2011 Urueta, 1975 Silva *et al.*, 2019	Pfp with roots Fruit

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Annona purpurea	Annonaceae	2	Yes as ornamental	no details	Anonymous, 1980 Sousa *et al.*, 2010 citing Bolland *et al.*, 1998 Migeon & Dorkeld, 2022 [Estebanes-Gonzalez & Baker 1968]	Pfp with roots Fruit
Annona reticulata	Annonaceae	2	Yes. Ornamental, probably limited.	Ochoa *et al.* 1994: in host mite list, no details	Ochoa *et al.*, 1994 Sousa *et al.*, 2010 citing Bolland *et al.*, 1998	Pfp with roots Fruit
Annona squamosa	Annonaceae	1	Yes, cultivated for fruit production, probably limited. Greece, Cyprus, Lebanon, and commercial varieties also available in Spain, Portugal, Israel (Yassine, 2014).	Sousa *et al.* 2010 studied life cycle on this plant	Sousa *et al.*, 2010; Sousa *et al.*, 2015 Paschoal, 1970	Pfp with roots Fruit
Annona x atemoya	Annonaceae	1	Yes. Cultivated for fruit production, including commercial, in a very limited part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	as '*A.* x *atemoya'* and '*A. cherimola* x *A. squamosa*' Sousa *et al.* 2015. Surveys on *Annona* 9 f, 5 m one location and date	Sousa *et al.*, 2015 Migeon & Dorkeld, 2022 [Livshits & Salinas-Croche 1968]	Pfp with roots Fruit
Arachis hypogaea	Fabaceae	1	Yes. Cultivated for edible seeds in some Southern countries	"A veces atacando plantaciones de mani"	Bernal & Piñeiro 1982	Pfp with roots? Stored products. peanuts Underground plant parts: shelled peanuts
Attalea speciosa	Arecaceae	2	No data found	As *Orbignya phalerata* No details	Santana & Flechtmann, 1998	Pfp with roots?
Averrhoa carambola	Oxalidaceae	2	Yes. Cultivated for fruit production, including commercial, in a very limited part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	No details in Paschoal, 1970, 1968b	Paschoal, 1970, 1968b Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1967]	Pfp with roots Fruit
Azadirachta indica	Meliaceae	2	No data found		Migeon & Dorkeld, 2022 no ref	Pfp with roots Wood, plant extracts

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Bactris gasipaes	Arecaceae	1	No data found	Stein & Daólio: found in the field, and life cycle studies on this plant Vasconcelos 2011 multiple individuals several times and locations. In Manaus municipality, high populations can be observed causing damage on incl. this plant (Vasconcelos, 2011).	Aguilar & Murillo, 2012 Vasconcelos, 2011 Stein & Daólio, 2012 Santana & Flechtmann, 1998 Flechtmann & Moraes, 2017 [; Stein, C.P. & Daólio, N., 2004; Vasconcelos, G.J.N. & Silva, N.M. da, 2011] Migeon & Dorkeld, 2022 [Aguilar & Murillo 2008 ; Migeon 2015]	Pfp with roots
Bauhinia sp.	Fabaceae	2	Yes. Genus of pantropical origins. Some spp (e.g. B. Variegata, *A. galpinii* and *A. tomentosa* cultivated sporadically as ornamentals in few, Southern countries	One finding reported (Antilles)	Flechtmann *et al.*, 1999	Pfp with roots
Beaucarnea recurvata	Asparagaceae	1	Yes. Grown as ornamental, mainly indoor. Origin: Mexico	Severely affected plants, colonies, females, males, eggs mentioned	NL NPPO, 2018, 2019	Pfp with roots
Bixa orellana#	Bixaceae	2	No data found	Peru, 4 f 5 m	(Guanilo *et al.*, 2012)	Pfp with roots? Wood
Bougainvillea sp.	Nyctaginaceae	1	Yes. Grown as ornamental in Southern countries, in particular *B. glabra* and *B. spectabilis*	Ochoa *et al.* 1994: describe symptoms, colonies mentioned	Ochoa *et al.*, 1994 Migeon & Dorkeld, 2022 no ref	Pfp with roots
Canavalia ensiformis	Fabaceae	1	Yes. Seeds available via internet-sales	Experimental host Maintained colonies of *T. urticae and T. mexicanus* on respectively *Phaseolus vulgaris* & *Canavalia ensiformis*	Argolo, 2008	Pfp = seeds only [beans/pods unlikely to be traded. not in large scale commercial cultivation, mildly toxic, used as cover crop]

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Carica papaya	Caricaceae	1	Yes. Small area of commercial cultivation for fruit, at least in Spain and Israel (EPPO, 2004), EPPO 2010). Mentioned as new and limited crop in the Almeria region and Spain (Honoré *et al.*, 2019). Likely in greenhouse. Available as ornamental/fruit plant in nurseries	Sanches *et al.* 2021 in a guide on mite pests of papaya, no details provided. Vasconcelos 2011 many individuals, locations and dates. In Manaus municipality, high populations can be observed causing damage on incl. this plant (Vasconcelos, 2011). Santos *et al.* 2018. symptoms, found on several isolated plants but not in a commercial papaya production area Domínguez Caises & Mateo Arce, in relation to findings of mites in samples from crops (one location, 1981) Aranda & Flechtmann, 1971: mentioned as one of the most important hosts in Paraguay Mendonca *et al.*, 2011 several localities and states, several dates Barroncas *et al.*, 2022 C. papaya is a better host than P. edulis Moraes & Flechtmann, 2008: T. mexicanus among other spider mites	Vasconcelos 2011 Aranda & Flechtman 1971 Ochoa, 1991Ochoa *et al.*, 1994 Santos *et al.*, 2018 Sanches *et al.*, 2000, 2021 Amaral *et al.*, 2017 Caises & Arce, 2008 Paschoal, 1970, 1968b Mendonça *et al.*, 2011 Flechtmann, 1967a Damasceno, 2008 Barroncas *et al.*, 2022 Moraes & Flechtmann, 2008 Flechtmann & Moraes, 2017 [Flechtmann, C.H.W. & Arruda, G.P., 1967; Vasconcelos, G.J.N. & Silva, N.M. da, 2011] Migeon & Dorkeld, 2022 [Martinez, Torre de la & Garcia 2004]	Pfp with roots Fruit
Cariniana estrellensis	Lecythidaceae	2	No data found	As *Couratai* (*Couratari*) *estrellensis* Possibly common name/Latin name confusion in Paschoal and Paschoal & Reis, because common name given as Jequitiba-vermelho in both articles, with different Latin names	Paschoal, 1970 [note Flechtmann & Moraes (2017) & Migeon & Dorkeld (2022) cite Paschoal & Reis (1968), who does not appear to mention that plant (but only C. legalis)]	Pfp with roots? Wood
Cariniana legalis	Lecythidaceae	2	No data found	As *Couratai* (*Couratari*) *legalis* No details	Paschoal & Reis, 1968	Pfp with roots? Wood
Carya illinoinensis	Juglandaceae	1	Yes. Cultivated, including commercial, in a very limited part of the region (e.g. NE Italy, Turkey mainly Antalya; L. Montecchio, N. Üstün, pers. comm.). Available as ornamental/fruit plant in nurseries (EPPO, 2020)	As *C. illinoensis*. Also as *Carya peca*, understood to be *C. pecan*, syn. of illinoinensis No details in Paschoal 1970 Paschoal, 1968b: “danificando sèriamente as seguintes fruteiras:”	Paschoal, 1970, 1968b	Pfp with roots Nuts Wood

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Caryocar brasiliense	Caryocaraceae	2	No data found	'cerrado' plant (F & B, 1975), no details	Flechtmann & Baker, 1975 Migeon & Dorkeld, 2022 [Aranda 1974]	Pfp with roots? Fruit? [uncultivated. fruit picked from Cerrado in Central Brazil – A. Teodoro, pers. comm.]
Caryota mitis	Arecaceae	2	Yes. Grown as ornamental	Males and females observed on the plants (no details nor figures provided). Specific record for *T. mexicanus* in Guadeloupe	Flechtmann & Etienne, 2006	Pfp with roots
Casearia sylvestris	Salicaceae	2	No data found	'cerrado' plant (F & B, 1975), no details	Flechtmann & Baker, 1975 Migeon & Dorkeld, 2022 [Aranda 1974]	Pfp with roots Herb, medicinal plant
Catasetum macrocarpum	Orchidaceae	2	Yes. Grown as (indoor) ornamental	No details	Flechtmann, 1967a Flechtmann & Moraes, 2017 [Paschoal, A.D., 1970]	Pfp with roots Cut flowers? (EU 2019/2072 incl requirements for cut flowers of Orchidaceae)
Cedrela fissilis	Meliaceae	1	No data found	Flechtmann, 1996: 'observed on plants in a greenhouse causing leaf spotting and total defoliation' Demite & Feres, 2005 (amongst records on native plants in a forest fragment close to a rubber plantation), no details	Flechtmann, 1996 Demite & Feres 2005 Migeon & Dorkeld, 2022 [Mesa Cobo & Zuluaga Cardona 1983]	Pfp with roots? Wood
Cedrela odorata	Meliaceae	1	No data found. However, seeds available via internet-sale	As *C. odorata* and *C. mexicana* Otero-Colina: study on the agricultural importance of mites in Tabasco, presents damage, feeding behaviour and seasonal occurrence (abstract)	Anonymous, 1980 Otero-Colina, 1986 Migeon & Dorkeld, 2022 [Estebanes-Gonzalez & Baker 1968]	Pfp with roots? (or seeds?) Wood
Celtis iguanaea	Cannabaceae	1	No data found	Feres *et al.* 2005 studies in native forest. 1f VII-92, 1f, 1m e 1n IX-92 Demite & Feres, 2005 (amongst records on native plants in a forest fragment close to a rubber plantation), no details	Feres *et al.*, 2005 Demite & Feres 2005 Flechtmann & Moraes, 2017 [Daud, R.D. & Feres, R.J.F., 2005]	Pfp with roots? [in Sth Am. local source of wood]
Celtis sp. [#]	Cannabaceae	1	Mostly trees. C. australis is native to the Mediterranean and used as ornamental	Survey in natural forest fragments. found in one location, VI-2008 (2f), IX-2008 (1m), III-2009 (3f and 1m)	Demite *et al.*, 2016	Pfp with roots
Centrosema pubescens	Fabaceae	1	No data found. Probably not (tropical forage plant)	describe symptoms, large colonies mentioned	Ochoa *et al.*, 1994	forage

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Citrus	Rutaceae	1	Yes. See details for individual species below.	Ochoa *et al.* 1994: describe symptoms and damage, colonies mentioned In Manaus municipality, high populations can be observed causing damage on incl. Citrus (Vasconcelos, 2011). Aranda & Flechtmann, 1971: mentioned as one of the most important hosts in Paraguay	Anonymous, 1980 Ochoa *et al.*, 1994 Flechtmann & Paschoal, 1967 Flechtmann & Baker, 1970 Flechtmann & Abreu, 1973 Moraes & Flechtmann, 1981 Aranda & Flechtman 1971 Flechtmann *et al.*, 1999 Flechtmann & Baker, 1975 Paschoal, 1970, 1968a, 1968b Suárez, 2004 Flechtmann & Moraes, 2017 [Noronha, A.C.S., Carvalho, J.E.B. & Caldas, R.C., 1997; Vasconcelos, G.J.N. & Silva, N.M. da, 2011; Paschoal, A.D., 1968] Migeon & Dorkeld, 2022 [Pritchard & Baker 1955; Rossi Simons 1961; Suarez 2004]	Pfp with roots Fruit Cut foliage?
Citrus aurantifolia (small-fruited acid lime)	Rutaceae	1	Yes. Cultivated for fruit production, incl. commercial, in a very limited part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	No details in Paschoal 1970, Diáz-Tejeda *et al.*, 2010 or Ochoa *et al.*, 1994 Paschoal 1968b: "danificando sèriamente as seguintes fruteiras:" High infestations in "limão galego" Paschoal, 1968a	Ochoa *et al.*, 1994 Paschoal, 1970 Paschoal, 1968a, 1968bDíaz-Tejeda *et al.*, 2010	Pfp with roots Fruit
Citrus latifolia (Tahiti lime)	Rutaceae	1	Yes, as ornamental. No evidence found of commercial cultivation for fruit	Quiros-Gonzalez *et al.*, 2000 : one of the common plant-feeding mites on *C. latifolia* Vasconcelos 2011 : 11 m 20 f /6 m + 6 f ; 2 locations and dates Mendonca *et al.* 2011 MG 09.V.2006, SP 10.I.2006	Quiros-Gonzalez, 2000 Vasconcelos, 2011 Mendonça *et al.*, 2011 Flechtmann & Moraes, 2017 [Daólio, N. & Stein, C.P., 2004]	Pfp with roots Fruit

Host scientific name (common name)	**Family**	**Cat.**	**Presence in PRA area**	**Comments** Abbreviations: n = nymph, f = female, m = male	**References**	**Possible commodities from the plant**
Citrus limetta (sweet lime)	Rutaceae	2	Yes. Cultivated for fruit production, incl. commercial, probably limited part of the region. Available as ornamental/fruit plant in nurseries	No details	Ochoa *et al.*, 1994	Pfp with roots Fruit
Citrus limon (lemon)	Rutaceae	1	Yes: cultivated for fruit production, incl. commercial, in part of the region (EC, 2021). Available as ornamental/fruit plant in nurseries (EPPO, 2020)	Herrero 1984: *Phytoseiulus macropilis* found on *T. mexicanus* in orange and lemon groves Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:"	Herrero, 1984 Ochoa *et al.*, 1994 Paschoal, 1968a, 1968b Damasceno, 2008 Pritchard & Baker, 1955	Pfp with roots Fruit
Citrus paradisi (pomelo)	Rutaceae	1	Yes: Cultivated for fruit production, incl. commercial, in part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	No details in Ochoa *et al.*, 1994, Paschoal, 1970, Paschoal 1968a Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:"	Ochoa *et al.*, 1994 Paschoal, 1970 Paschoal, 1968a, 1968b Migeon & Dorkeld, 2022 no ref	Pfp with roots Fruit
Citrus reticulata (mandarin)	Rutaceae	1	Yes: Widely cultivated for fruit production, incl. commercial, in part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	No details in Ochoa *et al.*, 1994 nor Paschoal & Reis, 1968, Paschoal, 1970, Paschoal, 1968a Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:" Also var *austera* in Flechtmann & Moraes (2017) citing Paschoal & Reis, 1968	Ochoa *et al.*, 1994 Paschoal & Reis, 1968 Paschoal, 1970 Paschoal, 1968a, 1968b Migeon & Dorkeld, 2022 [Guanilo, A.D., Moraes, G.J.d., Toledo, S., *et al.* 2010]	Pfp with roots Fruit

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Citrus sinensis (orange)	Rutaceae	1	Yes: Widely cultivated for fruit production. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	Major host	De Herrero, 1984 Anonymous, 1980 Ochoa *et al.*, 1994 Horn *et al.*, 2011 Bobot *et al.*, 2011 Mineiro *et al.*, 2009 Teodoro *et al.* 2020 Mendonça *et al.*, 2011 Paschoal, 1968a McGregor, 1950 Moraes & Flechtmann, 2008 Flechtmann & Moraes, 2017[Flechtmann, C.H.W., 1967; Horn, T.B., Ferla, N.J., Silva, J.F., Diehl, M. & Marchetti, M.M., 2006] Migeon & Dorkeld, 2022 [Aguilar & Murillo 2008]	Pfp with roots Fruit
Citrus sunki (sour mandarin)	Rutaceae	1	Not searched	As C. *reticulata var. austera* Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:" High infestations in "limão cravo" Paschoal, 1968a	Paschoal, 1968a, 1968b	Pfp with roots? Fruit
Cocos nucifera	Arecaceae	1	Yes. Grown as ornamental	Estrada-Venegas *et al.* 2013 reported on C. nucifera, no damage in Mexico. Records in several Brazilian states in Mendonca *et al.* 2011 (cited in Flechtmann & Moraes, 2017) Flechtmann 1966 & Paschoal, 1970 Flechtmann, 1967a, Urueta, 1975: no details	Estrada-Venegas *et al.*, 2013 Flechtmann, 1966 Flechtmann, 1967a Paschoal, 1970 Urueta, 1975 Beer & Lang, 1958 Flechtmann & Moraes, 2017 [Mendonça, R.S., Navia, D., Diniz, I.R. & C.H.W. Flechtmann, 2011; Paschoal, A.D., 1971]	Pfp with roots Fruit (nut)
Codiaeum	Euphorbiaceae	2	From an Internet search, C. variegatum (below) seems to be the main species used as ornamental	Moraes & Fletchmann: study of mites, collected, no details Flechtmann *et al.*, 1999 one finding reported (Antilles)	Moraes & Flechtmann, 1981 Fletchmann *et al.*, 1999	Pfp with roots

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Codiaeum variegatum	Euphorbiaceae	1	Yes. Grown as ornamental	Ochoa, 1994 describes symptoms, damage, time of the year Feres *et al.* 2009: 6f, 4m Flechtmann *et al.* 1999 several locations and years (Antilles)	Ochoa *et al.*, 1994 Feres *et al.*, 2009 Flechtmann *et al.*, 1999 Paschoal, 1970 (Andrews & Poe, 1980) Migeon & Dorkeld, 2022 [Livshits & Salinas-Croche 1968; Andrews & Poe 1980; Martinez, Torre de la & Garcia 2004]	Pfp with roots
Cordiera sessilis	Rubiaceae	2	No data found. Seeds available via internet	As *C. sessilis* and *Alibertia sessilis* 'cerrado' plant (F & B, 1975), no details	Flechtmann & Baker, 1975 Migeon & Dorkeld, 2022 [Aranda 1974]	Pfp with roots? (or seeds only?) Fruit [used locally where grown]
Couroupita guianensis	Lecythidaceae	2	No data found. Seeds available via internet	No details	Paschoal, 1970	Pfp with roots? Wood
Crotalaria retusa	Fabaceae	2	Possibly (seeds available from the Internet). Invasive	One finding reported (Antilles)	Flechtmann *et al.*, 1999	Pfp with roots? (or seeds only?)
Cupressus sp.	Cupressaceae	2	Yes. Widely grown, mainly as ornamental, sporadically for timber. Originating in several warm temperate regions of Northern hemisphere	no details in articles	Paschoal, 1970 Flechtmann, 1967a	Pfp with roots
Cymbopogon schoenanthus	Poaceae	2	Yes. Grown in North Africa for use in medicine and perfume. Originating from Asia, but now widely distributed also in Latin America	No details	Flechtmann, 2020	Pfp with roots?
Dioscorea alata (yam)	Dioscoreaceae	2	No data found	No details	Paschoal, 1970	Pfp: tuber Underground plant parts (tubers for consumption)
Doliocarpus dentatus#	Dilleniaceae	2	No data found	Survey in natural forest fragments. III-2008 (1m);	Demite *et al.*, 2016	Pfp with roots?

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Elaeis guineensis	Arecaceae	1	Yes. Grown as ornamental. Originating in Africa, but cultivated widely in the tropics	Aldana de la Torre mentioned as pest Vasconcelos 2011 4m 3f Aguilar Piedra „en invernadero“ Some damage on “palma africana” (Urueta, 1975)	Aldana de la Torre *et al.*, 2015 Aguilar-Piedra & Solano- Aldana de La Torre *et al.*, 2010 Vasconcelos 2011 Guevara, 2020 Urueta, 1975 Flechtmann & Moraes, 2017 [Azevedo, A.O., Noronha, A.C.S., Ferreira, C.T. & Oliveira, F.S., 2012]	Pfp with roots
Elaeis oleifera	Arecaceae	2	No data found. Seeds available via the internet	As “nolí”. No details in Urueta 1975	Urueta, 1975	Pfp with roots? (or seeds only?)
Erythrina poeppigiana	Fabaceae	1	No data found	Ochoa *et al.* 1994: describe symptoms, colonies mentioned	Ochoa *et al.*, 1994	Pfp with roots?
Erythrina variegata	Fabaceae	2	Yes. Grown as ornamental. [native to East Africa, India, Australia]	As *E. variagata* and *E. indica* Mendonca *et al.*, 2011: MG, 09.IV.2006, no details, mentioned as first report Mendonca 2009: no details	Mendonça *et al.*, 2011 Mendonça, 2009	Pfp with roots
Esenbeckia leiocarpa	Rutaceae	2	No data found	No details	Paschoal & Reis, 1968 Paschoal, 1970	Forage
Euterpe edulis	Arecaceae	2	No data found		Flechtmann & Moraes, 2017 [Daólio, N. & Stein, C.P., 2004]	Pfp with roots?
Euterpe oleracea (acai palm)	Arecaceae	2	No data found. Possibly as ornamental (seeds available for sale on the Internet)		Flechtmann & Moraes, 2017 [Daólio, N. & Stein, C.P., 2004]	Pfp with roots Fruit (but possibly mostly imported as processed pulp)
Fortunella japonica (kumquat)	Rutaceae	2	Yes, limited cultivation in some Mediterranean countries. Also ornamental https://antropocene.it/en/2019/01/22/citrus-japonica/	As *Citrus japonica*	Migeon & Dorkeld, 2022 [Fernadez 1972]	Pfp with roots Fruit
Fortunella sp.	Rutaceae	1	See above	No details in Paschoal, 1970 Paschoal, 1968b: “danificando sèriamente as seguintes fruteiras:”	Paschoal, 1970, 1968a, 1968b	Pfp with roots
Fragaria chiloensis	Rosaceae	1	Yes, at least available as ornamental/garden plant. No data found on ´commercial cultivation	Ochoa *et al.*, 1994. *F. chiloensis* listed amongst crops attacked by this species (mentioned in one list as F. chiloensis var ananassa, in another as F. chiloensis).	Ochoa *et al.*, 1994	Pfp with roots Fruit ?

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Fragaria x ananassa	Rosaceae	1	Yes: widely cultivated for fruit (indoors and outdoors)	Argolo, 2008. Secondary pest in *F. ananassa*. «despite not being reported as a primary pest, it is also observed in strawberry plantations in protected cultivation, causing injuries to the leaves. Once, high populations of *T. mexicanus* on strawberry plants were verified in a greenhouse. (obs. Pessoal) Mendonca *et al.* : Brasilia, 26.IV.2006 Ochoa *et al.*, 1994. as *F. chiloensis* var. *ananassa*, amongst crops attacked by this species (mentioned in one list as *F. chiloensis* var *ananassa*, in another as *F. chiloensis*) Oliveira *et al.*, 2008 reports finding of *T. mexicanus* on strawberry plants in greenhouse, and showed completion of the life cycle on strawberry leaves in the laboratory.	Argolo, 2008 Mendonça *et al.*, 2011 Ochoa *et al.*, 1994 Oliveira *et al.*, 2008	Pfp with roots Fruit
Genipa americana	Rubiaceae	2	No data found		Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1968]	Pfp with roots ? Wood
Glycine max	Fabaceae	2	Yes. Cultivated for food and fodder in Southern countries	RS 11.III.2005	Mendonça *et al.*, 2011	Fruit (fresh beans) Pfp = seeds Stored product (animal feed, processed food, other manufactures products): mostly meal, also oil (De Maria *et al.*, 2020)
Gossypium	Malvaceae	1		No details in Ochoa *et al.*, 1994 Aranda & Flechtmann, 1971: mentioned as one of the most important hosts in Paraguay Flechtmann & Bastos 1972: relatively harmful to cotton in Céara state	Ochoa *et al.*, 1994 Aranda & Flechtmann, 1971 Flechtmann & Bastos, 1972	Pfp = seeds
Gossypium barbadense	Malvaceae	2	Yes. Cultivated as fiber crop	SP 11.I. 2006	Mendonça *et al.*, 2011	Pfp = seeds Stored product (cotton)
Gossypium herbaceum	Malvaceae	1	Yes. Cultivated as fiber crop	Moraes & Flechtmann, 2008: *T. mexicanus* among other spider mites on cotton plants	Moraes & Flechtmann, 2008 Migeon & Dorkeld, 2022 no ref	Pfp = seeds Stored product (cotton)
Gossypium hirsutum	Malvaceae	1	Yes. Main Gossypium sp. cultivated as fiber crop	Azevedo & Vieira: regular and persistent presence in cotton agrosystem, potential risk Mendonca *et al.*, 2011 MG 07.IV.2006	Azevedo & Vieira, 2002 Mendonça *et al.*, 2011 Migeon & Dorkeld, 2022 no ref	Pfp = seeds Stored product (cotton)
Guettarda uruguensis[#]	Rubiaceae	1	Yes, ornamental, probably limited (few sites on the Internet)	Survey in natural forest fragments. XII-2007 (7f and 3m)	Demite *et al.*, 2016	Pfp with roots

Host scientific name (common name)	**Family**	**Cat.**	**Presence in PRA area**	**Comments** Abbreviations: n = nymph, f = female, m = male	**References**	**Possible commodities from the plant**
Hancornia speciosa	Apocynaceae	1	No data found	Native to Brazil, suitable for fresh consumption and processing. T. mex. was the most abundant mite species, potential threat	Silva *et al.*, 2020	Pfp with roots? Fruit? [in Sth America: from the wild, not domesticated. Friuit is highly perishable – A. Teodoro, pers. comm.]
Heliconia sp. #	Heliconiaceae	2	Yes. Some spp grown as ornamentals, e.g. H. rostrate, H. psittacorum, H. wagneriana	4 m 3 f, one locality and date	Vasconcelos, 2011	Pfp with roots
Heliconia wagneriana	Heliconiaceae	2	Yes, available as ornental		Flechtmann & Moraes, 2017 [Oliveira, A.R., Souza, I.V. de, Freitas, A.L.G.E. de & Bittencourt, M.A.L., 2008]	Pfp with roots
Hevea benthamiana	Euphorbiaceae	2	No data found	Unclear record, written as : '2F e 3M, 04-VIII e IF e 1M, 25-VIII-1997, *H. brasiliensis* - clone GT I, *H. benthamiana* e *H. pauciflora'* (study on mites in monocultures of several *Hevea* spp.)	Feres, 2000	Pfp with roots? Wood, possibly processed commodity (rubber)
Hevea brasiliensis	Euphorbiaceae	1	No data found	Feres, 2000: Many specimens (study on mites in monocultures of several *Hevea* spp.) Moraes & Flechtmann, 2008: low frequency of spider mites, incl. *T. mexicanus* Hernandes & Feres, 2006: in several states	Feres, 2000 Paschoal, 1970 Hernandes & Feres, 2006 Moraes & Flechtmann, 2008 Flechtmann & Moraes, 2017 [Chiavegato, L.G., 1968] Migeon & Dorkeld, 2022 [Flechtmann & Arleu 1984]	Pfp with roots? Wood, processed (rubber)
Hevea pauciflora	Euphorbiaceae	2	No data found	Unclear record, written as : '2F e 3M, 04-VIII e IF e 1M, 25-VIII-1997, *H. brasiliensis* - clone GT I, *H. benthamiana* e *H.pauciflora'* (study on mites in monocultures of several Hevea spp.)	Feres, 2000	Pfp with roots?
Hovenia dulcis	Rhamnaceae	2	Yes. Grown as ornamental [Asian origin]	no details in articles	Paschoal, 1970, 1968b Flechtmann, 1967a	Pfp with roots
Ilex paraguariensis (yerba mate)	Aquifoliaceae	1	No data found	mentioned as one of the most important hosts in Paraguay	Aranda & Flechtmann, 1971	Pfp with roots? [leaves and stems would be traded dry – A. Teodoro, pers. comm.]

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Litchi chinensis	Sapindaceae	1	Yes. Cultivated for fruit production, including commercial, in a very limited part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	Paschoal & Reis, 1968; Paschoal, 1970: no details Paschoal, 1968b: “danificando sèriamente as seguintes fruteiras:”	Paschoal & Reis, 1968 Paschoal, 1970, 1968b	Pfp with roots Fruit
Livistona sp.	Arecaceae	2	Yes. At least one sp. (L. rotundifolia) grown as ornamental	No details	Santana & Flechtmann, 1998	Pfp with roots
Luehea	Malvaceae	2	No data found		Migeon & Dorkeld, 2022 [da Silva, F.R., de Moraes, G.J., Knapp, M. 2008]	Pfp with roots?
Luehea speciosa#	Malvaceae	2	No data found	Studies in native forest. 1f	Feres *et al.*, 2005	Pfp with roots?
Maclura tinctoria	Moraceae	2	No data found		Migeon & Dorkeld, 2022 [Livshits & Salinas-Croche 1968]	Pfp with roots? Wood, processed commodity (for dyes)
Magnolia grandiflora	Magnoliaceae	2	Yes. Widely grown as ornamental	no details in Anonymous, 1980	Anonymous, 1980	Pfp with roots
Malpighia	Malpighiaceae	2	No data found, except for M. glabra		Migeon & Dorkeld, 2022 [Livshits & Salinas-Croche 1968]	Pfp with roots?
Malpighia glabra	Malpighiaceae	2	Yes. Grown as ornamental	MG 09.V.2006	Mendonça *et al.*, 2011	Pfp with roots Fruit
Malus sylvestris or *domestica*	Rosaceae	2	Yes. Widespread in the wild in Europe to Ural Mountains. Used as rootstock, sometimes as hedge plant, also available on own roots as ornamental/fruit plant in nurseries Malus domestica: Yes: Widely cultivated for fruit production within the EPPO region (PRA Naupactus xanthographus)	As *Pyrus malus*/*Pirus malus* or macieira. Not clear if authors refer to *M. domestica* or *M. sylvestris* Flechtmann & Baker, 1970 no details, collected Flechtmann 1966, 1967a, Paschoal 1970, 1968b no details Fletchmann publications: From field sampling no experiment done on development on this host (C. Fletchmann, pers. comm.)	Flechtmann, 1966 Flechtmann, 1967a Flechtmann & Baker, 1970 Flechtmann & Moraes, 2017 Paschoal, 1970, 1968b Flechtmann & Moras, 2017 [Flechtmann, C.H.W., 1968]	Pfp with roots Fruit (domestica) Wood (sylvestris)
Manihot esculenta	Euphorbiaceae	1	Yes. Cultivated in Mediterranean countries	Both as *M. esculenta* & *M. utilissima* (synonyms) Vasconcelos : 2m 6f & 8m 12 f (2 dates) CIAT : cassava handbook mentioned amongst cassave arthropod pests	CIAT, 2011 Vasconcelos 2011 Paschoal & Reis, 1968 Paschoal 1970	Pfp with roots Leaves (EU 2019/2072 incl. requirements for leaves of this plant) Pfp = cuttings Underground plant parts: rhizomes for consumption

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Melicoccus bijugatus	Sapindaceae	2	Yes. Available as ornamental/fruit plant in nurseries. No evidence found of commercial cultivation. (EPPO, 2020)	One finding reported (Antilles)	Flechtmann *et al.*, 1999	Pfp with roots Fruit
Micropholis gardneriana	Sapotaceae	2	No data found	As *Sideroxylon gardnerianum. no details*	Paschoal, 1970 Migeon & Dorkeld, 2022 [Flechtmann 1967]	Pfp with roots? Wood (tropical.theferns.info)
Morus alba[#]	Moraceae	2	Yes. Cultivated for leaves (animal feed for cattle, silkworm) and fruit, e.g. in Central Asia. Also ornamental [native from India, China, and naturalizedin part of the region, e.g. Central Asia, Europe]	1m 8f, one date and locality	Vasconcelos, 2011	Pfp with roots Animal feed (esp. silkworm?) Wood Fruit probably not traded
Morus nigra	Moraceae	2	Yes. Cultivated for leaves (animal feed for cattle, silkworm) and fruit e.g. in Central Asia. [native from Iran, naturalized in part of the region, e.g. Central Asia, Mediterranean etc.]	no details in articles available	Paschoal, 1970, 1968b Flechtmann, 1967a Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1967;	Pfp with roots Animal feed (esp. silkworm?). wood fruit probably not traded
Murraya paniculata	Rutaceae	1	Yes. Grown as ornamental (acc. to CABI)	12f, 3m e 7n (31-VIII)	Feres *et al.*, 2009	Pfp with roots Cut fresh plant parts? (EU 2019/2072 incl. requirements for plant parts of *Murraya*)
Musa	Musaceae	1	Yes. Limited cultivation for fruit, and also used as ornamental	Halbert 2008 slight infestation Vasconcelos, 2011 12f, 3m e 7n (31-VIII), one location F & Abreu, 1973, no details	Halbert, 2008 Vasconcelos 2011 Flechtmann & Abreu, 1973 Beer & Lang, 1958 Moraes & Flechtmann, 1981	Pfp with roots Fruit. Fresh leaves may be used for cooking, wrapping or food serving. Not sure if some commodities are packed in fresh banana leaves
Myrtus communis	Myrtaceae	2	Yes. Grown as ornamental	No details	Paschoal, 1971 Migeon & Dorkeld, 2022 no ref	Pfp with roots
Passiflora	Passifloraceae	2	See individual species	No details in F & A 1973	Flechtmann & Abreu, 1973	Pfp with roots

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Passiflora edulis	Passifloraceae	1	Yes. Cultivated for fruit and grown as ornamental. Major host	Incl. varieties edulis and flavicarpa Ochoa *et al.* 1994: describe symptoms, large colonies mentioned Hernández *et al.*, 1998 control Vasconcelos 2011 6m 24 f. In Manaus municipality, high populations can be observed causing damage on incl. this plant (Vasconcelos, 2011). Flechtmann *et al.*, 1999: two findings in 2 Antilles isl. Mendonca *et al.*, 2011 several localities and dates Barroncas *et al.*, 2022: C. papaya is a better host than P. edulis. Oliveira & Frizzas (2014) (on main pests ofP. edulis f. flavicarpa) mention colonies Urueta 1975: as maracuyá	Hernández *et al.*, 1988 Dominguez-Gil & McPheron, 1992 Ochoa *et al.*, 1994 da Silva *et al.*, 2020 Flechtmann *et al.*, 1999 Mendonça *et al.*, 2011 Flechtmann & Moraes, 2017 Urueta, 1975 [Vasconcelos, G.J.N. & Silva, N.M. da, 2011] Barroncas *et al.*, 2022 Moraes & Flechtmann, 2008 Oliveira & Frizzas, 2014 (f. flavicarpa : Flechtmann & Moraes, 2017 [Yamashiro, R. & A.S. Sampaio, 1977]	Pfp with roots Fruit
Passiflora ligularis	Passifloraceae	1	Yes. Grown as ornamental	Ochoa *et al.* 1994: describe symptoms, large colonies mentioned	Ochoa *et al.*, 1994 Migeon & Dorkeld, 2022 no ref	Pfp with roots Fruit
Passiflora membranacea	Passifloraceae	1	No data found	Ochoa *et al.* 1994: describe symptoms, colonies mentioned	Ochoa *et al.*, 1994 Migeon & Dorkeld, 2022 no ref	Pfp with roots? Fruit?
Paullinia cupana	Spindaceae	1	No data found.	colonies at all growth stages and webs. Infestation in a greenhouse(plastic).	Vasconcelos *et al.*, 2022	Pfp with roots? [Amazonian plant, cultivated. Seeds used in soft drink industry, and as stick, syrup, powder or extract – A. Teodoro, pers. comm.]
Persea americana	Lauraceae	1	Yes. Cultivated for fruit production, including commercial, in a limited part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	Mentioned amongst the most important hosts in Paraguay	Aranda & Flechtman, 1971	Pfp with roots Fruit
Petiveria alliacea	Phytolaccaceae	2	No data found	No details	Paschoal, 1970 Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1968]	Pfp with roots? Plant parts (leaves and stems) & Fruit: Medicinal and religious uses – A. Teodoro, pers. comm.

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Phaseolus lunatus (Lima bean)	Fabaceae	2	Yes. Cultivated for fodder and food (in Spain)	Possibly experimental host, unclear	Flechtmann & Moraes, 2017 [Chiavegato, L.G., 1973]	Fruit (other types as beans)? (but possibly not traded. traditionally cultivated by indigenous groups and smallholders mainly in northeastern Brazil– A. Teodoro, pers. comm.) Pfp = seeds
Phaseolus vulgaris (common bean)	Fabaceae	1	Yes: widely grown as a crop plant in the EPPO region (PRA Naupactus xanthographus)	No details in Ochoa, 1994 Argolo 2008 (in experiments) maintained colonies of T. urticae and *T. mexicanus* on respectively *Phaseolus vulgaris* & *Canavalia ensiformis* Moraes & Flechtmann, 2008: *T. mexicanus* among other spider mites	Ochoa *et al.*, 1994 Migeon & Dorkeld, 2022 no ref Argolo, 2008 Moraes & Flechtmann, 2008	Fruit (green beans, and other shelled common beans), stored products (unshelled common beans) Pfp = seeds
Philodendron sp.	Araceae	2	Yes. Many spp. grown as ornamental (e.g. *P. bipinnatifidum*, *P. melanochrysum*, *P. verrucosum*)	Note that only species named in the literature was *P. bipinnafidum*, which is now *Thaumatophyllum bipinnafidum* (unclear if other *Philodendron* are hosts) Paschoal 1970 & Flechtmann, 1967: "filodendro"	Paschoal, 1970 Flechtmann, 1967 Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1968]	Pfp with roots
Phyllanthus	Phyllanthaceae	2	Yes. Some spp. grown as ornamental, e.g. *P. fluitans* (for aquarium) and *P. mírabilis*	No details	Paschoal, 1970	Pfp with roots
Pittosporum tobira	Pittosporaceae	2	Yes. Grown as ornamental	No details	Paschoal, 1970 Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1968] Migeon & Dorkeld, 2022 [Vargas, Merayo & Aguilar 1996]	Pfp with roots Cut foliage (the plant is used for cut foliage – Wikipedia)
Plumeria alba	Apocynaceae	2	Yes. Grown as ornamental		Silva *et al.*, 2020 citing others Migeon & Dorkeld, 2022 no ref	Pfp with roots
Podranea ricasoliana	Bignoniaceae	2	Yes. Grown as ornamental. Introduced to Algeria, Spain, Canary Isl (Wikipedia) [native to Africa]	'cerrado' plant (F & B, 1975), no details	Flechtmann & Baker, 1975	Pfp with roots
Polyscias balfouriana	Araliaceae	2	Yes. Grown as ornamental	no details	Aguilar-Piedra & Solano-Guevara, 2020	Pfp with roots

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Poncirus trifoliata (trifoliate orange)	Rutaceae	1	Yes. rootstock, ornamental (probably not commercially for fruit, or only for processing)	As *Citrus trifoliata* Paschoal, 1970 no details Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:"	Paschoal, 1970, 1968a, 1968b Migeon & Dorkeld, 2022 no ref	Pfp with roots [probably not fruit, or only processed – not eaten fresh]
Populus tremuloides	Salicaceae	2	No data found	Ochoa, 1994 describes symptoms, citing Freítez 1974	Ochoa *et al.*, 1994; Migeon & Dorkeld, 2022 no ref	Pfp with roots? Cut fresh plant parts ? (EU 2019/2072 incl. requirements for cut branches of *Populus*) Wood
Portulaca oleracea	Portulacaceae	2	Yes. Cultivated as leaf vegetable	No details	Ochoa *et al.*, 1994	Leaf vegetable, ornamental? Pfp = seeds
Prunus persica	Rosaceae	1	Yes: Widely cultivated for fruit production Available as ornamental/fruit plant in nurseries (EPPO, 2020)	Aranda & Flechtmann, 1971: mentioned as one of the most important hosts in Paraguay No details in Ochoa *et al.* 1994 nor Paschoal, 1970 Paschoal & Reis, 1968: mention three localities Flechtmann, 1967a: Piracicaba, no details Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras	Ochoa *et al.*, 1994 Paschoal 1970, 1968b Paschoal & Reis, 1968 Aranda & Flechtman, 1971 Flechtmann, 1967a	Pfp with roots Fruit
Prunus salicina	Rosaceae	1	Yes: Cultivated for fruit in warm climatic regions in the EPPO region (PRA Naupactus xanthographus)	As *P. salicina* and *P. triflora* P & R 1968, P, 1970 no details Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:"	Paschoal & Reis, 1968 Paschoal, 1970, 1968b	Pfp with roots Fruit
Psidium guajava	Myrtaceae	2	Yes. Cultivated for fruit production, including commercial, in a very limited part of the region. Available as ornamental/fruit plant in nurseries (EPPO, 2020)	No details in Ochoa *et al.*, 1994	Ochoa *et al.*, 1994 Migeon & Dorkeld, 2022 no ref	Pfp with roots Fruit Wood
Psychotria sp. #	Rubiaceae	2	No data found	Survey in natural forest fragments. IX-2007 (2f and 6m);	Demite *et al.*, 2016	Pfp with roots?
Ptychosperma macarthurii	Arecaceae	2	No data found	One finding reported (Antilles)	Flechtmann *et al.*, 1999	Pfp with roots?
Pyrus communis	Rosaceae	1	Yes: Widely cultivated for fruit in the EPPO region (PRA Naupactus xanthographus)	No details in Paschoal, 1970 Paschoal, 1968b: "danificando sèriamente as seguintes fruteiras:"	Paschoal, 1970, 1968b Moraes & Flechtmann, 2008	Pfp with roots Fruit Wood
Ricinus communis#	Euphorbiaceae	1	Yes. Cultivated as oil crop and grown as ornamental	Vasconcelos, 2011. 4m 6 f. new record, one place and date.	Vasconcelos, 2011 Migeon & Dorkeld, 2022 [Guanilo, A.D., Moraes, G.J.d., Toledo, S., *et al.* 2010]	Pfp = seeds Stored products (beans), processed commodities (oil? jewellery made of beans)

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Rollinia mucosa	Annonaceae	1	No data found	Vasconcelos, 2011. 3 m, 8 f ; + 7m 13 f, 2 locations and dates (new record). In Manaus municipality, high populations can be observed causing damage on incl. this plant	Vasconcelos, 2011 Flechtmann & Moraes, 2017 [Vasconcelos, G.J.N. & Silva, N.M. da, 2011] Migeon & Dorkeld, 2022 [Livshits & Salinas-Croche 1968]	Pfp with roots? Fruit
Rosa	Rosaceae	2	Yes. Some species in the wild. Native or exotic species also widely cultivated	No details found (In Brazil, references are on three states, BA, SP, MG) Mendonca *et al.*, 2011 MG 09.V.2006 Flechtmann, 1967 (as roseira) Fletchmann publications: From field sampling, no experiment done on development on this host (C. Fletchmann, pers. comm.)	Paschoal, 1970 Flechtmann & Paschoal, 1967 Flechtmann, 1967aFlechtmann & Abreu, 1973 Mendonça *et al.*, 2011Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1968;]	Pfp with roots Cut flowers
Roystonea regia	Arecaceae	2	Yes. Available as ornamental plant in nurseries	One finding reported (Antilles)	Flechtmann *et al.*, 1999	Pfp with roots
Saccharum officinarum	Poaceae	2	Yes. Cultivated in some Mediterranean countries for sugar production		Migeon & Dorkeld, 2022 no ref	Cuttings Stored products (stalks thought to be processed locally and not traded)
Sapindus saponaria	Sapindaceae	2	Yes. Available as ornamental plant in nurseries.		Migeon & Dorkeld, 2022 [Livshits & Salinas-Croche 1968]	Pfp with roots
Schefflera vinosa	Araliaceae	2	No data found	(as *Didymopanax vinosus*) 'cerrado' plant (F & B, 1975), no details	Flechtmann & Baker, 1975 Migeon & Dorkeld, 2022 [Aranda 1974]	Pfp with roots?
Sida	Malvaceae	2	No data found		Migeon & Dorkeld, 2022 no ref	Pfp with roots?
Sida cf glutinosa	Malvaceae	2		No details	Ochoa *et al.*, 1994	
Smilax fluminensis	Smilacaceae	2	No data found	As *S. syringoides* Paschoal, 1970: no details Flechtmann, 1967b, finding in 'cerrado'	Paschoal, 1970 Flechtmann, 1967 Migeon & Dorkeld, 2022 no ref	Pfp with roots?

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Sorghum halepense	Poaceae	2	Yes. Cultivated widely as forage, and considered a weed in some areas	Anonymous: no details	Anonymous, 1980 Migeon & Dorkeld, 2022 no ref	Pfp with roots? Stored products (grain)
Stryphnodendron adstringens[#]	Fabaceae	2	No data found	Surveys in natural forest fragments. IX-2008 (2)	Demite *et al.*, 2016	Pfp with roots?
Syagrus[#]	Arecaceae	1	Yes. Some spp. (e.g. *S. plumosa*, *S. romanzoffiana*) grown as ornamentals	Surveys in natural forest fragments. VI-2008 (2f), III-2009 (12f and 3m)	Demite *et al.*, 2016	Pfp with roots
Tabernaemontana catharinensis[#]	Apocynaceae	2	No data found	Surveys in natural forest fragments. VI-2008 (3f), IX-2008 (1f and 1m)	Demite *et al.*, 2016	Pfp with roots?
Tecoma stans	Bignoniaceae	1	Yes. Grown as ornamental	1m, 1n	Feres *et al.*, 2009	Pfp with roots Forage, medicinal
Thaumatophyllum bipinnatifidum	Araceae	2	Yes grown as (mainly indoor) ornamental	*As Philodendron bipinnatifidum* Not clear where record comes from	Sanches *et al.*, 2021 citing others	Pfp with roots
Theobroma cacao	Malvaceae	1	Yes. Available as ornamental/fruit plant in nurseries. No evidence found of commercial cultivation (EPPO, 2020)	Suarez 1991: with *Rhizoeglyphus setosus*, the most significant mites in cocoa cultivation in Guantanamo, Cuba Nakayama *et al.*, 1987: Control measures Suárez, 2004: no details (Cuba) Sodré (ed) 2017: as secondary pest in Brazil	Flechtmann & Baker, 1970 Suarez, 1991 Nakayama *et al.*, 1987 Paschoal, 1970 Flechtmann & Abreu, 1973 Suárez, 2004 Flechtmann, 1967a Sodré, 2017 Flechtmann & Moraes, 2017 [Flechtmann, C.H.W., 1968; Abreu, J.M., 1969]	Pfp with roots? Stored products (cacao, pods for cacao production – but dried)
Theobroma grandiflorum[#]	Malvaceae	1	No data found	3 m 7 f	Vasconcelos, 2011	Pfp with roots? Fruit [consumed locally]
Trichilia casarettoi[#]	Meliaceae	1	No data found	Demite *et al.*, 2016. Surveys in natural forest fragments. Many specimens (over 250 in total, one observation with 76 f and 14 m) in many localities and dates	Demite *et al.*, 2016 Flechtmann & Moraes, 2017 [Demite, P.R., Lofego, A.C. & Feres, R.J.F., 2013]	Pfp with roots?
Vitis labrusca	Vitaceae	1	Yes. Cultivated for fruit production (probably only for wine, not fresh fruit), grown as ornamental, and sporadically spread to unmanaged areas	1 f & 1 larva in III.2010 in Andrade-Bertolo *et al.*, 2013. new reports of mites on *Vitis*.	Andrade-Bertolo *et al.*, 2013 Flechtmann & Moraes, 2017 [Ott, A.P., Andrade-Bertolo,, F.O. & Matioli, A.L., 2011]	Pfp with roots Fruit? [appear to mainly be used for wine, so possibly not traded fresh]

Host scientific name (common name)	Family	Cat.	Presence in PRA area	Comments Abbreviations: n = nymph, f = female, m = male	References	Possible commodities from the plant
Vitis vinifera	Vitaceae	1	Yes. Widely cultivated for fruit	Andrade-Bertolo *et al.* 2013: new reports on Vitis. Brazil, Rio Grande do Sul. Caxias do Sul: 7♀, II.2010; 2♀, IV.2010; in *V. vinifera*, Semilllon; 1♂, 3♀, I.2009; 1♂, I.2010; 1♂, III.2010; in *V. vinifera*, Cabernet Sauvignon. Mendonca 2009 mentions populations “populacoes de *T. mexicanus*, *P. ulmi*, *O.* aff. *mangifera* e uma nova especie do genero *Oligonychus*” Mendonça *et al.*, 2011. Pirapora, Minas Gerais,12.IV.2006. mention *V. vinifera* as first report on Vitaceae (not able to find appendix that may give more details) Paschoal & Bleicher 1973, no details	Andrade-Bertolo *et al.*, 2013 Mendonça *et al.*, 2011 Mendonça, 2009 Paschoal & Bleicher, 1973 Flechtmann & Moraes, 2017 [Ott, A.P., Andrade-Bertolo, F.O. & Matioli, A.L., 2011]	Pfp with roots Fruit
x Citrofortunella microcarpa (calamondin)	Rutaceae	2	Yes, available as ornamental/fruit plant in nurseries. No evidence found of commercial cultivation for fruit	No details in Sharkey *et al.*, 2022	Sharkey *et al.*, 2022	Pfp with roots Fruit
Xylopia aromatica#	Annonaceae	1	No data found	Surveys in natural forest fragments. VI-2008 (1f and 3m), IX-2008 (3f and 3m)	Demite *et al.*, 2016	Pfp with roots?
Zanthoxylum coco#	Rutaceae	2	No data found	As ‘*Z. stipitatum*’. Feres *et al.* Studies in native forest. 2f 2m VII-92	Feres *et al.*, 2005	Pfp with roots? Fresh cut plant parts? (EU 2019/2072, requirements for cut plant parts of *Zanthoxylum*)
Zanthoxylum monogynum#	Rutaceae	2	No data found	Survey in natural forest fragments. Found in one locality, one date. VI-2008 (4f), III-2009 (2f and 1m)	Demite *et al.*, 2016	Pfp with roots? Fresh cut plant parts? (EU 2019/2072, requirements for plant parts of *Zanthoxylum*)
Zingiber zerumbet#	Zingiberaceae	1	Yes. Grown as (mainly indoor) ornamental [native from Asia]	6m 5f (new host record, 1 locality, 1 date)	Vasconcelos, 2011	Pfp = rhizomes Underground plant parts (rhizomes)

The host status of the following plant species is even more uncertain than category 2 hosts and they are therefore not listed above:

- *Cucumis melo* (Migeon & Dorkeld, 2022). The database cites Flechtmann (1996), who does however not mention that plant in relation to *T. mexicanus*.
- *Cydonia oblonga* (Silva *et al.*, 2019, citing Moraes & Fletchmann 2008). *C. oblonga* is not in the host databases of Flechtmann & Moraes (2017) nor is it mentioned by Migeon & Dorkeld (2022), which otherwise abundantly cite Moraes & Flechtmann (2008).
- *Solanum melongena* (Cheng *et al.*, 1994 - from Google translation). This record of *T. mexicanus* from China is doubtful (see section 6), and therefore the host is also doubtful.

ANNEX 6. Imports of host plants for planting into seven EU countries

Data of imports of host plants for planting (in number of units) into seven EU countries (ISEFOR data, Eschen *et al.*, 2017) was extracted for countries where *T. mexicanus* is present, as well as other countries in Central and South America where it may be present (see section 6). Note that these data are old, i.e. they span 2000-2011, and therefore only provide a crude indication of the expected current import quantities. Further, the figures are an overestimate since e.g. the figures represent the imports from the whole USA but *T. mexicanus* is only present in 2 of the 50 states in USA.
Data was extracted in relation to Category 1. However, the data is mostly provided at genus level, i.e. it may not concern the species listed in Category 1.
Quantity as number of plants.
Quantities marked with * are specified in the data as “cuttings/budsticks“.
Quantities marked with # is mentioned in the data as imported under derogation (only registered at one occasion, i.e. for *Vitis* from Argentina in 2006).
Countries in grey were added because they are in Central or South America, but T. mexicanus is not recorded there (see section 6).

Plants imported (units)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Acalypha	**8**		**8**								**318**		**334**
Brazil											18		18
Guatemala											300*		300
USA	8		8										16
Annona											**300**		**300**
Costa Rica											300		300
Arachis	**4400**												**4400**
Costa Rica	4400												4400
Beaucarnea guatermalensis (not known host)										**104700**	**9600**		**114300**
Guatemala										104700	9600		114300
Beaucarnea recurvata										**10675**	**28550**	**14700**	**53925**
Costa Rica										10675	28550	14700	53925
Beaucarnea	**12749316**	**10697209**	**9305923**	**7207453**	**9172042**	**12833863**	**13935758**	**21417048**	**19031264**	**12012203**	**8415039**		**136777118**
Brazil	63000	126000	126000										315000
Costa Rica	1235000	130000	455000	1300000	2139238	1988654	2048000	2935838	1583271	1638914	1827370		17281285
Cuba	65000												65000
Ecuador								64500					64500
El Salvador					65630								65630
Guatemala	10534966	9929532	8469923	5907453	6882174	10673209	11887758	18161410	17362993	10288289	6587669		116685376
Honduras	595000	170000	255000		85000								1105000
Mexico	170650	170377						255300	85000	85000			766327
USA	85700	171300				172000							429000
Bougainvillea	**3430**	**2759**	**500**	**9900**	**1000**	**10976**	**5100**	**8797**	**8520**	**1500**			**52482**
Costa Rica	3430	520	500	2000	1000	10976	4000	8797	7520				38743
Ecuador				7900									7900
Honduras		2239											2239
USA							1100		1000	1500			3600
Carica		**186**	**10**										**196**
Costa Rica		186											186

Plants imported (units)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
USA			10										10
Carya illinoensis											**1**		**1**
USA											1		1
Carya											**6**	**2**	**8**
USA											6	2	8
Celtis occidentalis (not known host)											**150**		**150**
USA											150		150
Celtis											**6**		**6**
USA											6		6
Citrus	**19**	**1**	**1260**		**249583**								**250863**
Brazil	19	1											20
Mexico					249583								249583
USA			1260										1260
Cocos nucifera										**5**	**12**		**17**
Costa Rica											12		12
Honduras										5			5
Cocos	**592**	**641895**	**136613**	**6**	**382**		**5**	**235**	**156**	**9**			**779742**
Colombia										4			4
Costa Rica	32	641776	136595		150			225	5				778783
Ecuador					150								150
Guatemala	150												150
Honduras				6			5	10		5			26
USA	410	119	18		82								629
Codiaeum variegatum										**51908**	**166636**	**54329**	**272873**
Costa Rica										51908	166406	54329	272643
Guatemala											230		230
Codiaeum	**2283974**	**5058962**	**1498561**	**384798**	**837776**	**1468410**	**1803033**	**2024126**	**2037854**	**2391063**	**2209073**		**21997630**
Argentina				430									430
Brazil	53400		7150		2000								62550
Colombia			2160										2160
Costa Rica	2227553	5042210	1483227	382743	814059	1464320	1781113	2005416	2025152	2366067	2207873		21799733
Ecuador										9			9
El Salvador			35		840								875
Guatemala	2500	150	291		11259	4090	21920	18700	11684	24687	1200		96481
Honduras	71	16602	5698	1625	9613				1018				34627
Suriname	450												450
USA					5			10		300			315
Elaeis			**1**					**1**		**1**			**3**
Costa Rica								1					1
El Salvador										1			1
USA			1										1
Fragaria	**39825**	**5**	**9935**					**1629**	**10266885**	**189026**	**1947929**		**12455234**

Plants imported (units)	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Total**
Brazil										2400*			2400
Costa Rica	500	5	9935							8800*			21240
Costa Rica										2000			
Guatemala										3200*			3200
USA	39325							1629	10266885	167426	1947929		12428394
USA										5200*			
Ilex			**570**							**840**	**138**		**1548**
USA			570							840	138		1548
Litchi			**4**										**4**
USA			4										4
Manihot					**5**								**5**
USA					5								5
Murraya paniculata											**53**		**53**
Costa Rica											53		53
Murraya		**3**	**25**	**5**	**30**	**10**		**8**			**68**		**149**
Costa Rica				5	29	10		8			68		120
USA		3	25		1								29
Musa	**435488**	**164976**	**102716**	**4592**		**744**	**1500**	**84**	**3120**	**540**	**5272**		**719032**
Brazil			102700					84	420	140			103344
Colombia			1										1
Costa Rica	1350		15	107		1	1500			400			3373
Cuba	6										1		7
Honduras	38												38
Mexico	5100										2000		7100
USA	428994	164976		4485		743			2700		3271		605169
Passiflora	**4**												**4**
Colombia	4												4
Phaseolus	**16**	**7600**	**2**	**11000**									**18618**
Colombia			2										2
Guatemala	2												2
Suriname				11000									11000
USA	14	7600											7600
Prunus		**936**		**10170**			**1**					**5**	**11112**
Suriname		936		10170									11106
USA							1					5	6
Pyrus	**1**	**3**	**2**	**1**									**7**
USA	1	3	2	1									7
Syagrus romanzoffiana											**61**		**61**
Costa Rica											61		61
Syagrus	**20122**		**1**	**4**	**7**	**470**	**700**	**5270**	**2310**	**2260**	**1986**		**33130**
Argentina				4									4
Brazil										60	391		451
Costa Rica	22					470	700	5190	2166	2200	1513		12261

Plants imported (units)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
El Salvador								75	144				219
Guatemala											30		30
Honduras					7			5					12
USA	20100		1								52		20153
Theobroma								**4**					**4**
Costa Rica								4					4
Trichilia											**120**		**120**
USA											120		120
Vitis		**14**	**1**				**176#**				**22**		**37**
Argentina			1				176				22		23
Brazil		14											14
Zingiber		**364**	**3**	**17**									**384**
Costa Rica		344											344
USA		20	3	17									40

ANNEX 7. Imports of cut roses from Colombia in 2021

(Source: https://comtradeplus.un.org/))

Importer	amount (kg)
Spain	1,783,593
Netherlands	1,285,293
Russian Federation	1,274,118
Poland	908,337
Romania	463,876
Italy	430,558
Czechia	365,748
Kazakhstan	285,274
Israel	241,005
Belarus	171,417
France	75,590
Hungary	35,424
Latvia	34,438
Slovenia	22,338
Slovakia	13,889
Bosnia Herzegovina	13,441
Portugal	12,732
Azerbaijan	9,700
Norway	7,435
Ireland	4,629
Germany	3,761
Belgium	2,215
Croatia	1,411
Lithuania	1,388
Georgia	1,222
Switzerland	1,219
Morocco	922
Sweden	135
Denmark	49
Finland	11
Estonia	4