Pest categorisation of *Aulacaspis tubercularis*

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**Abstract**

The EFSA Panel on Plant Health performed a pest categorisation of *Aulacaspis tubercularis* (Hemiptera: Diaspididae), the white mango scale, for the EU. *A. tubercularis* is a tropical species that originates from Asia but is now established in several tropical and subtropical regions throughout the world. It also occurs within the EU and is established in Italy, Portugal and Spain. *A. tubercularis* is not listed in Commission Implementing Regulation (EU) 2019/2072. It is polyphagous, feeding on plants in more than 37 genera in 23 families and is most frequently reported on mango (*Mangifera indica*). Indeed, it is considered one of the key pests of mango crops around the world. No evidence was found indicating damage to crops other than mango. *A. tubercularis* is established in southern Spain (Andalusia) with four overlapping generations and two population peaks, one in summer and another in autumn. Andalusia is the main mango producing area of the EU and *A. tubercularis* can cause losses through downgrading of fruit. The main natural dispersal stage is the first instar, which crawls over the host plant or may be dispersed further by wind and animals. Plants for planting and fruits provide potential pathways for further entry and spread. Climatic conditions and availability of host plants in southern EU countries are conducive for establishment. Phytosanitary measures are available to reduce the likelihood of further entry and further spread. *A. tubercularis* satisfies the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest.

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**Keywords:** mango scale insect, Hemiptera, pest risk, plant health, plant pest, Diaspididae, quarantine

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background

The new Plant Health Regulation (EU) 2016/2031, on the protective measures against pests of plants, is applying from 14 December 2019. Conditions are laid down in this legislation in order for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. The lists of the EU regulated pests together with the associated import or internal movement requirements of commodities are included in Commission Implementing Regulation (EU) 2019/2072. Additionally, as stipulated in the Commission Implementing Regulation 2018/2019, certain commodities are provisionally prohibited to enter in the EU (high risk plants, HRP). EFSA is performing the risk assessment of the dossiers submitted by exporting to the EU countries of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting to the EU countries for derogations from specific EU import requirements.

In line with the principles of the new plant health law, the European Commission with the Member States are discussing monthly the reports of the interceptions and the outbreaks of pests notified by the Member States. Notifications of an imminent danger from pests that may fulfill the conditions for inclusion in the list of the Union quarantine pest are included. Furthermore, EFSA has been performing horizon scanning of media and literature.

As a follow-up of the above-mentioned activities (reporting of interceptions and outbreaks, HRP, derogation requests and horizon scanning), a number of pests of concern have been identified. EFSA is requested to provide scientific opinions for these pests, in view of their potential inclusion by the risk manager in the lists of Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary by the risk manager.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinions in the field of plant health.

EFSA is requested to deliver 53 pest categorisations for the pests listed in Annex 1A, 1B, 1D and 1E (for more details see mandate M-2021-00027 on the Open.EFSA portal). Additionally, EFSA is requested to perform pest categorisations for the pests so far not regulated in the EU, identified as pests potentially associated with a commodity in the commodity risk assessments of the HRP dossiers (Annex 1C; for more details see mandate M-2021-00027 on the Open.EFSA portal). Such pest categorisations are needed in the case where there are not available risk assessments for the EU.

When the pests of Annex 1A are qualifying as potential Union quarantine pests, EFSA should proceed to phase 2 risk assessment. The opinions should address entry pathways, spread, establishment, impact and include a risk reduction options analysis.

Additionally, EFSA is requested to develop further the quantitative methodology currently followed for risk assessment, in order to have the possibility to deliver an express risk assessment methodology. Such methodological development should take into account the EFSA Plant Health Panel Guidance on quantitative pest risk assessment and the experience obtained during its implementation for the Union candidate priority pests and for the likelihood of pest freedom at entry for the commodity risk assessment of High Risk Plants.

1.2. Interpretation of the Terms of Reference

_Aulacaspis tubercularis_ is one of a number of pests listed in Annex 1 to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest (QP) for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States (MS) referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores, and so inform EU decision making as to its appropriateness for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/ 2072. If a pest fulfils the criteria to be potentially listed as a Union QP, risk reduction options will be identified.
2. Data and methodologies

2.1. Data

2.1.1. Information on pest status from NPPOs

In the context of the current mandate, EFSA is preparing pest categorisations for new/emerging pests that are not yet regulated in the EU and for which, when the pest is reported in a MS, an official pest status is not always available. In order to obtain information on the official pest status for *A. tubercularis*, EFSA has consulted the NPPOs of Italy, Portugal and Spain. The results of this consultation are presented in Section 3.2.2.

2.1.2. Literature search

A literature search on *A. tubercularis* was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest as search term. Papers relevant for the pest categorisation were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

2.1.3. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online), the CABI databases and scientific literature databases as referred above in Section 2.1.1.

Data about the import of commodity types that could potentially provide a pathway for the pest to enter the EU and about the area of hosts grown in the EU were obtained from EUROSTAT (Statistical Office of the European Communities).

The Europhyt and TRACES databases were consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTE) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission’s multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the MS and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

GenBank was searched to determine whether it contained any nucleotide sequences for *A. tubercularis* which could be used as reference material for molecular diagnosis. GenBank® (www.ncbi.nlm.nih.gov/genbank/) is a comprehensive publicly available database that as of August 2019 (release version 227) contained over 6.25 trillion base pairs from over 1.6 billion nucleotide sequences for 450,000 formally described species (Sayers et al., 2020).

2.2. Methodologies

The Panel performed the pest categorisation for *A. tubercularis* following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013).

The criteria to be considered when categorising a pest as a potential Union QP is given in Regulation (EU) 2016/2031 Article 3 and Annex I, Section 1 of the Regulation. Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. In judging whether a criterion is met the Panel uses its best professional judgement (EFSA Scientific Committee, 2017) by integrating a range of evidence from a variety of sources (as presented above in Section 2.1) to reach an informed conclusion as to whether or not a criterion is satisfied.

The Panel's conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU)
No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. While the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018). Article 3 (d) of Regulation (EU) 2016/2031 refers to unacceptable social impact as a criterion for QP status. Assessing social impact is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as derived from Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

| Criterion of pest categorisation | Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest (article 3) |
|----------------------------------|----------------------------------------------------------------------------------|
| Identity of the pest (Section 3.1) | Is the identity of the pest clearly defined, or has it been shown to produce consistent symptoms and to be transmissible? |
| Absence/presence of the pest in the EU territory (Section 3.2) | Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed. |
| Pest potential for entry, establishment and spread in the EU territory (Section 3.4) | Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways for entry and spread. |
| Potential for consequences in the EU territory (Section 3.5) | Would the pests’ introduction have an economic or environmental impact on the EU territory? |
| Available measures (Section 3.6) | Are there measures available to prevent pest entry, establishment, spread or impacts? |
| Conclusion of pest categorisation (Section 4) | A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met. |

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Is the identity of the pest clearly defined, or has it been shown to produce consistent symptoms and/or to be transmissible?

Yes, the identity of the pest is established and *Aulacaspis tubercularis* (Newstead) is the accepted name.

The mango scale, or white mango scale, *Aulacaspis tubercularis* (Newstead, 1906) is an insect species within the order Hemiptera, family Diaspididae. The species was described first by Newstead in 1906 as *Aulacaspis (Diaspis) tubercularis* from specimens collected on *Cinnamomum zeylanicum* in Java, Indonesia (García Morales et al., 2016). It was subsequently redescribed by Newstead in 1908 as *A. cinnamoni* from specimens collected on *C. zeylanicum* in Java and in 1911 as *Diaspis (Aulacaspis) cinnamoni var. mangiferae* (García Morales et al., 2016). Detailed morphological descriptions and illustrations of adults can be found in Takagi (1970, 2010) and of first and second female and male instars in Moharum (2012). The EPPO code (Griessinger and Roy, 2015; EPPO, 2019) for this species is AULSTU (EPPO, online).

3.1.2. Biology of the pest

*A. tubercularis* presents sexual dimorphism and its post embryonic development comprises of four male instars (nymph I, nymph II, prepupa and pupa) and two female instars (nymph I and nymph II) (Labuschagne, 1993; Del Pino et al., 2020). Crawlers and male adults are the only stages which can
move (Labuschagne, 1993). The crawlers are mobile and disperse over the host plant to find a suitable place to settle on. Once settled, they insert their stylets into the plant tissue and start feeding (Juarez-Hernandez et al., 2014). Female crawlers are randomly established on leaves, stems or on the fruits where they feed (Del Pino et al., 2020). They usually move away from their mother while male crawlers establish in groups of 10–80 individuals near the adult female (Gutierrez, 2003; Moharum, 2012). Of the hatched crawlers, about 80% are usually males (Otieno, 2021). In Egypt and Spain, it has three to four overlapping generations per year (Kwaiz, 2009; Nabil et al., 2012; Del Pino et al., 2021; Otieno, 2021), and in southern Spain it shows two population peaks, one in summer and another in autumn (Del Pino et al., 2021).

Important features of the life history strategy of *A. tubercularis* are summarised in Table 2.

**Figure 1:** *Aulacaspis tubercularis*: A, adult female scale cover, diameter 2.0 mm; B, scale cover removed to reveal body of adult female and purple eggs; C, immature male tests, length 0.6 mm; D, mango shoot exhibiting necrosis due to heavy infestation of scale in the Caribbean (Source: Chris Malumphy)

**Table 2:** Important features of the life history strategy of *Aulacaspis tubercularis*

| Life stage | Phenology and relation to host | Other relevant information |
|------------|--------------------------------|----------------------------|
| Egg        | Eggs are laid underneath the female scale and remain there until crawlers’ hatch (Labuschagne, 1993). The number of eggs laid is influenced by host plant and temperature. On *Cucurbita moschata* the mean number of eggs laid per female was 82.45, 261.9 and 203.15 for winter (7 & 23°C), spring (13 & 26°C) and summer (18 & 29°C) simulated conditions, respectively (Labuschagne, 1993). | In winter (7 & 23°C), spring (13 & 26°C) and summer (18 & 29°C) simulated conditions, the duration of egg stage ranged from 10.3 to 15.6 days (Labuschagne, 1993). At 27°C and 81% Relative Humidity the egg stage lasts 8 days (Gutierrez, 2003). |
3.1.3. Host range/Species affected

*Aulacaspis tubercularis* is polyphagous, feeding on plants in more than 37 genera in 23 families (Appendix A provides a full host list). Although it has a broad range of hosts, it is most frequently found on, and causes damage to mango trees (*Mangifera indica*). Large populations are often found on mango while other potential host species nearby are free from the scale. For example, although citrus and avocados are hosts of *Aulacaspis tubercularis*, the pest has not been found on these crops in areas of southern Spain where these crops are grown in the vicinity of mangoes (Boyero et al., 2017).

3.1.4. Intraspecific diversity

No intraspecific diversity is reported for this species.

3.1.5. Detection and identification of the pest

| Are detection and identification methods available for the pest? |
|---------------------------------------------------------------|
| Yes, visual detection is possible, and morphological and molecular identification methods are available. |

**Detection**

Careful visual examination of plants and fruits is an effective way for the detection of *Aulacaspis tubercularis*. Male crawlers settle in groups of 10–80, often near their mother and these groups are conspicuous due to the white scale covers (known as tests) they produce (Moharum, 2012). Moreover, the pink blemishes on the infested mango fruit and chlorotic patches on the foliage are easily detectable. Yellow sticky traps can also be used to determine the presence of the winged adult males although morphological species identification is not possible (Del Pino et al., 2021).
Identification

The identification of *A. tubercularis* requires microscopic examination of slide-mounted adult females and verification of the presence of key morphological characteristics as given by Takagi (2010).

Lo Verde et al. (2020) provide details to distinguish between congeneric species.

A key to identify adult females of 56 species of this genus recorded in China is provided by Wei et al. (2016) and a key to armoured scales on avocado is available by Evans et al. (2009).

Molecular techniques for species identification have also been developed (Fita et al., 2021). GenBank contains nucleotide sequences for *A. tubercularis*.

Symptoms

The main symptoms of *A. tubercularis* infestation on mango trees (Abo-Shanab, 2012; Nabil et al., 2012) are:

- Excessive leaf loss and malformation in young trees.
- Drying out of young twigs resulting in dieback.
- Poor blossoming.
- Infested (mango) fruits have conspicuous pink or pale blemishes around the feeding sites of the scales.
- Premature fruit dropping.
- Mature fruits are smaller and less juicy.
- Severe early-stage infestation retards growth of young nursery plants.

Description

- Eggs have an average length of 0.17 mm, oval and red-brown to purple (Labuschagne, 1993).
- First instar nymphs (crawlers) are deep bright brick red (Hodges and Hamon, 2016). They are flattened, elongate-oval, about 0.25 (male) and 0.28 (female) mm long with eyes, and well-developed legs and antennae (Moharum, 2012). The newly hatched nymphs are totally bare of any wax secretion. After settling, they begin to exude from the body fine threads of wax which appear cottony (Moharum, 2012).
- Second instar nymph female is broadly oval, rounded at the posterior end and approximately 0.43 mm long while the male is ovoid and about 0.38 mm long. Both have reduced antenna, but they do not have eyes and legs (Moharum, 2012).
- Adult females are about 1.14 mm in length, an elongate body with enlarged angular prosoma and distinct lateral tubercles, wingless, legless and yellow to purple brown (Del Pino et al., 2020). The female is covered with a nearly circular, flat, thin and often wrinkled, opaque greyish-white coloured scale, about 2 mm in diameter (Hodges and Hamon, 2016; Del Pino et al., 2020). Exuviae are marginal, and are yellowish-brown, with a median black ridge, forming a distinct dark median line.
- The male adult has one pair of wings, is yellow to orange, about 0.53 mm long (Labuschange, 1993), with well-developed legs and antennae (Del Pino et al., 2020).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

*A. tubercularis* is a tropical species that originates from Asia but is now established in many tropical and subtropical regions throughout the world (Sayed, 2012, Belay and Nagassa, 2021). It has a wide distribution in several countries in Africa, Asia, Oceania, North America, South America and in the Caribbean; it has a restricted distribution in Europe (EPPO, online; CABI, online; Garcia Morales et al., 2016) (Figure 2). For a detailed list of countries where *A. tubercularis* is present, see Appendix B.
3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.

Yes, *A. tubercularis* has been recorded in Italy, Spain and Portugal.

Specifically, in the EU the pest is established in mango growing regions:
- in Italy (Sicily) (Pellizzari and Porcelli, 2014). The NPPO of Italy regard *A. tubercularis* as having restricted distribution in Italy.
- in Spain (Canary Islands and Andalusia) (Del Pino et al., 2021). The Canary Islands though are not part of the EU for plant health purposes. The NPPO of Spain regard *A. tubercularis* as being present on mango crops in Andalusia and the Canary Islands.
- in Portugal (Madeira Islands) (EPPO, online). The NPPO of Portugal regard *A. tubercularis* as being present on the island of Madeira and associated with mango. No official control measures are in place.

Note that when a pest is found in parts of its potential distribution and there are areas free from the pest that could suffer losses were the pest to spread or be introduced to such areas, the pest can be considered as not widely distributed (FAO, 2021 (ISPM No. 5, Supplement 1)). Hence, because *A. tubercularis* is not known to occur in Greece, where there is some mango production and impacts would be likely were *A. tubercularis* to be introduced there, *A. tubercularis* can be regarded as being not widely distributed in the EU.

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

*A. tubercularis* is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, an implementing act of Regulation (EU) 2016/2031.
3.3.2. Hosts or species affected that are prohibited from entering the Union from third countries

According to the Commission Implementing Regulation (EU) 2019/2072, Annex VI, introduction of several *A. tubercularis* hosts into the EU from certain third countries is prohibited (Table 3).

**Table 3:** List of plants, plant products and other objects that are *Aulacaspis tubercularis* hosts whose introduction into the Union from certain third countries is prohibited (Source: Commission Implementing Regulation (EU) 2019/2072, Annex VI)

| Description                                                                 | CN Code      | Third country, group of third countries or specific area of third country                                                                 |
|----------------------------------------------------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 8. Plants for planting of Chaenomeles Ldl., Crataegus L., Cydonia Mill., Malus Mill., Prunus L., Pyrus L. and Rosa L., other than dormant plants free from leaves, flowers and fruits | ex 0602 10 90 | Third countries other than: Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Faeroe Islands, Georgia, Iceland, Liechtenstein, Moldova, Monaco, Montenegro, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Turkey and Ukraine. |
| 9. Plants for planting of Cydonia Mill., Malus Mill., Prunus L. and Pyrus L. and their hybrids, and Fragaria L., other than seeds | ex 0602 10 90 | Third countries, other than: Albania, Algeria, Andorra, Armenia, Australia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canada, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, New Zealand, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)) and San Marino, Serbia, Switzerland, Syria, Tunisia, Turkey, Ukraine, and United States other than Hawaii. |
| 11. Plants of Citrus L., Fortunella Swingle, Poncirus Raf., and their hybrids, other than fruits and seed | ex 0602 10 90 | All third countries                                                                                                                       |
3.4. Entry, establishment and spread in the EU

3.4.1. Entry

Is the pest able to enter into the EU territory? If yes, identify and list the pathways

Yes, the pest has already entered the EU territory. It could further enter the EU territory with fruits (mainly mangoes).

Comment on plants for planting as a pathway

The pest could further enter the EU territory with plants for planting (mainly mangoes) although some of the host plants from some third countries are prohibited (Table 4).

Plants for planting and fruits are the main potential pathways for entry of \textit{A. tubercularis} (Table 4).

Table 4: Potential pathways for \textit{Aulacaspis tubercularis} into the EU 27

| Pathways       | Description (e.g. host/intended use/source) | Life stage            | Relevant mitigations [e.g. prohibitions (Annex VI) or special requirements (Annex VII) within Implementing Regulation 2019/2072] |
|----------------|--------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------|
| Plants for planting | Eggs, nymphs and adults | Plants for planting that are hosts of \textit{A. tubercularis} and are prohibited to import from third countries (Regulation 2019/2072, Annex VI) are listed in Table 3. There is a temporary prohibition for High Risk plants (Regulation 2018/2019) some of which are \textit{A. tubercularis} hosts i.e. \textit{Acer}, \textit{Acacia}, \textit{Persea} and \textit{Prunus}. Plants for planting from third countries require a phytosanitary certificate (Regulation 2019/2072, Annex XI, Part A). |
| Fruits         | Eggs, nymphs and adults                  | Fruits from third countries require a phytosanitary certificate to import into the EU (2019/2072, Annex XI, Part A). According to Regulation 2019/2072, Annex XI, Part C fruits of \textit{Cocos nucifera} do not require a phytosanitary certificate for their introduction into the Union territory. |

The import of some host plants for planting of \textit{A. tubercularis} from some third countries is not allowed (Implementing Regulation 2019/2072, Annex VI). There is a temporary prohibition for High Risk plants (Regulation 2018/2019) some of which are \textit{A. tubercularis} hosts, i.e. \textit{Acer}, \textit{Acacia}, \textit{Persea} and \textit{Prunus}. All the other known host plants for planting can be imported to the EU with a phytosanitary certificate (Implementing Regulation 2019/2072, Annex XI, Part A).

Fruits that are imported in the EU must have a phytosanitary certificate. However, fruits of \textit{Cocos nucifera} which are hosts of the pest do not require a phytosanitary certificate for their introduction into the EU (Implementing Regulation 2019/2072, Annex XI, Part C).

Annual imports of \textit{A. tubercularis} hosts from countries where the pest is known to occur are provided in Appendix C.

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As at 10/12/2021 (search date), there was one record of interception of \textit{A. tubercularis} in the Europhyt and TRACES databases:

- in 2005 on \textit{Mangifera indica} fruits imported from the Dominican Republic.

\textit{A. tubercularis} was intercepted several times in England and Wales in the UK on imported fresh mango fruits prior to 1995 (Malumphy, 1996). Between 1996 and 2020, it was intercepted 162 times, mostly on mango fruit imported from Africa, Asia and the Caribbean. It was occasionally found on fruits of rambutan (\textit{Nephelium lappaceum}), lychee (\textit{Litchi chinensis}) and bitter melon (\textit{Momordica charantia}) and once on cinnamon foliage (\textit{Cinnamomum verum}).
3.4.2. Establishment

**Is the pest able to become established in the EU territory?**

Yes, *A. tubercularis* is established in Italy, Portugal and Spain. In the EU countries of southern Europe, the climate is suitable and there are available hosts that can support establishment.

Climatic mapping is the principal method for identifying areas that could provide suitable conditions for the establishment of a pest taking key abiotic factors into account (Baker, 2002). Availability of hosts is considered in Section 3.4.2.1. Climatic factors are considered in Section 3.4.2.2.

### 3.4.2.1. EU distribution of main host plants

*A. tubercularis* is a polyphagous pest. The main hosts of the pest cultivated in the EU between 2016 and 2020 are shown in Table 5. Citrus and stone fruits are highly economically important crops in the EU.

| Crop             | 2016     | 2017     | 2018     | 2019     | 2020     |
|------------------|----------|----------|----------|----------|----------|
| Citrus           | 519.01   | 502.84   | 508.99   | 512.83   | 519.98   |
| Cucumbers        | 32.34    | 31.81    | 32.65    | 33.70    | 27.78    |
| Stone fruits     | No data  | 625.46   | 621.32   | 612.67   | No data  |
| Avocados         | 12.24    | 12.72    | 13.22    | 17.50    | 19.60    |

The crop area of mango, the main host, is limited to 5,700 ha in 2020 in Spain (Del Pino et al., 2021; MAPA, 2021) of which approximately 90% occurs in Andalusia and 10% in the Canary Islands (Hernández Delgado, 2016). There is production of 55 ha in Italy (Testa et al., 2018) and sporadic cultivation in southern Crete, Greece. The pest is already established in Sicily, Italy and in southern Spain (Andalusia). These areas are likely to represent over 95% of total EU mango production.

### 3.4.2.2. Climatic conditions affecting establishment

*A. tubercularis* is a thermophilic insect and is distributed mainly in areas with tropical and subtropical climates in Asia, Africa, Australia and the Americas. Moreover, it has also established in Southern Spain, Sicily (Italy) and Madeira Islands (Portugal). Figure 3 shows the World distribution of Köppen–Geiger climate types (Kottek et al., 2006) that occur in the EU and which occur in countries where *A. tubercularis* has been reported. Southern EU countries provide suitable climatic conditions for the establishment of *A. tubercularis* and it is already established in some of those areas, where mangoes are grown. It is unlikely that the insect could establish in the central and northern EU countries (Baufeld and Wilstermann, 2018) and if it did, the populations are likely to be small and have no impact. There is a possibility that *A. tubercularis* could occur in greenhouses and on indoor plantings in cooler areas.
3.4.3. Spread

Describe how the pest would be able to spread within the EU territory following establishment?

Natural spread by the first instars crawling or being carried by wind, other animals, or machinery, will occur locally and relatively slowly. All stages may be moved over long distances by the trade of infested plant materials (plants for planting, fruits and unripe fruits with attached twigs).

The spread of *A. tubercularis* over short distances is possible by the crawling of the first instar nymphs. This is probably facilitated by the wind which may transport crawlers to neighbouring plants. The white mango scale can also move with the help of wind, birds and insects (Teshale et al., 2019). Long-distance dispersal of white mango scale is also possible if infested plant materials (plants for planting, twigs or fruits) are transported outside of the infested areas (Anjulo, 2009; Teshale et al., 2019).

3.5. Impacts

Would the pests’ introduction have an economic or environmental impact on the EU territory?

Yes, *A. tubercularis* is a key pest of mango in many mango producing areas of the world including Andalusia (Spain) and management intervention is required to reduce losses. Losses could also be expected in other mango producing areas of the EU. There is very little or no information available on the impact of this pest on other economically important hosts, such as citrus and avocado.

*A. tubercularis* is a serious pest on mango in Australia, East and West Africa, North and South America, and the Caribbean Islands (Nabil et al., 2012). It has become a devastating pest to mango fruit in western Ethiopia (Ofgaa and Emana, 2015) where it has emerged to be the second most important mango pest after anthracnose disease (Anjulo, 2019). It also causes significant damages on mango in South Africa, and it is one of the most destructive pests of mango trees in Egypt (Bakry and Abdel-Baky, 2020). However, in Kenya it is not considered an important pest (Ofgaa et al., 2014).

The pest injures the shoots, twigs, leaves, branches and fruits of mango by sucking plant sap with the mouthparts, causing deformation, defoliation, drying up of young twigs, dieback, poor blossoming, death of twigs possibly by the action of toxic saliva (Abo-Shanab, 2012; Nabil et al., 2012; Sayed, 2012). Heavily infested fruits drop prematurely, and mature fruits are smaller in size, less juicy, rotten and unfit for commercial use (Bakr et al., 2009; Abo-Shanab, 2012; Lo Verde et al., 2020). On mature fruits, pink or pale blemishes develop around the scale feeding sites decreasing their commercial value, especially for the international export markets (Labuschagne et al., 1995).
Bienvenido et al. (2020) state that in Spain A. tubercularis can cause up to 50% loss of mango value due to downgrading. The presence of four to five scales per fruit is enough to downgrade the fruit. Severe attacks can result in defoliation. Mango producers incur management costs through chemical treatments to minimise impacts. A substantial amount of mango production in Spain is organic and organic producers need to manage A. tubercularis accordingly.

### 3.6. Available measures and their limitations

**Are there measures available to prevent pest entry, establishment, spread or impacts such that the risk becomes mitigated?**

Yes, although the existing phytosanitary measures identified in Section 3.3.2 do not specifically target A. tubercularis, they mitigate the likelihood of its entry into, establishment and spread within the EU.

### 3.6.1. Identification of potential additional measures

Phytosanitary measures (prohibitions) are currently applied to some host plants for planting (see Section 3.3.2). Additional potential risk reduction options and supporting measures are shown in Sections 3.6.1.1 and 3.6.1.2.

#### 3.6.1.1. Additional potential risk reduction options

Potential additional control measures are listed in Table 6.

**Table 6:** Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance.

| Control measure/Risk reduction option (Blue underline = Zenodo doc, Blue = WIP) | RRO summary | Risk element targeted (entry/establishment/spread/impact) |
|---|---|---|
| Growing plants in isolation | Plants could be grown in a dedicated facility such as an insect proof greenhouse. | Entry/Spread |
| Biological control and behavioural manipulation | The biological control of the species is feasible since there have been recorded 18 species of parasitoids and 50 species of predators of A. tubercularis (Del Pino et al., 2020). Generalist predators occur in the EU. Encarsia citrina Crawford (Hymenoptera: Aphelinidae) is one of the most common parasitoids of A. tubercularis worldwide and has been found in Andalusia (Del Pino et al., 2020). | Impact/Spread |
| Chemical treatments on crops including reproductive material | Used to mitigate likelihood of infestation of pests susceptible to chemical treatments. Many insecticides (organophosphates, pyrethroids and neonicotinoids) have been used successfully in reducing the A. tubercularis populations on mango trees (Kumari et al., 2014; Ayalew et al., 2015; Mendoza-Montero et al., 2017; Del Pino et al., 2020). However, the use of many of them has been banned in the EU and the application of these insecticides results in high mortality of pest’s natural enemies. Good results have also been reported by the use of mineral oils (Abo-Shanab, 2012) and of propylene glycol monolaurate and mineral oil (Mendoza-Montero et al., 2017). | Entry/ Establishment/Spread/Impact |
| Chemical treatments on consignments or during processing | Treatments can be applied to plants or to plant products after harvest, during process or packaging operations and storage. e.g. fumigation; spraying/dipping pesticides; surface disinfectants. | Entry/Spread |
3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 7.

Table 7: Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance

| Supporting measure | Summary | Risk element targeted (entry/establishment/spread/impact) |
|--------------------|---------|---------------------------------------------------------|
| **Inspection and trapping** | Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5). The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques. | Establishment/Spread |
| **Laboratory testing** | Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests. | Entry |
| **Sampling** | According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing | Entry |
| **Phytosanitary certificate and plant passport** | An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade) | Entry |
3.6.1.3. Biological or technical factors limiting the effectiveness of measures

- Due to its small size, A. tubercularis may not be easily detected in cases where low populations occur.
- A. tubercularis is polyphagous, making the inspections of all consignments containing hosts from countries where the pest occurs difficult.
- Limited number of registered active substances for use in mango against A. tubercularis.
- The waxy scale covering and sessile nature of the later instar nymphs and adult female A. tubercularis reduces the efficacy from treatments with contact insecticides.

3.7. Uncertainty

The main sources of uncertainty regarding the establishment and impact potential of A. tubercularis within the EU include:

- The magnitude of potential economic impact on hosts other than mango, given that there are no records of A. tubercularis causing damage in any other crop apart from mango.

4. Conclusions

A. tubercularis satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential UnionQP (Table 8).

Table 8: The Panel’s conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

| Criterion of pest categorisation | Panel’s conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest | Key uncertainties |
|----------------------------------|-------------------------------------------------|-------------------|
| Identity of the pest (Section 3.1) | The identity of the pest is established. Taxonomic keys based on morphology of female adults exist. | None |
| Absence/presence of the pest in the EU (Section 3.2) | The pest has a restricted distribution in the EU territory, it is present in southern Spain (Andalusia), southern Italy (Sicily) and Portugal (Madeira islands). | None |
| Pest potential for entry, establishment and spread in the EU (Section 3.4) | Aulacaspis tubercularis is able to enter into, become established, and spread within the EU territory. The main pathways are: – plants for planting (regulated, some of which are prohibited – fruits (regulated, except fruits of Cocos nucifera). | None |
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### Table: *Aulacaspis tubercularis*: Pest categorisation

| Criterion of pest categorisation | Panel’s conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest | Key uncertainties |
|----------------------------------|--------------------------------------------------------------------------------------------------|-------------------|
| **Potential for consequences in the EU (Section 3.5)** | *A. tubercularis* is a key pest of mango in Andalusia and management intervention is required to reduce losses. Losses could also be expected in other mango producing areas of the EU, where the pest is not present, such as Greece and the Azores. | None |
| **Available measures (Section 3.6)** | There are measures available to prevent the re-entry, establishment and spread of *A. tubercularis* within the EU. Risk reduction options include the inspections and physical treatments on consignments of fresh plant material from infested countries and the production of plants for import into the EU in pest free areas. | None |
| **Conclusion (Section 4)** | *A. tubercularis* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest. | |

Aspects of assessment to focus on/scenarios to address in future if appropriate:
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**Abbreviations**

DG SANTÉ  Directorate General for Health and Food Safety  
EPPO  European and Mediterranean Plant Protection Organization  
FAO  Food and Agriculture Organization  
IPPC  International Plant Protection Convention  
ISPM  International Standards for Phytosanitary Measures  
MS  Member State  
PLH  EFSA Panel on Plant Health  
PZ  protected zone  
TFEU  Treaty on the Functioning of the European Union  
ToR  Terms of Reference

**Glossary**

**Containment (of a pest)** Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 2021)

**Control (of a pest)** Suppression, containment or eradication of a pest population (FAO, 2021)

**Entry (of a pest)** Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2021)

**Eradication (of a pest)** Application of phytosanitary measures to eliminate a pest from an area (FAO, 2021)

**Establishment (of a pest)** Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2021)

**Greenhouse** A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material
and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment.

**Hitchhiker**
An organism sheltering or transported accidentally via inanimate pathways including with machinery, shipping containers and vehicles; such organisms are also known as contaminating pests or stowaways (Toy and Newfield, 2021).

**Impact (of a pest)**
The impact of the pest on the crop output and quality and on the environment in the occupied spatial units

**Introduction (of a pest)**
The entry of a pest resulting in its establishment (FAO, 2021)

**Pathway**
Any means that allows the entry or spread of a pest (FAO, 2021)

**Phytosanitary measures**
Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2021)

**Quarantine pest**
A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2021)

**Risk reduction option (RRO)**
A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager

**Spread (of a pest)**
Expansion of the geographical distribution of a pest within an area (FAO, 2021)
Appendix A – *Aulacaspis tubercularis* host plants/species affected

Host plants of *Aulacaspis tubercularis* based on García Morales et al. (2016) and Otieno (2021).

| Host status | Host name               | Plant family | Common name                                                                 | Reference                                      |
|-------------|-------------------------|--------------|------------------------------------------------------------------------------|------------------------------------------------|
| Cultivated hosts | Mangifera               | Anacardiaceae | Mango                                                                       | García Morales et al. (2016)                  |
|              | Mangifera indica        | Anacardiaceae | Mango                                                                       | García Morales et al. (2016)                  |
|              | Cocos                   | Areaceae     | Coconut                                                                     | García Morales et al. (2016)                  |
|              | Cocos nucifera          | Areaceae     | Pacific almond, canarium nut, pili nut, Java almond, Kenari nut, galip nut, nangai, ngali. | García Morales et al. (2016)                  |
|              | Canarium                | Burseraceae  |                                                                              |                                                 |
|              | Calophyllum inophyllum  | Calophyllaceae | Alexandrian laurel                                                           | García Morales et al. (2016)                  |
|              | Cucumis                 | Cucurbitaceae | Melons, cucumbers, gherkins                                                 | García Morales et al. (2016)                  |
|              | Cucurbita               | Cucurbitaceae | Pumpkin                                                                     | García Morales et al. (2016)                  |
|              | Cucurbita pepo          | Cucurbitaceae | Marrow                                                                      | García Morales et al. (2016)                  |
|              | Luffa                   | Cucurbitaceae | Chinese okra                                                                 | García Morales et al. (2016)                  |
|              | Acacia                  | Fabaceae     | Wattle, acacia                                                              | García Morales et al. (2016)                  |
|              | Acacia auriculiformis   | Fabaceae     | Northern black wattle, Australian babul, Australian wattle, coast wattle, ear leaf acacia, earpod black wattle, Papua wattle, Papuan wattle | García Morales et al. (2016)                  |
|              | Acacia mangium          | Fabaceae     | Brown salwood, black wattle, broadleaf salwood, hickory wattle, mangium, Sabah salwood, sally wattle | García Morales et al. (2016)                  |
|              | Dietes                  | Iridaceae    | Wood iris, fortnight lily, African iris, Japanese iris, butterfly iris       | García Morales et al. (2016)                  |
|              | Dietes iridioides       | Iridaceae    | African iris, fortnight lily, morea iris                                    | García Morales et al. (2016)                  |
|              | Cinnamomum              | Lauraceae    |                                                                              | García Morales et al. (2016)                  |
|              | Cinnamomum camphora     | Lauraceae    | Camphor, camphor tree, Japanese camphor, camphorwood, camphor laurel         | García Morales et al. (2016)                  |
|              | Cinnamomum cassia       | Lauraceae    | Chinese cassia, Chinese cinnamon                                            | García Morales et al. (2016)                  |
|              | Cinnamomum parthenoxylon| Lauraceae    | Selasian wood, saffrol laurel, Martaban camphor wood                        | García Morales et al. (2016)                  |
|              | Cinnamomum verum        | Lauraceae    | True cinnamon tree, ceylon cinnamon tree                                     | García Morales et al. (2016)                  |
| Host status | Host name           | Plant family | Common name                                                                 | Reference                      |
|-------------|---------------------|--------------|-----------------------------------------------------------------------------|--------------------------------|
| Laurus      | Lauraceae           |              | Laurel                                                                      | García Morales et al. (2016)   |
| Laurus nobilis | Lauraceae         |              | Bay tree, bay laurel, sweet bay, true laurel, Grecian laurel                | García Morales et al. (2016)   |
| Litsea      | Lauraceae           |              |                                                                             | García Morales et al. (2016)   |
| Litsea glutinosa | Lauraceae       |              | Soft bollygum, bolly beech, Bollywood, bolly gum, brown bollygum, brown      | García Morales et al. (2016)   |
| Persea      | Lauraceae           |              |                                                                             | García Morales et al. (2016)   |
| Persea americana | Lauraceae       |              | Avocado, avocado pear, alligator pear, holly ghost pear                    | García Morales et al. (2016)   |
| Aglaia      | Meliaceae           |              |                                                                             | García Morales et al. (2016)   |
| Xylocarpus granatum | Meliaceae     |              | Cannonball mangrove, cedar mangrove, puzzlenut tree                       | García Morales et al. (2016)   |
| Psidium     | Myrtaceae           |              | Guava                                                                      | García Morales et al. (2016)   |
| Ternstroemia | Pentaphylacaceae   |              |                                                                            | García Morales et al. (2016)   |
| Pittosporum | Pittosporaceae      |              | Pittosporum, cheesewood                                                   | García Morales et al. (2016)   |
| Pittosporum glabratum | Pittosporaceae |              |                                                                             | García Morales et al. (2016)   |
| Bruguiera sexangula | Rhizophoraceae |              | Upriver orange mangrove                                                    | García Morales et al. (2016)   |
| Rhizophora apiculata | Rhizophoraceae |              | True mangrove                                                              | García Morales et al. (2016)   |
| Prunus      | Rosaceae            |              | Stone fruit                                                                 | García Morales et al. (2016)   |
| Citrus      | Rutaceae            |              | Citrus                                                                     | García Morales et al. (2016)   |
| Dimocarpus  | Sapindaceae         |              |                                                                            | García Morales et al. (2016)   |
| Dimocarpus longan | Sapindaceae  |              | Longan tree                                                                | García Morales et al. (2016)   |
| Litchi      | Sapindaceae         |              |                                                                            | García Morales et al. (2016)   |
| Litchi chinensis | Sapindaceae  |              | Lichi, leechee, lici, litchee, litchi nut, litchia, lychee                 | García Morales et al. (2016)   |
| Nephelium   | Sapindaceae         |              | Rambutan                                                                   | García Morales et al. (2016)   |
| Illicium cambodianum | Schisandraceae |              | Star anise, anisetree                                                      | García Morales et al. (2016)   |
| Zingiber officinale | Zingiberaceae |              | Ginger, common ginger, garden ginger, true ginger                          | García Morales et al. (2016)   |
| Host status       | Host name                   | Plant family     | Common name                  | Reference                          |
|-------------------|----------------------------|------------------|------------------------------|-----------------------------------|
| Wild weed hosts   | Desmos                     | Annonaceae       |                              | García Morales et al. (2016)      |
|                   | Acer kawakamii             | Aceraceae        | Kawakami maple               | García Morales et al. (2016)      |
|                   | Shorea laxa                | Dipterocarpaceae | Yellow meranti                | García Morales et al., 2016       |
|                   | Polysoma                   | Escalloniaceae   |                              | García Morales et al., 2016       |
|                   | Dietes prolongata          | Iridaceae        |                              | Otiento et al., 2021              |
|                   | Actinodaphne sphaerocarpa  | Lauraceae        |                              | García Morales et al., 2016       |
|                   | Cinnamomum ceylanicum      | Lauraceae        |                              | Otieno (2021)                     |
|                   | Lindera                    | Lauraceae        | Spicewood, spicebush, benjamin bush | García Morales et al. (2016) |
|                   | Lindera nacusua            | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Lindera pipericarpa        | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Lindera pulcherima         | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Litsea monopetala          | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Litsea pungens             | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Machilus                   | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Machilus wangchiana        | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Neolitsea lanuginosa       | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Phoebe                     | Lauraceae        |                              | García Morales et al. (2016)      |
|                   | Gaiadendron                | Loranthaceae     |                              | García Morales et al. (2016)      |
|                   | Acer caudatiformis         | Sapindaceae      |                              | García Morales et al. (2016)      |
Appendix B – Distribution of *Aulacaspis tubercularis*

Distribution records based on the EPPO Global Database (EPPO, online), CABI (online) and García Morales et al. (2016) and other references.

| Region               | Country      | Sub-national (e.g. State) | Status                        | Reference                              |
|----------------------|--------------|---------------------------|-------------------------------|----------------------------------------|
| North America        | Mexico       | Present, restricted distribution | EPPO (online)                  |
|                      | Mexico       | Jalisco, Present, no details | García Morales et al. (2016)   |
|                      | Mexico       | Colima, Present, no details | García Morales et al. (2016)   |
|                      | Mexico       | Sinaloa, Present, no details | García Morales et al. (2016)   |
|                      | Mexico       | Nayarit, Present, no details | García Morales et al. (2016)   |
|                      | USA          | Present, few occurrences  | EPPO (online)                  |
|                      | USA          | Florida, Present, no details | EPPO (online)                  |
| Central America      | El Salvador  | Present, no details       | CABI (online)                  |
| Caribbean            | Antigua and Barbuda | Present, no details | EPPO (online)                  |
|                      | Aruba        | Present, no details       | EPPO (online)                  |
|                      | Barbados     | Present, no details       | EPPO (online)                  |
|                      | Dominican Republic | Present, no details | EPPO (online)                  |
|                      | Grenada      | Present, no details       | EPPO (online)                  |
|                      | Guadeloupe   | Present, no details       | EPPO (online)                  |
|                      | Haiti        | Present, no details       | EPPO (online)                  |
|                      | Jamaica      | Present, no details       | EPPO (online)                  |
|                      | Martinique   | Present, no details       | EPPO (online)                  |
|                      | Puerto Rico  | Present, no details       | EPPO (online)                  |
|                      | Saint Lucia  | Present, no details       | CABI (online)                  |
|                      | Trinidad and Tobago | Present, no details | EPPO (online)                  |
|                      | Virgin Islands (British) | Present, no details | EPPO (online)                  |
|                      | Virgin Islands (US) | Present, no details | EPPO (online)                  |
| South America        | Chile        | Present, no details       | EPPO (online)                  |
|                      | Argentina    | Present, restricted distribution | EPPO (online)                  |
|                      | Brazil       | Present, no details       | EPPO (online)                  |
|                      | Brazil       | Espirito Santo, Present, no details | EPPO (online)                  |
|                      | Brazil       | Goias, Present, no details | EPPO (online)                  |
|                      | Brazil       | Maranhao, Present, no details | EPPO (online)                  |
|                      | Brazil       | Minas Gerais, Present, no details | EPPO (online)                  |
|                      | Brazil       | Rio de Janeiro, Present, no details | EPPO (online)                  |
|                      | Brazil       | Rio Grande do Sul, Present, no details | EPPO (online)                  |
|                      | Brazil       | Sao Paulo, Present, no details | EPPO (online)                  |
|                      | Brazil       | Bahia, Present, no details | García Morales et al. (2016)   |
|                      | Brazil       | Pernambuco, Present, no details | García Morales et al. (2016)   |
|                      | Colombia     | Present, no details       | EPPO (online)                  |
|                      | Guyana       | Present, no details       | García Morales et al. (2016)   |
|                      | Suriname     | Present, no details       | EPPO (online)                  |
|                      | Venezuela    | Present, no details       | EPPO (online)                  |
| Region | Country | Sub-national (e.g. State) | Status | Reference |
|--------|---------|--------------------------|--------|-----------|
| EU (27) | Italy | Present, few occurrences | EPPO (online) |
| | Sicilia | Present, few occurrences | EPPO (online) |
| | Portugal | Present, restricted distribution | EPPO (online) |
| | Madeira | Present, no details | EPPO (online) |
| | Spain | Present, restricted distribution | EPPO (online) |
| | Canary Islands | Present, restricted distribution | EPPO (online) |
| | Andalusia | Present, restricted distribution | Del Pino et al., 2021 |
| Africa | Benin | Present, no details | EPPO (online) |
| | Cote d'Ivoire | Present, no details | EPPO (online) |
| | Egypt | Present, no details | EPPO (online) |
| | Ethiopia | Present, no details | EPPO (online) |
| | Gambia | Present, no details | EPPO (online) |
| | Ghana | Present, no details | EPPO (online) |
| | Kenya | Present, no details | EPPO (online) |
| | Liberia | Present, no details | EPPO (online) |
| | Madagascar | Present, no details | EPPO (online) |
| | Malawi | Present, no details | EPPO (online) |
| | Mauritius | Present, no details | EPPO (online) |
| | Mozambique | Present, no details | EPPO (online) |
| | Reunion | Present, no details | EPPO (online) |
| | Seychelles | Present, no details | EPPO (online) |
| | Sierra Leone | Present, no details | EPPO (online) |
| | South Africa | Present, no details | EPPO (online) |
| | Tanzania | Present, no details | EPPO (online) |
| | Tanzania Zanzibar Island | Present, no details | CABI (online) |
| | Togo | Present, no details | EPPO (online) |
| | Uganda | Present, no details | EPPO (online) |
| | Zambia | Present, no details | EPPO (online) |
| | Zimbabwe | Present, no details | EPPO (online) |
| Asia | China | Present, no details | EPPO (online) |
| | China Guangdong | Present, no details | EPPO (online) |
| | China Hainan | Present, no details | EPPO (online) |
| | China Sichuan | Present, no details | EPPO (online) |
| | China Hong Kong | Present, no details | EPPO (online) |
| | India | Present, no details | EPPO (online) |
| | India Bihar | Present, no details | Garcia Morales et al. 2016 |
| | India Andaman and Nicobar Islands | Present, no details | EPPO (online) |
| | India Andhra Pradesh | Present, no details | EPPO (online) |
| | India Himachal Pradesh | Present, no details | EPPO (online) |
| | India Karnataka | Present, no details | EPPO (online) |
| | India Kerala | Present, no details | EPPO (online) |
| | India Uttar Pradesh | Present, no details | EPPO (online) |
| Region | Country       | Sub-national (e.g. State)                  | Status               | Reference                                      |
|--------|---------------|--------------------------------------------|----------------------|------------------------------------------------|
| India  | Gujarat       | Present, no details                        | CABI (online)        |
| India  | Haryana       | Present, no details                        | CABI (online)        |
| India  | Sikkim        | Present, no details                        | García Morales et al. (2016) |
| India  | Tamil Nadu    | Present, no details                        | García Morales et al. (2016) |
| India  | West Bengal   | Present, no details                        | García Morales et al. (2016) |
| Indonesia | Java   | Present, no details                        | EPPO (online)        |
| Indonesia | Java   | Present, no details                        | EPPO (online)        |
| Indonesia | Borneo  | Present, no details                        | CABI (online)        |
| Iraq   |               | Present, no details                        | EPPO (online)        |
| Israel |               | Present, no details                        | EPPO (online)        |
| Japan  |               | Present, no details                        | EPPO (online)        |
| Laos   |               | Present, no details                        | CABI (online)        |
| Malaysia | West    | Present, no details                        | EPPO (online)        |
| Malaysia | Peninsular Malaysia | Present, no details | CABI (online) |
| Malaysia | Sabah     | Present, no details                        | CABI (online)        |
| Malaysia | Sarawak   | Present, no details                        | CABI (online)        |
| Malaysia | Malaya    | Present, no details                        | García Morales et al., 2016 |
| Myanmar|               | Present, no details                        | EPPO (online)        |
| Nepal  |               | Present, no details                        | CABI (online)        |
| Pakistan |          | Present, no details                        | EPPO (online)        |
| Philippines |      | Present, no details                        | EPPO (online)        |
| Sri Lanka |          | Present, no details                        | EPPO (online)        |
| Taiwan |               | Present, no details                        | EPPO (online)        |
| Thailand |            | Present, no details                        | EPPO (online)        |
| Vietnam |               | Present, no details                        | EPPO (online)        |
| Andaman Islands |         | Present, no details                        | García Morales et al., 2016 |
| Oceania | Australia     | Present, no details                        | EPPO (online)        |
| Australia | Northern Territory | Present, no details   | EPPO (online) |
| Australia | Queensland   | Present, no details                        | EPPO (online)        |
| Australia | Western Australia | Present, no details | EPPO (online) |
| New Caledonia |          | Present, restricted distribution           | EPPO (online)        |
| Papua New Guinea |         | Present, no details                        | CABI (online)        |
| Vanuatu |               | Present, no details                        | EPPO (online)        |
### Appendix C – Import data

**Table C.1:** Fresh or dried citrus (CN code: 0805) imported in 100 kg into the EU (27) from regions where *Aulacaspis tubercularis* is known to occur (Source: Eurostat accessed on 10 December 2021)

| Country                  | 2016           | 2017           | 2018           | 2019           | 2020           |
|--------------------------|----------------|----------------|----------------|----------------|----------------|
| Antigua and Barbuda      | 2,412,706.76   | 1,913,772.23   | 2,242,298.89   | 1,585,087.09   | 1,403,348.80   |
| Argentina                | 3,279.84       | 1,284.38       | 644.97         | 10,645.40      | 2,343.47       |
| Brazil                   | 864,863.09     | 903,432.95     | 900,907.24     | 822,134.46     | 902,583.06     |
| China                    | 827,840.57     | 1,084,857.27   | 1,024,163.15   | 1,108,595.22   | 1,098,689.98   |
| Colombia                 | 44,825.37      | 79,400.99      | 123,887.46     | 136,914.85     | 172,197.70     |
| Dominican Republic       | 11,178.95      | 9,336.81       | 10,426.97      | 7,355.36       | 12,886.58      |
| Egypt                    | 1,931,586.64   | 2,246,998.88   | 2,643,272.02   | 2,206,932.71   | 2,850,745.77   |
| Ghana                    | 280.09         | 348.28         | 99.50          |                |                |
| Guyana                   |                |                |                | 24.00          |                |
| Haiti                    | 207.41         | 176.53         | 72.10          | 31.00          | 248.29         |
| India                    | 246.80         | 1.00           | 449.63         | 88.51          | 254.95         |
| Indonesia                | 566.73         | 555.70         | 779.35         | 836.73         | 864.54         |
| Iraq                     | 3.60           | 11.20          | 0.30           | 20.00          |                |
| Israel                   | 799,118.49     | 969,403.62     | 824,601.66     | 812,738.57     | 878,713.18     |
| Japan                    | 352.58         | 417.44         | 270.73         | 319.24         | 162.50         |
| Jamaica                  | 3,633.97       | 3,325.11       | 675.68         | 2,409.55       | 1,646.87       |
| Kenya                    |                |                | 8.80           |                | 34.56          |
| Laos                     | 51.94          | 2.10           |                |                | 20.23          |
| Madagascar               | 2.70           | 26.42          | 11.62          | 7.16           | 22.16          |
| Mauritius                | 213.74         | 14.00          |                |                | 7.35           |
| Mexico                   | 570,402.80     | 553,818.66     | 589,021.12     | 443,743.54     | 349,648.63     |
| Malaysia                 | 4.18           | 39.02          | 83.45          | 7.71           |                |
| Nepal                    |                |                | 1,170.00       |                |                |
| Pakistan                 |                |                | 2.45           | 0.59           |                |
| Philippines              |                |                | 0.20           | 7.71           | 0.10           |
| El Salvador              | 36.83          | 35.77          | 4.76           |                |                |
| Thailand                 | 426.42         | 1,283.13       | 659.74         | 624.93         | 194.87         |
| Taiwan                   | 157.49         |                |                |                |                |
| Tanzania                 | 179.90         | 190.01         | 144.12         | 35.95          | 75.50          |
| Venezuela                | 744.08         | 2,216.36       | 681.07         |                |                |
| South Africa             | 5,278,830.95   | 5,802,017.61   | 6,381,124.73   | 6,196,837.96   | 7,830,147.60   |
| Zimbabwe                 | 297,550.62     | 328,595.48     | 397,906.49     | 348,303.06     | 391,868.70     |
| Uganda                   | 3.99           | 4.16           | 6.81           | 7.35           | 11.88          |
| United States            | 301,229.06     | 231,210.47     | 185,706.99     | 177,755.45     | 148,608.92     |
Table C.2: Fresh or dried guavas, mangoes and mangosteens (CN code: 080450) imported in 100 kg into the EU (27) from regions where *Aulacaspis tubercularis* is known to occur (Source: Eurostat accessed on 10 December 2021)

| Country                  | 2016     | 2017     | 2018     | 2019     | 2020     |
|--------------------------|----------|----------|----------|----------|----------|
| Antigua and Barbuda      | 193.61   |          |          |          |          |
| Argentina                | 14.40    |          |          |          |          |
| Australia                | 25.72    | 94.18    | 62.92    |          |          |
| Benin                    | 26.40    |          |          |          | 226.79   |
| Brazil                   | 1,025,325.37 | 1,158,717.06 | 1,241,860.63 | 1,437,569.20 | 1,577,043.99 |
| China                    | 38.95    | 51.87    | 180.81   | 78.23    | 104.34   |
| Colombia                 | 2,321.38 | 2,553.75 | 3,139.67 | 6,833.02 | 4,131.75 |
| Dominican Republic       | 96,728.22 | 85,119.28 | 105,553.46 | 118,508.00 | 110,481.33 |
| Egypt                    | 4,135.64 | 9,186.69 | 4,855.57 | 6,407.46 | 12,233.16 |
| Ghana                    | 8,896.27 | 9,114.51 | 106,72.35 | 11,138.06 | 30,296.55 |
| Haiti                    | 4.87     |          |          |          |          |
| India                    | 5,989.34 | 8,148.87 | 9,470.36 | 9,315.51 | 7,347.61 |
| Indonesia                | 1,981.20 | 2,004.36 | 2,926.64 | 2,386.27 | 1,406.94 |
| Israel                   | 143,726.08 | 140,551.30 | 108,353.48 | 121,875.16 | 98,143.59 |
| Japan                    | 0.66     |          |          |          | 0.01     |
| Kenya                    | 232.06   | 4.08     | 65.09    | 10.30    | 66.53    |
| Laos                     | 753.34   | 620.36   | 603.14   | 806.50   | 525.32   |
| Madagascar               | 246.94   | 22.10    | 15.02    | 0.66     | 1.05     |
| Malawi                   |          |          |          |          | 648.00   |
| Mexico                   | 35,095.07 | 40,848.36 | 46,001.68 | 50,935.79 | 51,841.89 |
| Malaysia                 | 289.86   | 197.22   | 170.64   | 72.72    | 44.56    |
| Myanmar (Burma)          | 0.28     | 1.47     | 1.00     |          |          |
| Mozambique               | 122.61   | 126.65   | 134.13   |          |          |
| Pakistan                 | 17,149.78 | 15,912.58 | 21,867.43 | 29,207.33 | 16,196.50 |
| Philippines              | 1,028.05 | 519.88   | 795.56   | 368.97   | 128.10   |
| Sierra Leone             | 4.99     |          | 55.06    |          |          |
| Thailand                 | 6,460.81 | 7,401.80 | 6,911.89 | 6,743.91 | 5,260.84 |
| Taiwan                   | 3.48     |          | 17.34    | 0.92     |          |
| Tanzania                 | 0.50     |          | 1.14     |          |          |
| Venezuela                | 2,917.57 | 2,033.75 | 2,401.44 | 1,939.11 | 282.69   |
| South Africa             | 8,550.13 | 13,015.45 | 9,739.99 | 12,116.95 | 8,656.28 |
| Zambia                   | 2.46     |          |          | 23.04    |          |
| Uganda                   | 257.30   | 452.71   | 360.01   | 662.25   | 389.56   |
| United States            | 78,874.11 | 45,478.21 | 54,660.34 | 82,580.54 | 82,852.21 |

*Aulacaspis tubercularis*: Pest categorisation

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Table C.3: Coconuts, Brazil nuts and cashew nuts. fresh or dried, whether or not shelled or peeled (CN code: 0801) imported in 100 kg into the EU (27) from regions where Aulacaspis tubercularis is known to occur (Source: Eurostat accessed on 13 December 2021)

| Country            | 2016     | 2017     | 2018     | 2019     | 2020     |
|--------------------|----------|----------|----------|----------|----------|
| Argentina          | 6,351.16 | 3.36     |          |          |          |
| Australia          | 326.68   | 161.34   | 3.97     | 3.09     | 0.02     |
| Benin              | 3,230.85 | 2,034.22 | 2,584.36 | 8,774.77 | 11,418.80|
| Brazil             | 36,419.17| 28,181.64| 51,378.25| 59,924.59| 75,715.61|
| Chile              | 2,615.82 | 180.28   | 4,103.40 | 382.01   | 3,141.93 |
| China              | 1,409.93 | 1,078.20 | 995.67   | 1,091.95 | 3,073.07 |
| Colombia           | 449.85   | 4.91     | 480.00   | 0.62     |          |
| Dominican Republic | 1,350.04 | 1,731.11 | 2,313.84 | 594.68   | 467.96   |
| Egypt              | 4.20     | 3.23     | 2.77     | 14.96    | 0.84     |
| Ghana              | 10,890.16| 11,671.46| 9,733.90 | 15,089.42| 20,769.02|
| Gambia             | 31.67    | 14.00    | 21.52    |          |          |
| India              | 170,399.32| 243,346.77| 192,497.06| 205,693.06| 172,138.65|
| Iraq               | 0.02     | 10.11    | 23.16    |          |          |
| Indonesia          | 255,797.58| 287,011.09| 302,686.51| 259,519.02| 238,720.48|
| Israel             | 2.40     | 12.32    | 4.95     | 2.36     | 11.16    |
| Kenya              | 17.01    | 696.35   | 57.73    | 244.49   | 1,191.89 |
| Laos               | 0.09     | 280.00   | 0.23     |          |          |
| Madagascar         | 615.99   | 624.94   | 783.06   | 426.35   | 524.37   |
| Malaysia           | 5,507.22 | 8,394.49 | 4,041.78 | 2,329.06 | 4,411.77 |
| Mauritius          | 8.15     | 1.76     | 0.2      |          |          |
| Mexico             | 15.38    | 0.48     | 0.05     | 0.25     | 0.10     |
| Mozambique         | 15,031.71| 7,490.17 | 10,508.99| 16,038.30| 12,972.32|
| Myanmar            | 0.15     | 10.00    |          |          |          |
| Pakistan           | 63.15    | 11.50    | 22.53    | 24.60    | 25.70    |
| Philippines        | 368,573.57| 419,893.07| 419,609.28| 398,109.92| 395,721.76|
| Sierra Leone       | 120.00   | 0.21     | 0.10     |          |          |
| El Salvador        | 2.00     | 90.71    | 86.73    |          | 81.87    |
| South Africa       | 1.24     | 103.64   | 0.50     | 0.79     | 205.46   |
| Suriname           | 71.21    | 58.90    | 57.38    | 0.10     |          |
| Thailand           | 79,261.58| 78,956.34| 68,012.09| 59,013.35| 35,161.47|
| Taiwan             | 14.36    | 3.40     |          |          |          |
| Tanzania           | 1,889.75 | 2,570.78 | 1,197.66 | 1,931.29 | 1,800.05 |
| United States      | 2,447.78 | 1,994.95 | 1,377.75 | 511.55   | 845.48   |
| Uganda             | 2.07     | 2.99     | 3.61     | 1.90     |          |
| Venezuela          | 317.52   |          |          |          |          |
| Virgin Islands     | 635.04   | 158.76   | 635.04   | 158.76   |          |
| Viet Nam           | 761,279.37| 798,319.82| 818,389.73| 967,893.87| 1,177,974.48|
| Vanuatu            | 158.76   |          |          |          |          |
### Table C.4: Fresh or dried avocados (CN code: 080440) imported in 100 kg into the EU (27) from regions where *Aulacaspis tubercularis* is known to occur (Source: Eurostat accessed on 10 December 2021)

| Country          | 2016   | 2017   | 2018   | 2019   | 2020   |
|------------------|--------|--------|--------|--------|--------|
| Argentina        | 950.00 |        |        |        |        |
| Brazil           | 44,357.36 | 71,040.50 | 68,697.61 | 78,673.73 | 48,183.83 |
| China            | 193.97 | 35.28  | 1.23   | 0.04   |        |
| Colombia         | 152,115.55 | 210,139.60 | 251,050.33 | 387,367.23 | 663,148.97 |
| Dominican Republic | 53,962.41 | 55,001.50 | 52,897.18 | 95,531.91 | 100,024.05 |
| Egypt            | 211.20 | 5.35   | 4.58   | 79.92  | 363.95 |
| Ethiopia         | 110.19 | 137.32 | 310.59 | 11.78  | 35.83  |
| Ghana            | 18.48  | 134.58 | 22.64  | 40.45  | 21.88  |
| India            | 0.04   | 2.06   | 0.52   | 0.06   |        |
| Israel           | 301,123.91 | 424,267.97 | 370,378.23 | 437,318.01 | 345,664.24 |
| Kenya            | 228,426.16 | 243,947.31 | 404,593.87 | 346,231.90 | 435,308.72 |
| Madagascar       |        |        | 0.96   |        |        |
| Mauritius        | 124.44 | 36.13  | 42.27  | 24.28  | 15.23  |
| Mexico           | 503,687.52 | 445,611.06 | 463,741.28 | 767,878.48 | 716,092.02 |
| Malaysia         |        |        | 47.04  |        |        |
| Mozambique       |        | 559.80 | 1,294.13 | 7,134.23 | 8,014.81 |
| Thailand         | 3.68   | 9.76   | 9.66   | 9.06   | 3.39   |
| Tanzania         | 26,823.05 | 25,773.58 | 55,517.16 | 60,480.96 | 50,769.74 |
| Venezuela        | 0.09   | 233.40 | 111.12 | 71.29  |        |
| South Africa     | 419,768.89 | 315,854.56 | 652,817.98 | 401,352.79 | 416,290.22 |
| Zambia           |        |        | 53.68  |        |        |
| Zimbabwe         | 130,30.06 | 20,378.85 | 36,539.24 | 32,020.52 | 38,872.63 |
| Uganda           | 1,912.57 | 2,195.25 | 2,233.81 | 3,364.25 | 3,575.70 |
| United States    | 8,819.53 | 1.19   | 2,546.86 | 0.02   | 4.66   |

### Table C.5: Apricots, cherries, peaches incl. nectarines, plums and sloes, fresh (CN code: 0809) imported in 100 kg into the EU (27) from regions where *Aulacaspis tubercularis* is known to occur (Source: Eurostat accessed on 10 December 2021)

| Country          | 2016   | 2017   | 2018   | 2019   | 2020   |
|------------------|--------|--------|--------|--------|--------|
| Argentina        | 7,231.35 | 7,695.92 | 13,271.11 | 7,692.29 | 8,620.46 |
| Australia        | 373.51 | 378.21 | 487.00 | 372.26 | 631.59 |
| Brazil           | 183.53 | 356.14 | 22.65 | 40.40 |        |
| China            | 0.90   | 3.24   |        |        |        |
| Colombia         | 230.90 | 211.68 |        |        |        |
| Egypt            | 2,586.73 | 2,450.75 | 909.77 | 1,457.95 | 906.27 |
| India            | 0.45   |        |        |        |        |
| Israel           | 632.55 | 419.54 | 91.11 | 46.42 | 3.80 |
| Japan            | 0.86   | 1.00   | 2.82  |        |        |
| Mauritius        |        |        |        |        | 67.75 |
| Mexico           |        |        |        |        | 140.00 |
| Malaysia         |        |        |        |        | 1.78 |
| Pakistan         | 5.10   | 0.50   | 1.20   | 1.36   | 4.40 |
| Thailand         | 7.34   | 0.85   | 0.28   | 32.98  |        |
| South Africa     | 307,820.44 | 321,979.30 | 297,609.30 | 242,780.96 | 271,615.89 |
| Zimbabwe         | 261.12 | 148.46 | 23.52 | 11.94 | 0.12 |
| United States    | 453.30 | 4,303.88 | 1,741.06 | 923.44 | 216.12 |
Table C.6: Fresh melons (excl. watermelons) (CN code: 080719) imported in 100 kg into the EU (27) from regions where *Aulacaspis tubercularis* is known to occur (Source: Eurostat accessed on 10 December 2021)

| Country          | 2016       | 2017       | 2018       | 2019       | 2020       |
|------------------|------------|------------|------------|------------|------------|
| Argentina        | 564.00     |            | 171.64     |            |            |
| Brazil           | 1,502,128.30 | 1,656,430.83 | 1,709,558.65 | 1,625,992.77 | 1,648,465.15 |
| China            | 4.00       |            | 158.00     |            |            |
| Colombia         |            |            | 218.76     |            | 27.56      |
| Dominican Republic | 4,438.77   | 4,377.46   | 3,156.55   | 2,242.51   | 1,041.49   |
| Egypt            | 1,516.68   | 1,037.42   | 3,010.96   | 2,310.98   | 2,817.34   |
| Ghana            | 4.20       | 1,799.76   |            | 0.85       | 9.88       |
| India            | 0.01       | 158.00     | 0.75       |            | 0.52       |
| Israel           | 6308.05    | 2812.40    | 119.77     | 244.39     | 29.52      |
| Japan            | 4.12       | 0.36       | 9.37       | 3.21       | 12.88      |
| Laos             | 0.38       | 0.47       |            |            |            |
| Mexico           |            | 23.91      | 27.85      | 2.25       | 5.86       |
| Malaysia         | 1,443.99   | 1.63       |            | 0.60       |            |
| Pakistan         | 35.39      | 71.88      | 9.11       | 1.01       |            |
| Thailand         | 65.02      | 41.40      | 17.02      | 33.77      | 0.06       |
| South Africa     | 23,473.14  | 51,784.68  | 17,080.91  | 27,547.46  | 13,724.83  |
| Uganda           | 4.32       | 5.40       | 1.80       |            |            |
| United States    | 221.80     | 1.97       | 2.35       |            | 0.10       |

Table C.7: Fresh or chilled pumpkins, squash and gourds ‘*Cucurbita* spp.’ (CN code: 070993) imported in 100 kg into the EU (27) from regions where *Aulacaspis tubercularis* is known to occur (Source: Eurostat accessed on 10 December 2021)

| Country          | 2016        | 2017        | 2018        | 2019        | 2020        |
|------------------|-------------|-------------|-------------|-------------|-------------|
| Argentina        | 35,650.38   | 41,755.68   | 39,686.56   | 27,438.57   | 48,953.86   |
| Brazil           | 4,941.92    | 8,703.47    | 21,454.98   | 26,141.53   | 53,595.35   |
| China            | 2,984.90    | 3,712.73    | 3,691.38    | 3,029.60    | 2,674.09    |
| Colombia         | 87.80       | 247.00      | 749.98      |            |             |
| Dominican Republic | 752.87     | 1,143.55    | 941.13      | 746.09      | 486.49      |
| Egypt            | 9,250.66    | 18,183.52   | 27,167.43   | 17,111.09   | 27,553.57   |
| Ghana            | 11.93       | 3.08        | 416.00      | 10.59       | 18.42       |
| Grenada          |            |             | 8.82        |            |             |
| Haiti            | 14.50       | 26.00       | 27.02       |            |             |
| India            | 1,517.85    | 1,742.50    | 24,076.7    | 1,433.35    | 1,514.03    |
| Israel           | 3,509.40    | 4,648.08    | 4,671.33    | 2,307.44    | 1,742.04    |
| Japan            | 6.53        | 2.34        | 3.66        | 8.35        | 20.42       |
| Jamaica          |            |             |            | 3.82        |             |
| Kenya            | 242.52      | 478.20      | 234.60      | 69.41       | 387.74      |
| Laos             | 0.72        | 1.04        |            | 0.17        |             |
| Madagascar       |            |             | 312.65      | 5.16        | 20.60       |
| Mauritius        | 0.50        |             |            |             |             |
| Mexico           | 5,964.65    | 4,573.80    | 5,977.44    | 2,262.99    | 6,575.05    |
| Malaysia         | 40.30       | 8.67        |            |             |             |
| Nepal            | 1.20        |             |            |             |             |
| Pakistan         | 1,215.53    | 1,433.31    | 1,904.34    | 1,554.71    | 1,061.31    |
| Thailand         | 35.79       | 35.81       | 33.67       | 242.76      | 30.14       |
| Taiwan           | 60.00       |             |            |             |             |
| Country        | 2016     | 2017     | 2018     | 2019     | 2020     |
|---------------|----------|----------|----------|----------|----------|
| Tanzania      | 0.20     |          |          | 0.07     |          |
| South Africa  | 40,523.42| 51,408.54| 72,015.54| 55,537.38| 120,122.00|
| Zimbabwe      | 75.87    | 7.55     |          |          |          |
| Uganda        | 28.77    | 52.65    | 71.60    | 15.13    | 24.21    |
| United States | 2.64     | 4.80     | 0.94     | 10.94    | 9.48     |