European Food Safety Authority

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SCIENTIFIC OPINION

Scientific Opinion on the pest categorisation of *Aonidiella citrina*[1]

EFSA Panel on Plant Health (PLH)[2,3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

The Panel on Plant Health undertook a pest categorisation for the scale insect *Aonidiella citrina* for the European Union. *A. citrina* is a distinct species, but examination with a microscope is required to distinguish it from *A. aurantii*, which is also a citrus pest originating from Asia, but is much more widespread in southern Europe and far more damaging than *A. citrina*. *A. citrina* was first found in Europe in 1994 but has been recorded only in Italy, France and Greece. It is primarily a citrus pest, but has been found in association with a variety of other plant genera. Southern areas of the EU, where citrus plants are cultivated, are potentially suitable for outdoor establishment of *A. citrina*. The pest has not been recorded in protected cultivation. No serious impacts of *A. citrina* have been recorded in Europe, and an integrated pest management programme, combining chemical and biological controls, is considered to be effective. *A. citrina* is an insect listed in Annex IIAI of Council Directive 2000/29/EC in relation to its main hosts: *Citrus*, *Fortunella* and *Poncirus* plants. These hosts are also regulated in Annex III and Annex V and are explicitly mentioned in Council Directive 2008/90/EC.

KEY WORDS

Citrus yellow scale, entomology, exotic insects, invasion ecology, pest biology, phytosanitary regulations, plant health

[1] On request from the European Commission, Question No EFSA-Q-2014-00267, adopted on 27 November 2014.

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[3] The Panel wishes to thank the members of the Working Group on Directive 2000/29 Insects, Richard Baker, Gianni Gilioli and Gritta Schrader, for the preparatory work on this scientific opinion, and EFSA staff, Sara Tramontini and Sybren Vos, for the support provided to this scientific opinion.

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The current European Union plant health regime is established by Council Directive 2000/29/EC on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community (OJ L 169, 10.7.2000, p. 1).

The Directive lays down, amongst others, the technical phytosanitary provisions to be met by plants and plant products and the control checks to be carried out at the place of origin on plants and plant products destined for the Union or to be moved within the Union, the list of harmful organisms whose introduction into or spread within the Union is prohibited and the control measures to be carried out at the outer border of the Union on arrival of plants and plant products.

The Commission is currently carrying out a revision of the regulatory status of organisms listed in the Annexes of Directive 2000/29/EC. This revision targets mainly organisms which are already locally present in the EU territory and that in many cases are regulated in the EU since a long time. Therefore it is considered to be appropriate to evaluate whether these organisms still deserve to remain regulated under Council Directive 2000/29/EC, or whether, if appropriate, they should be regulated in the context of the marketing of plant propagation material, or be deregulated. The revision of the regulatory status of these organisms is also in line with the outcome of the recent evaluation of the EU Plant Health Regime, which called for a modernisation of the system through more focus on prevention and better risk targeting (prioritisation).

In order to carry out this evaluation, a recent pest risk analysis is needed which takes into account the latest scientific and technical knowledge on these organisms, including data on their agronomic and environmental impact, as well as their present distribution in the EU territory. In this context, EFSA has already been asked to prepare risk assessments for some organisms listed in Annex IIAII. The current request concerns 23 additional organisms listed in Annex II, Part A, Section II as well as five organisms listed in Annex I, Part A, Section I, one listed in Annex I, Part A, Section II and nine organisms listed in Annex II, Part A, Section I of Council Directive 2000/29/EC. The organisms in question are the following:

Organisms listed in Annex II, Part A, Section II:

- *Ditylenchus destructor* Thorne
- *Circulifer haematoceps*
- *Circulifer tenellus*
- *Helicoverpa armigera* (Hübner)
- *Radopholus similis* (Cobb) Thorne (could be addressed together with the IIAI organism *Radopholus citrophilus* Huettel Dickson and Kaplan)
- *Paysandisia archon* (Burmeister)
- *Clavibacter michiganensis* spp. *insidiosus* (McCulloch) Davis et al.
- *Erwinia amylovora* (Burr.) Winsl. et al. (also listed in Annex IIB)
- *Pseudomonas syringae* pv. *persicae* (Prunier et al.) Young et al.
- *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye
- *Xanthomonas campestris* pv. *pruni* (Smith) Dye
- *Xylophilus ampelinus* (Panagopoulos) Willems et al.
- *Ceratocystis fimbriata* f. sp. *platani* Walter (also listed in Annex IIB)
- *Cryphonectria parasitica* (Murrill) Barr (also listed in Annex IIB)
- *Phoma tracheiphila* (Petri) Kanchaveli and Gikashvili
- *Verticillium albo-atrum* Reinke and Berthold
- *Verticillium dahliae* Klebahn
- Beet leaf curl virus
- Citrus tristeza virus (European isolates) (also listed in Annex IIB)
- Grapevine flavescence dorée MLO (also listed in Annex IIB)

- Potato stolbur mycoplasma
- *Spiroplasma citri* Saglio et al.
- Tomato yellow leaf curl virus

Organisms listed in Annex I, Part A, Section I:

- *Rhagoletis cingulata* (Loew)
- *Rhagoletis ribicola* Doane
- Strawberry vein banding virus
- Strawberry latent C virus
- Elm phloem necrosis mycoplasm

Organisms listed in Annex I, Part A, Section II:

- *Spodoptera littoralis* (Boisd.)

Organisms listed in Annex II, Part A, Section I:

- *Aculops fuchsiae* Keifer
- *Aonidiella citrina* Coquillet
- Prunus necrotic ringspot virus
- Cherry leafroll virus
- *Radopholus citrophilus* Huettel Dickson and Kaplan (could be addressed together with IIAII organism *Radopholus similis* (Cobb) Thorne
- *Scirtothrips dorsalis* Hood
- *Atropellis* spp.
- *Eotetranychus lewisi* McGregor
- *Diaporthe vaccinii* Shear.

TERMS OF REFERENCE AS PROVIDED BY THE EUROPEAN COMMISSION

EFSA is requested, pursuant to Article 29(1) and Article 22(5) of Regulation (EC) No 178/2002, to provide a pest risk assessment of *Ditylenchus destructor* Thorne, *Circulifer haematoceps, Circulifer tenellus, Helicoverpa armigera* (Hübner), *Radopholus similis* (Cobb) Thorne, *Paysandisia archon* (Burmeister), *Clavibacter michiganensis* spp. *insidiosus* (McCulloch) Davis et al., *Erwinia amylovora* (Burr.) Winsl. et al., *Pseudomonas syringae pv. persicae* (Prunier et al.*)* Young et al. *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye, *Xanthomonas campestris* pv. *pruni* (Smith) Dye, *Xyîophilus ampelinus* (Panagopoulos) Willems et al., *Ceratocystis fimbriata* f. sp. *platani* Walter, *Cryphonectria parasitica* (Murrill) Barr, *Phoma tracheiphila* (Petri) Kanchaveli and Gikashvili, *Verticillium alboatrum* Reinke and Berthold, *Verticillium dahliae* Klebahn, Beet leaf curl virus, Citrus tristeza virus (European isolates), Grapevine flavescence dorée MLO, Potato stolbur mycoplasma, *Spiroplasma citri* Saglio et al., Tomato yellow leaf curl virus, *Rhagoletis cingulata* (Loew), *Rhagoletis ribicola* Doane, Strawberry vein banding virus, Strawberry latent C virus, Elm phloem necrosis mycoplasma, *Spodoptera littoralis* (Boisd.), *Aculops fuchsiae* Keifer, *Aonidiella citrina* Coquillet, Prunus necrotic ringspot virus, Cherry leafroll virus, *Radopholus citrophilus* Huettel Dickson and Kaplan (to address with the IIAII *Radopholus similis* (Cobb) Thorne), *Scirtothrips dorsalis* Hood, *Atropellis* spp., *Eotetranychus lewisi* McGregor and *Diaporthe vaccinii* Shear, for the EU territory.

In line with the experience gained with the previous two batches of pest risk assessments of organisms listed in Annex II, Part A, Section II, requested to EFSA, and in order to further streamline the preparation of risk assessments for regulated pests, the work should be split in two stages, each with a specific output. EFSA is requested to prepare and deliver first a pest categorisation for each of these 38 regulated pests (step 1). Upon receipt and analysis of this output, the Commission will inform EFSA for which organisms it is necessary to complete the pest risk assessment, to identify risk reduction options and to provide an assessment of the effectiveness of current EU phytosanitary requirements (step 2). *Clavibacter michiganensis* spp. *michiganensis* (Smith) Davis et al. and

Xanthomonas campestris pv. *vesicatoria* (Doidge) Dye, from the second batch of risk assessment requests for Annex IIAII organisms requested to EFSA (ARES(2012)880155), could be used as pilot cases for this approach, given that the working group for the preparation of their pest risk assessments has been constituted and it is currently dealing with the step 1 "pest categorisation". This proposed modification of previous request would allow a rapid delivery by EFSA by May 2014 of the first two outputs for step 1 "pest categorisation", that could be used as pilot case for this request and obtain a prompt feedback on its fitness for purpose from the risk manager's point of view.

As indicated in previous requests of risk assessments for regulated pests, in order to target its level of detail to the needs of the risk manager, and thereby to rationalise the resources used for their preparation and to speed up their delivery, for the preparation of the pest categorisations EFSA is requested, in order to define the potential for establishment, spread and impact in the risk assessment area, to concentrate in particular on the analysis of the present distribution of the organism in comparison with the distribution of the main hosts and on the analysis of the observed impacts of the organism in the risk assessment area.

ASSESSMENT

1. Introduction

1.1. Purpose

This document presents a pest categorisation prepared by the EFSA Scientific Panel on Plant Health (hereinafter referred to as the Panel) for the species *Aonidiella citrina* in response to a request from the European Commission.

1.2. Scope

This pest categorisation is for *A. citrina*.

The risk assessment area is the territory of the European Union (hereinafter referred to as the EU) with 28 Member States (hereinafter referred to as EU MSs), restricted to the area of application of Council Directive 2000/29/EC, which excludes Ceuta and Melilla, the Canary Islands and the French overseas departments.

2. Methodology and data

2.1. Methodology

The Panel performed the pest categorisation for *A. citrina* following guiding principles and steps presented in the EFSA Guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010) and as defined in the International Standards for Phytosanitary Measures (ISPM) No 11 (FAO, 2013) and ISPM No 21 (FAO, 2004).

In accordance with the Guidance on a harmonised framework for pest risk assessment in the EU (EFSA PLH Panel, 2010), this work is initiated as result of the review or revision of phytosanitary policies and priorities. As explained in the background of the European Commission request, the objective of this mandate is to provide updated scientific advice to the European risk managers for their evaluation of whether these organisms listed in the Annexes of the Directive 2000/29/EC still deserve to remain regulated under Council Directive 2000/29/EC, or whether they should be regulated in the context of the marketing of plant propagation material, or be deregulated. Therefore, to facilitate the decision making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for quarantine pest according to ISPM 11 (FAO, 2013) but also for regulated non-quarantine pest according to ISPM 21 (FAO, 2004) and includes additional information required as per the specific terms of reference received by the European Commission. In addition, for each conclusion the Panel provides a short description of its associated uncertainty.

Table 1 presents the ISPM 11 (FAO, 2013) and ISPM 21 (FAO, 2004) pest categorisation criteria against which the Panel provides its conclusions. It should be noted that the Panel's conclusions are formulated respecting its remit and particularly with regards to the principle of separation between risk assessment and risk management (EFSA founding regulation[4]), therefore, instead of determining whether the pest is likely to have an unacceptable impact, the Panel will present a summary of the observed pest impacts. Economic impacts are expressed in terms of yield and quality losses and not in monetary terms, in agreement with the Guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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

Table 1: International Standards for Phytosanitary Measures ISPM 11 (FAO, 2013) and ISPM 21 (FAO, 2004) pest categorisation criteria under evaluation

Pest categorisation criteria	ISPM 11 for being a potential quarantine pest	ISPM 21 for being a potential regulated non-quarantine pest
Identity of the pest	The identity of the pest should be clearly defined to ensure that the assessment is being performed on a distinct organism, and that biological and other information used in the assessment is relevant to the organism in question. If this is not possible because the causal agent of particular symptoms has not yet been fully identified, then it should have been shown to produce consistent symptoms and to be transmissible	The identity of the pest is clearly defined
Presence (ISPM 11) or absence (ISPM 21) in the PRA area	The pest should be **absent from all or a defined part of the PRA area**	The pest is **present** in the PRA area
Regulatory status	If the pest is present but not widely distributed in the PRA area, it should be under official control or expected to be under official control in the near future	The pest is under official control (or being considered for official control) in the PRA area with respect to the specified plants for planting
Potential for establishment and spread in the PRA area	The PRA area should have ecological/climatic conditions including those in protected conditions suitable for the establishment and spread of the pest and, where relevant, host species (or near relatives), alternate hosts and vectors should be present in the PRA area	–
Association of the pest with the plants for planting and the effect on their intended use	–	Plants for planting are a pathway for introduction and spread of this pest
Potential for consequences (including environmental consequences) in the PRA area	There should be clear indications that the pest is likely to have an unacceptable economic impact (including environmental impact) in the PRA area	–
Indication of impact(s) of the pest on the intended use of the plants for planting	–	The pest may cause severe economic impact on the intended use of the plants for planting
Conclusion	If it has been determined that the pest has the potential to be a quarantine pest, the PRA process should continue. If a pest does not fulfil all of the criteria for a quarantine pest, the PRA process for that pest may stop. In the absence of sufficient information, the uncertainties should be identified and the PRA process should continue	If a pest does not fulfil all the criteria for a regulated non-quarantine pest, the PRA process may stop

In addition, in order to reply to the specific questions listed in the terms of reference, three issues are specifically discussed only for pests already present in the EU: the analysis of the present EU

distribution of the organism in comparison with the EU distribution of the main hosts, the analysis of the observed impacts of the organism in the EU and the pest control and cultural measures currently implemented in the EU.

The Panel will not indicate in its conclusions of the pest categorisation whether to continue the risk assessment process as it is clearly stated in the terms of reference that at the end the pest categorisation the European Commission will indicate if further risk assessment work is required following their analysis of the Panel's scientific opinion.

2.2. Data

2.2.1. Literature search

2.2.2. Data collection

To complement the information concerning the current situation of the pest provided by the literature and online databases on pest distribution, damage and management, the Panel sent a short questionnaire on the current situation at country level, based on the information available in the European and Mediterranean Plant Protection Organization (EPPO) Plant Quarantine Retrieval (PQR) system, to the National Plant Protection Organisation (NPPO) contacts of the 28 EU MSs, and of Iceland and Norway. Iceland and Norway are part of the European Free Trade Association (EFTA) and are contributing to EFSA data collection activities, as part of the agreements EFSA has with these two countries. A summary of the pest status based on EPPO PQR and NPPO replies is presented in Table 2.

3. Pest categorisation

3.1. Identity and biology of *Aonidiella citrina*

3.1.1. Taxonomy

Preferred name:

Aonidiella citrina (Coquillett).

Other scientific names:

Aspidiotus citrinus Craw, 1890; *Chrysomphalus aurantii citrinus* (Craw); *Chrysomphalus citrinus* (Craw).

Common names:

Citrus yellow scale (English); escama amarilla de los cítricos (Spanish, Mexico); cochenille jaune (French); cocciniglia gialla (Italian); sari kosnil (Turkish).

Taxonomic position:

Domain: Eukaryota; kingdom: Metazoa; phylum: Arthropoda; sub-phylum: Uniramia; class: Insecta; order: Hemiptera; sub-order: Sternorrhyncha; superfamily: Coccoidea; family: Diaspididae; genus: *Aonidiella*; species: *Aonidiella citrina*.

3.1.2. *Aonidiella citrina* biology

A. citrina is native to Asia (EPPO, 2005; CABI, 2014).

Nel (1933) reported that, on average, the life cycle of the scale on oranges is 65 days in California, with an active first instar followed by two further instars before the adult reproductive adult stage is reached. The reproductive period lasts 60 days under a constant temperature of 27.8 °C. Adult males

have two wings, with the wings emerging from the elongated scale covers after four moults. Males live for about six hours, and their sole purpose is to mate. The number of male flights and the number of generations per year varies according to the growing region and the climate, but is generally about four flights per year (Grafton-Cardwell et al., 2014). In Turkey (Izmir), three generations were observed from May to September on satsuma and grapefruit. The pest was found to overwinter mainly as a second instar. A minimum development threshold of 14.8 °C, with a "thermal constant" of 449 degree-days, was shown to be required for egg to adult development (Onder, 1982).

The species is biparental and ovoviviparous, and has higher fecundity on fruit than on leaves. A female can produce up to 150 first instars on lemon fruit. After birth, larvae stay under the scale of the mother for a short period, clustered around the pygidium. They start crawling around and settle when they have found a suitable feeding place; preferred sites are beside the midrib or some other prominent leaf vein. Settlement was observed to occur 6 to 24 hours after emergence; the larvae then pierce the epidermis with their mouthparts. Following this, the dorsal surface of the larvae become covered with fine, silvery white threads of wax. If this wax covering is removed, it is quickly replaced by a new one. The highest mortality rates occur during the first larval stage (Ferris, 1938; Nel, 1933). Nel (1933) gives a detailed description of the different moults of the scale. Only during the second, post-fertilisation phase of the adult is the body firmly attached to the scale cover.

Moreno et al. (1972a, b) identified species-specific sex pheromones that attract the winged males. These were described in detail by Gieselmann et al. (1979).

A. citrina is highly polyphagous (Onder, 1982; EPPO, 2005). The scale mainly infests leaves and fruit (Nel, 1933), and, in comparison with *A. aurantii*, is rarely, if ever, found on bark (EPPO, 2005; Ferris, 1938).

3.1.3. Detection and identification of *Aonidiella citrina*

The armoured scale cover of the adult female is translucent, with the yellow body of the insect showing through the scale. After hatching, it is soft, flat and round, with a diameter of 1.5–2 mm, while the fully grown adult female is kidney-shaped, and the prosomatic region is heavily sclerotised. It is yellow-brown in colour, with the waxy surface and exuviae placed centrally or sub-centrally relative to previous instars. The colour of the two-winged adult male is similar to that of the female, but the male is more oval in shape and smaller than the female, with the exuviae placed near one end. Because of its morphological similarity to *A. aurantii*, which is also commonly intercepted on imported citrus fruit, these species can be easily confused, though *A. citrina* is usually more yellow than *A. aurantii*, which is orange-red (Ferris, 1938; EPPO, 1997, 2005; Bell et al., 2014; Grafton-Cardwell et al., 2014). Grafton-Cardwell et al. (2000) state that, where both species are present, it is difficult for experts to distinguish them. This is confirmed by Miller and Davidson (2005), who noted that, although no single character can be used to separate *A. aurantii* from *A. citrina*, a combination of features can be effective when identifying a series of specimens.

Since the scale is small, sessile from the second instar onwards, and relatively inconspicuous in colour, it is difficult to detect when it is present in small numbers without very careful examination of fruit and leaves (CABI, 2014). The wax-producing ducts, pores, plates and setae, as well as the internal apophyses, are important diagnostic characteristics that can be seen only under a microscope (EPPO, 2005). However, the difficulties of morphological identification and differentiation can be circumvented by using species-specific pheromone traps, since the sex pheromones of the two scales differ in chemical structure and no cross-attraction between the two species has been observed (Moreno et al. 1972b; Roelofs et al., 1982).

The symptoms that occur on host plants with high infestations include leaf drop, dieback of apical twigs and the discoloration, stunting and pitting of fruit, which may, as a result, fall prematurely.

The symptoms visible on leaves are characteristic chlorotic streaks. The scale rarely infests twigs, but high population levels can cause serious damage to trees. The scale has been detected mainly on

consignments of *Citrus sinensis* (EPPO, 2005; Grafton-Cardwell et al., 2014). However, in the EU, according to the interceptions reported in the EUROPHYT database, the pest has been intercepted only six times since 1999, and only once (in 2009) on a *Citrus* sp. that might have been *C. sinensis*.

Fargerlund and Moreno (1974) evaluated the effectiveness of using sticky trap cards baited with sex pheromones. The number of collected males was higher, on traps baited with mature virgin females, when the traps were positioned on C*itrus* spp. trees at a height of 2.4 m above the ground. A detailed description of the use of sex pheromone-baited traps is given by Grafton-Cardwell et al. (2000). When *Aphytis* is present in an orchard, male scale numbers can be very high, even if the female population is low, since it has a preference for parasitising females (Grafton-Cardwell et al., 2014).

3.2. Current distribution of *Aonidiella citrina*

3.2.1. Global distribution of *Aonidiella citrina*

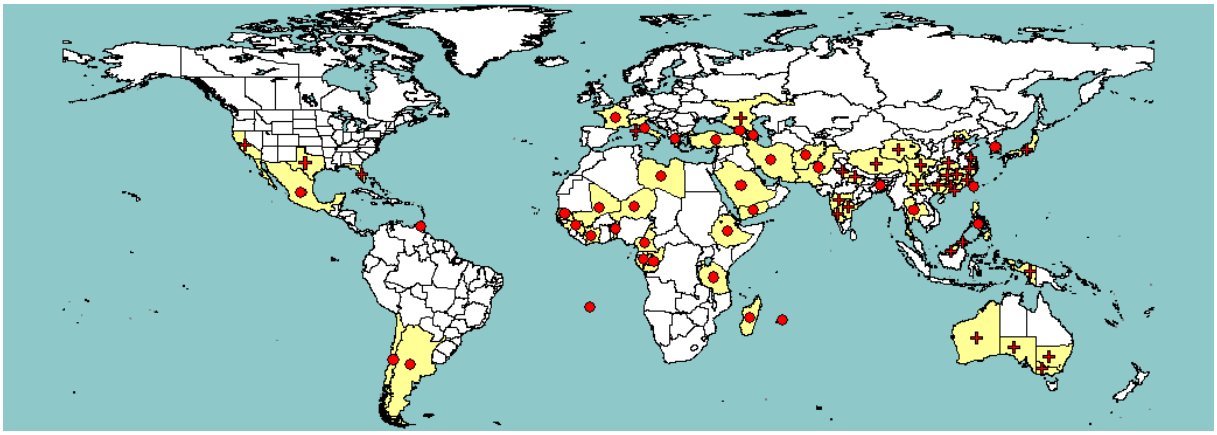

Figure 1: Global distribution of *Aonidiella citrina* (extracted from EPPO PQR, version 5.3.1, accessed 14 October 2014). Red circles represent national records of pest presence and red crosses show sub-national records of pest presence

A. citrina is present in all continents.

3.2.2. *Aonidiella citrina* distribution in the EU

Table 2: Current distribution of *Aonidiella citrina* in the 28 EU MSs, Iceland and Norway, based on the answers received via email from the NPPOs or, in the absence of a reply, on information from EPPO PQR (and other sources if relevant)

Country	NPPO answer	Other sources
Austria	Absent, no pest records	
Belgium	Absent, no pest records	
Bulgaria	Absent	
Croatia	Absent, no pest records	
Cyprus	–	
Czech Republic	Absent, no pest records	
Denmark	Not known to occur	
Estonia	Absent, no pest records	
Finland	Absent, no pest records	
France	Present, restricted distribution	Corsica, Cote d'Azur (Gieselmann et al., 1979; Germain and Bertaux, 2002)
Germany	Absent, no pest records	
Greece [(a)]	–	Present, no details (EPPO PQR)
Hungary	Absent, no pest records	
Ireland	Absent, no pest records	

Country	NPPO answer	Other sources
Italy	Present, restricted distribution	Reported in Calabria. Impact not different from other *Aonidiella* species. (Italian NPPO) (Longo et al., 1994, 2001; Palmeri et al., 2005)
Latvia [(a)]	–	
Lithuania [(a)]	–	
Luxembourg [(a)]	–	
Malta	Absent, no pest records	
Netherlands	Absent, confirmed by survey	
Poland	Absent, no pest records	
Portugal	No records	
Romania [(a)]		
Slovak Republic	Absent, no pest records	
Slovenia	Absent: no pest records on *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf.	
Spain	Absent	
Sweden	Absent, no pest records	
United Kingdom	Absent	
Iceland [(a)]	–	
Norway [(a)]	–	

(a): When no information was made available to EFSA, the pest status in the EPPO PQR was used.
–: No information available.
EPPO PQR, European and Mediterranean Plant Protection Organization Plant Quarantine Data Retrieval System; NPPO, National Plant Protection Organisation.

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

3.3.1.1. *Aonidiella citrina*

A. citrina is currently listed in the Council Directive 2000/29/EC in Annex II, Part A, Section I, point 5 (see Table 3).

Table 3: *Aonidiella citrina* in Annex IIAI of Council Directive 2000/29/EC

Annex II, Part A	Harmful organisms whose introduction into, and spread within, all Member States shall be banned if they are present on certain plants or plant products	
Section I	Harmful organisms not known to occur in the community and relevant for the entire community	
(a)	Insects, mites and nematodes, at all stages of their development	
	Species	Subject of contamination
5	*Aonidella citrina* Coquillet*	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds

* The Panel notes that *Aonidella citrina* Coquillet should read *Aonidiella citrina* Coquillett

It is important to note that the pest is currently present in three MSs (see Table 2).

3.3.1.2. Regulated hosts for *Aonidiella citrina*

A. citrina is a polyphagous pest and its potential host plants belong to more than 50 genera in 32 families. Its host range is much wider than the hosts for which it is regulated in Annex IIAI (see section 3.4.1, Host range). In addition to plants, it is important to mention that fruits could also be a pathway for the introduction of the pest into the risk assessment area.

Table 4 includes the specific requirements of Annex III, Annex IV and Annex V of the Council Directive 2000/29/EC for only the host plants and commodities regulated for *A. citrina* in Annex IIAI.

Table 4: *Aonidiella citrina* host plants in Annex III and V of Council Directive 2000/29/EC

Annex III, Part A	Plants, plant products and other objects the introduction of which shall be prohibited in all Member States	
	Description	Country of origin
16	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds	Third countries
Annex V	Plants, plant products and other objects which must be subject to a plant health inspection (at the place of production if originating in the Community, before being moved within the Community—in the country of origin or the consignor country, if originating outside the Community) before being permitted to enter the Community	
Part A	Plants, plant products and other objects originating in the Community	
Section I	Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community and which must be accompanied by a plant passport	
1	Plants and plant products	
1.4	Plants of *Fortunella* Swingle, *Poncirus* Raf., and their hybrids and *Vitis* L., other than fruit and seeds	
2	Plants, plant products and other objects produced by producers whose production and sale is authorised to persons professionally engaged in plant production, other than those plants, plant products and other objects which are prepared and ready for sale to the final consumer, and for which it is ensured by the responsible official bodies of the Member States, that the production thereof is clearly separate from that of other products	
2.1	Plants intended for planting other than seeds of the genera […] and other plants of herbaceous species, other than plants of the family Gramineae, intended for planting, and other than bulbs, corms, rhizomes, seeds and tubers	

3.3.2. Marketing directives

Host plants of *A. citrina* that are regulated in Annex IIAI of Council Directive 2000/29/EC are explicitly mentioned in the following marketing directive:

Plant propagation material of *Citrus* L. is addressed by Council directive 2008/90/EC[5] of 29 September 2008 on the marketing of fruit plant propagating material and fruit plants intended for fruit production (OJ L 267, 08/10/2008, p. 8–22).

3.4. Elements to assess the potential for establishment and spread in the EU

3.4.1. Host range

Although *A. citrina* is reported as a polyphagous pest with more than 50 genera in 32 families (CABI, 2014), *Citrus* species "are by far the most common host" (Miller and Davidson, 2005). The following *Citrus* species are listed by both CABI (2014) and EPPO PQR (2014) as major (EPPO) or main (CABI) hosts: *C. limon*, *C. paradisi*, *C. reticulata sensu stricto* and *C. sinensis*. *C. unshiu* is also listed by CABI (2014) as a main host. The categories of major and minor hosts, as described by EPPO PQR, are based on expert judgements made by taking into account the extent of damage caused to the host

[5] Council directive 2008/90/EC of 29 September 2008 on the marketing of fruit plant propagating material and fruit plants intended for fruit production. OJ L 267, 08/10/2008, p. 8–22.

plant, and the economical importance of the host plant (Françoise Petter, EPPO, personal communication). Main hosts (as defined by CABI) are those on which economically relevant damage occurs (Lesley Mcgillivray, CABI, personal communication).

Citrofortunella microcarpa, *Citroncirus*, *Fortunella* and *Poncirus trifoliata* are listed as minor hosts by EPPO PQR and as "other" hosts by CABI (2014). "Other" hosts are those that are attacked by the pest, but not as often or not as severely as main hosts are attacked (Lesley Mcgillivray, CABI, personal communication)

The additional host species of *A. citrina* listed include wild and ornamental plants (EPPO PQR, 2014), but it is not known whether or not *A. citrina* can complete its life cycle on these hosts. A list of host plants is also available from ScaleNet (http:/www.sel.barc.usda.gov/scalecgi/hostsof.exe?Family=Diaspididae&genus=Aonidiella&species=citrina&subspecies/=). No host susceptibility studies on non-*Citrus* hosts could be found in the literature. However, since identification of *A. citrina* is possible only for adult females, their presence on hosts other than *Citrus* confirms that the pest can complete its life cycle on these plants. The lack of data on fertility, or other components of life history strategies, prevents a clearer evaluation of how host plants affect the biology of *A. citrina* (G. Pellizzari, University of Padova, personal communication). Although EPPO PQR lists "woody plants" as minor hosts, the only named non-*Citrus* plants are described as "incidental". This means that such hosts are very rarely reported in the literature (Françoise Petter, personal communication).

The incidental host plants listed by EPPO PQR are *Acacia* sp., *Camellia*, *Camellia sinensis*, *Clematis* hybrids, Cucurbitaceae, *Eucalyptus*, *Euonymus japonicus*, *Ficus*, *Hedera helix*, *Jasminum nudiflorum*, *Ligustrum*, *Magnolia grandiflora*, *Mangifera indica*, *Musa* × *paradisiaca*, *Myrica*, *Olea europea*, *Populus*, *Prunus persica*, *Psidium guajava*, *Rosa*, *Schefflera actinophylla*, *Strelitzia reginae*, *Viburnum* and *Yucca*. CABI (2014) also gives a long list of non-*Citrus* host plants, but these are described as "other" hosts (as defined above) or as "habitat/association" (i.e. plants that provide habitat, breeding ground etc. for the pest but are not attacked by it (Lesley Mcgillivray, CABI, personal communication)).

C. Malumphy (Food and Environment Research Agency, personal communication) states that: "it also needs to be mentioned that host plant lists can be very misleading particularly for some common citrus-feeding diaspids in the genera *Aonidiella*, *Lepidosaphes* and *Parlatoria*. Many of these species are recorded as polyphagous although they all exhibit a strong preference for *Citrus*. These diaspids are often found on non-citrus hosts adjacent to heavily infested citrus orchards and it is not known if these non-citrus species can support the scale insects over the long term. For example, in Europe *A. citrina* is usually found exclusively on *Citrus* despite the fact that is recorded as broadly polyphagous. There is also a possibility that (as known for other examples), although the pest may be able to feed on a wide range of plants during outbreak situations, it is unlikely to sustain a population on such a wide range of hosts".

3.4.2. EU distribution of host plants

Based on the discussion in section 3.4.1, the main focus in this opinion is given to citrus hosts. The commonly cultivated citrus species belong to three genera—*Citrus*, *Fortunella* and *Poncirus*—all of which are closely related and belong to the plant family Rutaceae (Swingle, 1967). All the genera have persistent, unifoliolate or simple leaves, except the monotypic genus *Poncirus*, which has trifoliolate, deciduous leaves.

The genus *Fortunella* (kumquat) includes species of small trees and shrubs. All species of this genus have small leaves and orange-coloured fruits of small size.

Species of the genus *Citrus* are the most important from an agronomic point of view.

Table 5: The principal citrus species cultivated in Europe (source: CABI Datasheets (CABI, 2014))

Botanical name	Common English name
Fortunella spp.	Kumquat
Citrus medica L.	Citron
Citrus limon (L.) Burm.f.	Lemon
Citrus aurantifolia (Christm.) Swingle	Key lime
Citrus aurantium L.	Sour orange
Citrus sinensis Osbeck	Sweet orange
Citrus reticulata Blanco	Mandarin
Citrus unshiu (Swingle) Marcow.	Satsuma mandarin
Citrus maxima (Burm.) Merr.	Pomelo
Citrus × *paradisi* Macfad.	Grapefruit

Citrus production in the EU is concentrated mainly in Croatia, Cyprus, France, Greece, Italy, Malta, Portugal and Spain (see Figure 2). Detailed information on the production areas of orange varieties, lemon varieties, small-fruited citrus varieties and overall citrus varieties from EUROSTAT and FAOSTAT are presented in Table 9 of EFSA PLH Panel (2014).

Greece, France, Portugal, Spain and Italy are the main producers of citrus propagating material for fruit production and ornamentals (EFSA PLH Panel, 2014). However, citrus trees, mainly sour oranges (*C. aurantium*), are commonly planted in southern EU MSs along city streets and in public and private gardens.

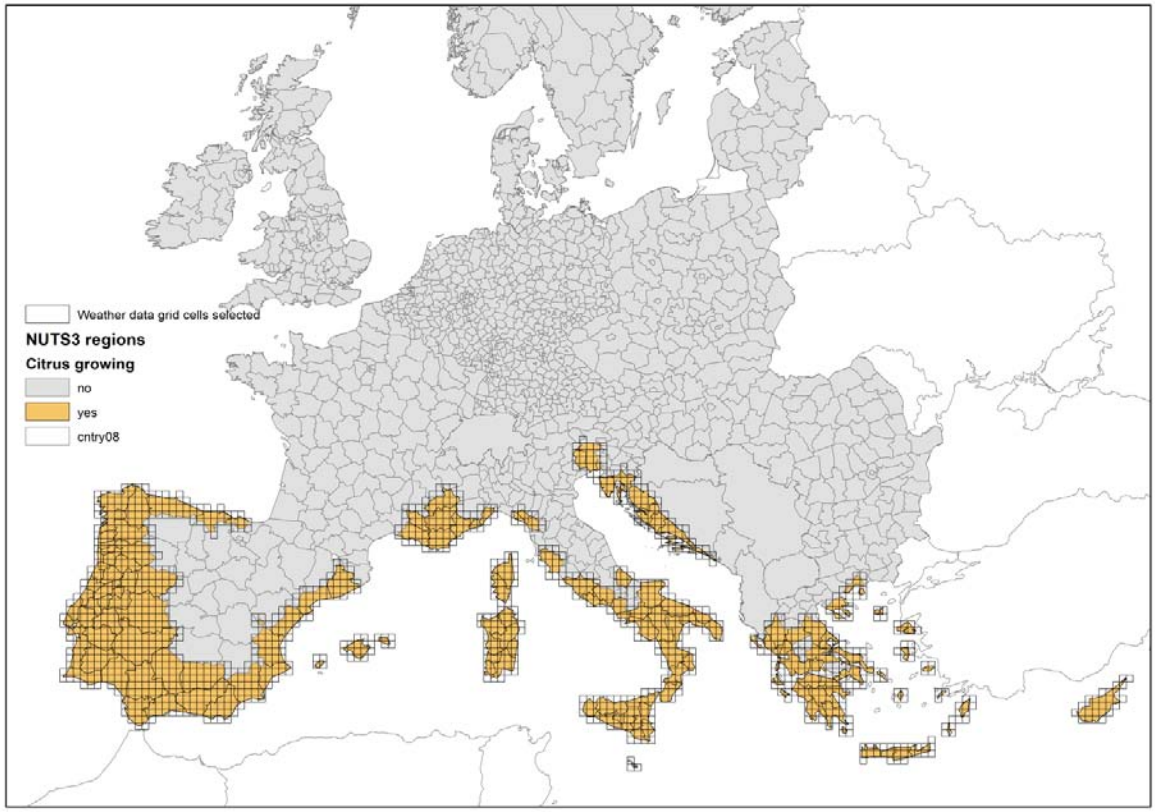

Figure 2: EU map of NUTS3 (Nomenclature of Territorial Units for Statistics, level 3) citrus-growing regions based on citrus production data extracted from the national statistical databases of Portugal, Spain, France, Italy, Malta, Croatia, Greece and Cyprus (source: Figure 29 in EFSA PLH Panel, 2014)

Regarding the other potential host plants of *A. citrina*, many of them, e.g. *Acacia* and *Eucalyptus*, have similar climatic requirements to the citrus species, and their geographic distributions overlap with the citrus-growing areas. Some of them are ornamental plants, such as *Rosa* spp., that are grown throughout the EU in protected cultivation and in private and public gardens and are also present in the wild.

Taking into account the clear preference of *A. citrina* for citrus plants, and the lack of susceptibility studies on potential non-citrus hosts, the Panel concludes that suitable host plants are mainly distributed in the southern EU MSs of Portugal, Spain, France, Italy, Malta, Croatia, Greece and Cyprus, even though ornamental hosts are available throughout the EU.

3.4.3. Analysis of the potential distribution of *Aonidiella citrina* in the EU

Analysis of the worldwide distribution of *A. citrina* suggests that most of southern Europe is climatically suitable for establishment. Low winter temperature is the major limiting factor for establishment in areas distant from the Mediterranean coast. The area of potential distribution coincides with the major *Citrus* hosts. However, since many other potential hosts are present in southern Europe and in the Mediterranean area, host availability might not be a limiting factor for establishment.

It has been documented that *A. aurantii* displaced *A. citrina* in citrus groves in southern California; therefore, it is assumed that *A. citrina* is unlikely to establish where *A. aurantii* is already present in the EU (Reits and Trumble, 2002). Both scales were introduced into California, and the first records of this introduction date back to the late 19th century. Initially, *A. citrina* was predominant and more widespread in southern California (DeBach et al., 1978). However, by 1930, populations of *A. aurantii* had started to increase and, by 1970, *A. citrina* populations had been displaced from southern California (DeBach et al., 1978). Based on historical records and a series of laboratory experiments, DeBach et al. (1978) found that *A. aurantii* has a higher reproductive rate and survivorship, and a broader feeding range on citrus, than *A. citrina*. At that time, no evidence had been found regarding different susceptibilities to insecticides, natural enemies or other environmental factors that could have been responsible for the displacement of *A. citrina* by *A. aurantii*. Differences in biological responses to environmental conditions, such as temperature or relative humidity, were also considered not to explain the observed displacement (McLaren, 1971; Badary and Abd-Rabou, 2010). In their native habitats, *A. citrina* and *A. aurantii* coexist (DeBach and Rosen, 1991), but, in a less diverse, novel environment, such as citrus, displacement is thought to have occurred because, unlike in its native range, *A. citrina* does not have refuge plants (Reitz and Trumble, 2002) comparable to *Citrus* in terms of preference.

3.4.4. Spread capacity

A. citrina is native to Asia. It has spread to other tropical and sub-tropical regions all over the world. The main dispersal stage, as for other diaspidids, is the first instar, which can be dispersed naturally by wind and by animals. After selecting a feeding site, the scale becomes sessile and no further dispersal occurs. Spread can then occur only with human assistance, e.g. the scale can be distributed with consignments of plant material (including plants for planting) and fruit (EPPO, 1997).

Spread throughout the area of potential distribution in Europe may be being hindered by competition with *A. aurantii*, which is a common pest of citrus in many citrus-growing areas. As discussed in section 3.4.3, *A. aurantii* has been found to be a superior competitor with the capacity to replace *A. citrina*, as was shown to have occurred in areas of California, where both species were present (DeBach et al., 1978).

Palmeri et al. (2005) stated that *A. citrina*, 10 years after its first record, remained restricted to the area in which it was first detected, and they attributed this to the presence of *A. aurantii*, the environmental conditions (in particular temperature) and the presence of natural enemies.

A. citrina is easily controlled by natural enemies (Grafton-Cardwell et al., 2014), and at least two parasitoids (*Encarsia citrina* and *Aphytis melinus*) are present in the Mediterranean area (Longo et al., 1995). Combined with competition from *A. aurantii*, this maintains local populations at very low levels, without specific control measures (CABI, 2014), and also limits the capacity for spread.

3.5. Elements to assess the potential for consequences in the EU

3.5.1. Potential effects of *Aonidiella citrina*

High densities of yellow scale cause cosmetic harm to the fruit and directly damage leaves, resulting in twig dieback (DeBach et al., 1978).

The scales were found to damage citrus fruit in some citrus-growing regions of California. It was an important pest of citrus in the San Joaquin Valley in the 1950s, but has since become rare. *A. citrina* sucks the plant sap; highly infested plants become weak and the shoots dry out, indirectly affecting yield (Mahmood et al., 2014). The scale usually attacks only fruit and leaves; branches and trunks are generally not affected. Heavily infested fruit may lose their commercial value and can be downgraded in the packinghouse because of pits and discoloration caused by the pest. When the pest feeds on leaves and infestation levels are high, this can cause leaf yellowing, leaf drop and dieback of apical twigs and limbs. Occasionally, it can lead to death of the tree (EPPO, 1997; Grafton-Cardwell et al., 2014). Shi et al. (2009) noted that the growth of ornamental plants in green belts was severely affected; they found that the type and degree of damage differed between host plants.

According to Grafton-Cardwell (personal communication, 2014), *A. citrina* was fairly easy to find in the 1990s in California, but there have not been any reports of the pest for the past 15 years. This may be because of the introduction of insect growth regulators against red scale in California in 1998; *A. citrina* is easily controlled by this group of insecticides in combination with natural enemies. Therefore, *A. citrina* is no longer considered to be a significant pest of Californian citrus.

3.5.2. Observed impact of *Aonidiella citrina* in the EU

Since the first records of the pest in Europe (1994 in Italy, 2001 in France and 2007 in Greece), no significant damage has been reported.

Longo et al. (1994) considered *A. citrina* to be a minor pest in Italy because of its "bioethological characteristics" and because at least two parasitoids (*Encarsia citrina* and *Aphytis melinus*) which can regulate population levels are present.

In France, the scale causes a low level of damage. In addition, treatments against other scales (e.g. *A. aurantii*) and natural enemies control pest populations. As in Italy, *A. citrina* is considered to be only a minor pest of citrus (Germain and Bertaux, 2002).

These authors (Longo et al., 1994; Germain and Bertaux, 2002) indicate that in areas where other scale insects, such as *A. aurantii*, are present, the control methods applied and the presence of natural enemies in the citrus orchards are sufficient to keep the population under control.

According to CABI (2014), *A. citrina* is present in Greece, but no damage has been recorded.

3.6. Currently applied control methods

Based on experience in the USA, the combined use of natural enemies and chemical treatments is the most efficient control strategy.

3.6.1. Chemical control

Chemical control of the scales is reported to be difficult. The sprays need to reach the insects, which are on the underside of the lower and inner foliage (CABI, 2014). Moreover, the waxy surface of the

leaves, intermittent feeding and overlapping generations of the insect can reduce the efficacy of control (Carmean, 1988). Pesticide-resistant populations have also been reported, and it is therefore important to alternative products and to ensure that the time interval between treatments is optimal.

3.6.2. Integrated pest management programmes

Grafton-Cardwell et al. (2014) recently revised the integrated pest management (IPM) programme for *A. citrina* and *A. aurantii* in California. The authors stated that, during the 1990s in the San Joaquin Valley, many populations of both species developed resistance to pesticides (mainly to organophosphates and carbamates). In these areas, the growers' control tactics shifted, from the use of these pesticides, to the combined use of bio-control measures such as the release of *Aphytis* parasitoids, oil treatments and specific insect growth regulators. In locations where biologically based IPM is practised, *A. citrina* is easily controlled by parasites and is not currently a problem, whereas *A. aurantii* continues to be a key pest.

3.6.3. Biological control

Natural enemies are important, including *Encarsia citrina* which parasitised over 60 % of *A. citrina* in Turkey (Onder, 1982). Hely et al. (1982) reported *Aphytis chrysomphali* and *Comperiella bifasciata* as important natural enemies in Australia. Longo et al. (1994) concluded that natural enemies of *A. aurantii* in southern Italy (*Encarsia citrina*, *Aphytis melinus* and *Chilocorus nigritus*) are also effective against *A. citrina*.

To control *A. citrina* in the USA, a new strain of *Comperiella bifasciata*, with a strong preference for *A. citrina*, was introduced from Japan (Clausen, 1978). Other parasitoids have either been introduced deliberately for the control of citrus scales or were inadvertently introduced with their hosts. Thus, although they probably originated with their hosts in China and Japan, they are now widespread.

3.6.4. Monitoring

Male flight can be monitored using synthetic pheromones that are commercially available. Pheromone trapping can be used to determine suitable timings for summer applications.

3.7. Uncertainty

3.7.1. Detection

Where both species *A. citrina and A. aurantii* are present, it is very difficult for experts to distinguish between them.

3.7.2. Presence/absence

Only one MS confirmed absence by survey. Since *A. citrina and A. aurantii* are so similar, control methods against both species are the same and, because *A. aurantii* is so much more important, it is probable that very little monitoring of *A. citrina* is undertaken in the EU.

3.7.3. Host plants

Impacts on the minor, other and incidental hosts, and their roles in providing reservoirs for *A. citrina*, are poorly understood.

3.7.4. Observed impact

No economic impacts have been reported in the EU, but these could be masked by the presence of *A. aurantii*.

CONCLUSIONS

The Panel summarises in Table 6 its conclusions on the key elements addressed in this scientific opinion in consideration of the pest categorisation criteria defined in ISPM 11 and ISPM 21, and of the additional questions formulated in the terms of reference.

Table 6: The Panel's conclusions on the pest categorisation criteria defined in ISPM No 11 and No 21 and on the additional questions formulated in the terms of reference

Criterion for pest categorisation	Panel's conclusions on ISPM 11 criterion	Panel's conclusions on ISPM 21 criterion	Uncertainties
Identity of the pest	*Is the identity of the pest clearly defined? Do clearly discriminative detection methods exist for the pest?* *Aonidiella citrina* is a distinct, well-defined taxon but it is very similar morphologically to *A. aurantii*, another citrus pest of Asian origin, which is not only much commoner and more widespread in southern Europe, but is also a significant pest. Reliable identification of *A. citrina* requires microscopic examination but males of the two species are attracted to different pheromones		Although distinct taxonomically, some specimens can be difficult to separate
Absence/presence of the pest in the risk assessment area	*Is the pest absent from all or a defined part of the risk assessment area?* The pest is established only in Italy, France and Greece	*Is the pest present in the risk assessment area?* Yes	Only one MS confirmed absence of the pest by survey. Its presence in other MSs could be masked by the much larger and more extensive populations of *A. aurantii*
Regulatory status	*Mention in which annexes of 2000/29/EC and the marketing directives the pest and associated hosts are listed without further analysis. Indicate also whether or not the hosts and/or commodities for which the pest is regulated in AIIAI or II are comprehensive of the host range* This species is a regulated harmful organism in the EU and listed in Council Directive 2000/29/EC in Annex IIAI. Only the main host plant genera of *A. citrina*, *Citrus*, *Fortunella* and *Poncirus*, are regulated for this pest in Annex IIAI. In addition, the species can be associated with a wide range of other plant species and these could also provide a pathway of introduction of the pest into the risk assessment area. It is also important to mention that fruits are a potential pathway for the pest		
Potential establishment and spread	*Does the risk assessment area have ecological conditions (including climate and those in protected conditions) suitable for the establishment and spread of the pest?* *Indicate whether or not the host plants are also grown in areas of the EU where the pest is absent. And, where relevant, are host species (or near relatives), alternate hosts and vectors present in the risk assessment area?*	*Are plants for planting a pathway for introduction and spread of the pest?* Plants for planting are a pathway for introduction and spread. However all kinds of host plant material can also act as a pathway	Uncertainty exists concerning the limits to its current distribution because of confusion with *A. aurantii*. The capacity of *A. aurantii* to outcompete *A. citrina* in Europe is poorly documented

Criterion for pest categorisation	Panel's conclusions on ISPM 11 criterion	Panel's conclusions on ISPM 21 criterion	Uncertainties
	Southern areas of the EU where its citrus hosts are present are climatically suitable for the pest to establish and spread. It is not recorded as a pest in protected cultivation. Local populations are maintained at a very low level of abundance without specific control measures, and this also limits the capacity for spread		
Potential for consequences in the risk assessment area	*What are the potential consequences in the risk assessment area? Provide a summary of impact in terms of yield and quality losses and environmental consequences* Despite its presence in Europe, only minor damage has been recorded since 1994. IPM programmes targeted at *A. aurantii* are considered to be effective in controlling *A. citrina*	*If applicable is there indication of impact(s) of the pest as a result of the intended use of the plants for planting?* As a result of the trade in plants for planting new introductions may occur but any impacts are likely to be minor	These conclusions are based on the assumption that of the two species only *A. aurantii* is capable of causing significant damage to citrus in the EU
Conclusion on pest categorisation	*A. citrina* is a well-defined organism but it is very similar morphologically to *A. aurantii*, which is widespread in southern Europe and a serious citrus pest. In addition to Italy, France and Greece where the pest is present, large areas of southern Europe where citrus is cultivated are also climatically suitable for establishment. Only minor impacts have been recorded since its first finding in Europe 20 years ago. An IPM programme combining chemical and biological control is considered to be effective	*A. citrina* is a well-defined organism. Plants for planting are a possible pathway for introduction and spread of the pest	Uncertainty exists concerning possible confusion with *A. aurantii*
Conclusion on specific terms of reference questions	*Provide a brief summary of:* - *the analysis of the present distribution of the organism in comparison with the distribution of the main hosts, and the distribution of hardiness/climate zones, indicating in particular if in the risk assessment area, the pest is absent from areas where host plants are present and where the ecological conditions (including climate and those in protected conditions) are suitable for its establishment* *A. citrina* is only established in Italy, France and Greece, but other southern EU MSs with extensive citrus production and similar climates, such as Spain, are also suitable for establishment. - *and the analysis of the observed impacts of the organism* Only minor impacts have been observed since it was first found in Europe 20 years ago		

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ABBREVIATIONS

EFSA	European Food Safety Authority
EPPO	European and Mediterranean Plant Protection Organization
EPPO-PQR	European and Mediterranean Plant Protection Organization Plant Quarantine Retrieval System
EU	European Union
IPM	Integrated Pest Management
ISPM	International Standard for Phytosanitary Measures
MS(s)	Member State(s)
NPPO	National Plant Protection Organisation
NUTS3	Nomenclature of Territorial Units for Statistics, level 3
PLH Panel	Plant Health Panel
PRA	Pest Risk Analysis