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Pest categorisation of *Arboridia kakogawana*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of the Japanese grape leafhopper, *Arboridia kakogawana* (Matsumura, 1932) (Hemiptera: Cicadellidae), for the EU territory. This species is not included in the EU Commission Implementing Regulation 2019/2072. Adults of *A. kakogawana* overwinter in broad-leaved and mixed forests and move to vineyards in the spring where there may be up to four generations, before adults move back to forests during late summer–early autumn to overwinter, possibly under diapause. *A. kakogawana* has a restricted host range (*Vitis* spp. and *Parthenocissus quinquefolia*). It is native to Eastern Asia, from where it moved westwards reaching southern Russia in 1999, and subsequently Ukraine, Romania, Bulgaria and Serbia in 2020. *A. kakogawana* develops on the abaxial side of the leaves causing chlorotic spots that reduce grape quality. Plants for planting of *Vitis* L. are banned from entering the EU except from Switzerland, where *A. kakogawana* is not known to occur. Therefore, this can be considered as a closed entry pathway. However, other plants for planting including the host *P. quinquefolia* and many broad-leaved trees where overwintering takes place, as well as isolated bark and wood with bark provide potential pathways which are partly regulated but remain open. There are no EU records of interception. Additional introductions and further spread of *A. kakogawana* into/within the EU, coupled with the ample availability of grapevines and the climatic conditions would most probably allow successful establishment in most EU member states. Should this happen, economic impact in table and wine grapes is anticipated. *A. kakogawana* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest (UQP).

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Keywords: Cicadellidae, Japanese grape leafhopper, pest risk, plant health, plant pest, quarantine, *Vitis* spp.

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Figure 1: Source: EPPO GD-C. Chireceanu (Research & Development Institute for Plant Protection, Romania); Figure 2: Source: EPPO GD-C. Chireceanu (Research & Development Institute for Plant Protection, Romania); Figure 4a: Chireceanu et al., 2019, 2020; Figure 4b: Tomov, 2020.



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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 fulfil 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

Arboridia kakogawana is one of a number of pests listed in Annex 1 to the Terms of Reference (ToR) (1.1.2.1) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States 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 European Commission 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 quarantine pest, risk reduction options will be identified.

1.3. Additional information

This pest categorisation was initiated following the inclusion of *A. kakogawana* in the EPPO Alert List in 2020 (EPPO GD).

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 an MS, an official pest status is not always available. In order to obtain information on the official pest status for *A. kakogawana*, EFSA has consulted the NPPOs of Bulgaria and Romania. The results of this consultation are presented in Section 3.2.2.

2.1.2. Literature search

A literature search on *A. kakogawana* 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 2.1.2.

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 SANTÉ) 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 Member States 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. kakogawana* 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. kakogawana* 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) and No. 21 (FAO, 2004).

The criteria to be considered when categorising a pest as a potential Union quarantine pest (QP) is given in Regulation (EU) 2016/2031 Article 3 and Annex I, Section 1 to this 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. Whilst 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 quarantine pest status. Assessing social impact is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as 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	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 established, 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 widely distributed within the EU? Describe the pest distribution briefly
Regulatory status (Section 3.3)	If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future.
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 of 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 impact?
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 established, or has it been shown to produce consistent symptoms and/or to be transmissible?

Yes. The identity of *A. kakogawana* is established. It is a species belonging to the Cicadellidae (Hemiptera) family.

The Japanese grape leafhopper, *A. kakogawana* (Matsumura, 1932) (Hemiptera: Cicadellidae) was originally named as *Zygina kakogawana* Matsumura, 1932, from specimens collected in the island of Kyūshū, southern Japan, on an unspecified host (Matsumura, 1931). The holotype was fully described 1 year later (Matsumura, 1932) and corresponds to a female collected at Kakogawa, near Akashi in the

island of Honshu, northeast of Kyūshū, on an unspecified host. *Z. kakogawana* and *Erythroneura kakogawana* Ishihara, 1953, are considered junior synonyms of this species.

The EPPO code¹ (Griessinger & Roy, 2015; EPPO, 2019) for this species is: ARBOKA (EPPO, online).

3.1.2. Biology of the pest

A. kakogawana overwinters in broad-leaved and mixed forests in the vicinity of vineyards. *Vitis* is the main host (EPPO GD, online, see also Section 3.1.3). In Korea, *A. kakogawana* adults start infesting vineyards in early May (Ahn et al., 2005). Females insert their eggs into the veins on the underside of the leaf (Martynov et al., 2019). By mid-June, nymphs can be detected in the vineyards. Populations peak twice, first in late June and then again in mid-August in Korea (Ahn et al., 2005), three times in Donbass (Russia) and four in Crimea (Ukraine) (Martynov et al., 2019), Xinjiang (China) (Cao et al., 2017) and Romania (Chireceanu et al., 2019). Peak densities increase with time and the last peak shows the highest annual densities. By early autumn, *A. kakogawana* adults abandon the vineyards in search of an overwintering site (Ahn et al., 2005). These adults may enter diapause (Chireceanu et al., 2019). In an experiment where different overwintering sites were studied at Okcheon (Chungbuk province, Republic of Korea), including (1) fabric strip on grapevines, (2) greenhouse, (3) ground vegetation, (4) bark, (5) soil, (6) litter and (7) fabric strip on trees, about two-thirds of the catches corresponded to the greenhouse and the remaining third to the fabric strips on trees, with no adults recovered from the other substrates considered (Ahn et al., 2005). Therefore, this species does not overwinter in vine bark, open-field vineyards and surrounding weeds but as adults sheltered either in the bark of the broad-leaved trees growing close to vineyards or in fallen leaves in facilities like the greenhouse of the experiment (Ahn et al., 2005).

Colonies of *A. kakogawana* include adults and nymphs, which aggregate along the veins on the abaxial side of the leaf. Their piercing-sucking feeding produces chlorotic spots that gradually extend from the veins to the rest of the leaf as density increases up to 80 individuals per leaf (Gnezdilov et al., 2008a; Martynov et al., 2019). Adults can also be found on the adaxial side of the leaves, from where they actively fly to neighbouring plants on sunny days (Martynov et al., 2019). According to Ahn et al. (2005), the development time for the egg of *A. kakogawana* is 20.1, 13.3 and 10.7 days at 20, 25 and 30°C, respectively. Similarly, it takes 29.0, 17.6 and 12.8 days for the nymphs to reach adulthood.

3.1.3. Host range/Species affected

According to the EPPO Global Database (EPPO GD, online), *A. kakogawana* has a narrow host range. Its main host is *Vitis vinifera*, with two additional Vitaceae hosts, *V. amurensis* (Amur grape) and *Parthenocissus quinquefolia* (Virginia creeper), which are considered minor hosts.

3.1.4. Intraspecific diversity

Although there are no reports of intraspecific variation for *A. kakogawana*, Tryapsin et al. (2020) suggest that the holotype of this species described by Matsumura (1932) may differ from specimens reported elsewhere. The reason is that there are no reports of *A. kakogawana* as a pest of cultivated grapes in its native range (i.e. Japan), whereas it is considered a pest of grapes in all the other countries where it has been found up to now (i.e. Republic of Korea, Russia, Ukraine, Bulgaria, Romania, Serbia). Because current identification methods (see 3.1.5) are based on the morphology of the male genitalia (Gnezdilov et al., 2008b), the female holotype described by Matsumura (1932) may even not be conspecific with the males identified in these other countries. This uncertainty does not affect the conclusions of this categorisation, but requires further research to confirm the identity of the species occurring in Japan because two other *Arboridia* spp. (*A. apicalis* (Nawa) and *A. suzukii* (Matsumura)) have been recorded in this country as pests of cultivated grapes (Biosecurity Australia, 2011).

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, there are detection and identification methods for *A. kakogawana*.

¹ An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed, the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (Griessinger & Roy, 2015; EPPO, 2019).

Symptoms

Due to the piercing and sucking feeding habits of *A. kakogawana*, its presence can be inferred from the presence of small chlorotic spots along the central veins of the abaxial side of the leaf. These spots gradually extend and merge, forming large chlorotic zones that cover most of the leaf as the population density grows (Martynov et al., 2019; Tomov, 2020) (Figure 1), especially at the end of the season, in coincidence with highest pest density in the vineyard.



Figure 1: Chlorotic spots caused by *Arboridia kakogawana* on grapevine leaves (Source: EPPO GD-C. Chireceanu (Research & Development Institute for Plant Protection, Romania))

Detection

Yellow sticky traps have been used to monitor *A. kakogawana* adult populations in Ukraine (Martynov et al., 2019) and for its detection in Romania (Chireceanu et al., 2019).

Identification/Description (for full description, see Gnezdilov et al., 2008b)

According to Martynov et al. (2019), the body length of the adult is 2.6–4.0 mm, light yellow or yellowish-green, with brown to orange spots on the forewings and two black spots on the vertex and upper corners of the scutellum. Nymphs are wingless and yellowish green. Gnezdilov et al. (2008b) (Figure 2) provide a detailed description of this species, whose recognition is based on the morphology of the male genitalia.

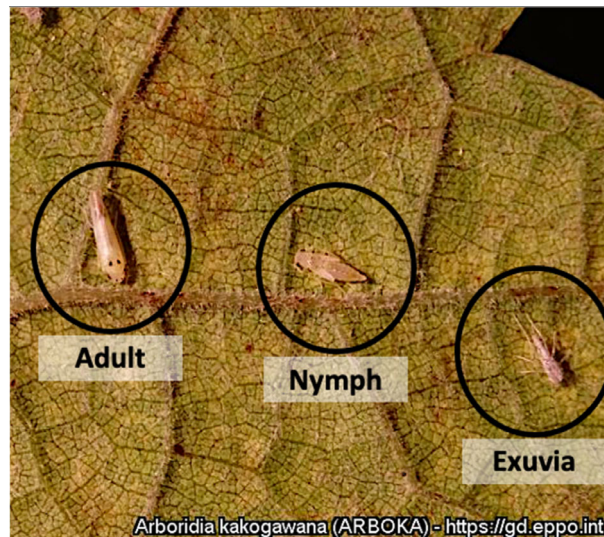


Figure 2: Adult, nymph and nymphal exuvia of *Arboridia kakogawana* on a vinegrape leaf (Source: EPPO GD-C. Chireceanu (Research & Development Institute for Plant Protection, Romania))

Gene bank

Molecular diagnostic methods based on the cytochrome c oxidase I (COI) sequence could be applied to identify *A. kakogawana* with nine accessions in Genbank (<https://www.ncbi.nlm.nih.gov/nucleotide/?term=arboridia+kakogawana>).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Figure 3 shows the reported global distribution of *A. kakogawana* (EPPO GD, online). Outside the EU, this pest is known to occur in China (Xinjiang), Japan (Kyūshū and Honshū Islands), the Republic of Korea, Russia (Far East and Southern Russia), Serbia and Ukraine (EPPO, GD).

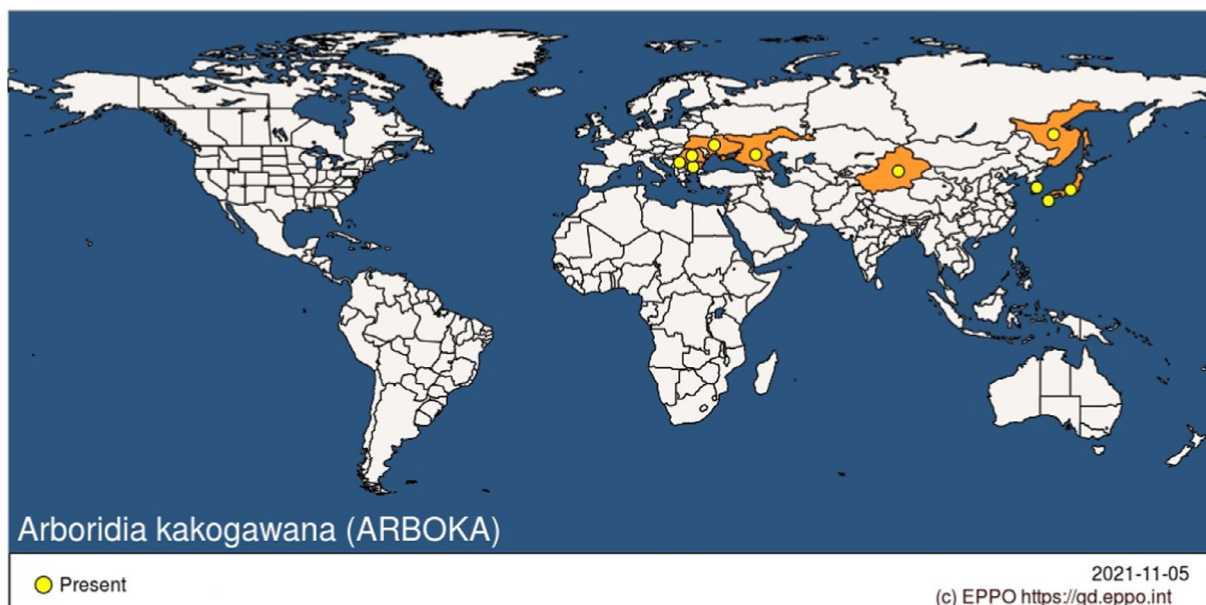


Figure 3: Global distribution of *Arboridia kakogawana* (Source: EPPO GD, accessed 5.11.2021)

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest widely distributed within the EU?

Yes. *A. kakogawana* is known to occur in Romania since 2016 (current situation: present, few occurrences) and in Bulgaria since 2019 (current situation: present, restricted distribution).

Because *A. kakogawana* is not included in the list of Union quarantine pests (Annex II of Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019), no reporting obligations have been established for Member States regarding this species.

A. kakogawana was first identified in Romania in 2018 (> 60,000 adults) on yellow sticky traps set up in a vineyard in Bucharest (Chireceanu et al., 2019). However, a re-examination of the yellow sticky traps used in 2016–2017 in this area demonstrated that *A. kakogawana* was already present there in 2016. Subsequently, in a survey carried out in 2019 in Romania (Chireceanu et al., 2020), *A. kakogawana* was found only in one vineyard out of 16 inspected in the Moldova Hills Region (north-eastern Romania) and 64 additional plantations in 10 additional locations covering the east and the west of the country and including Bucharest (Figure 4a).

According to Tomov (2020), *A. kakogawana* had a limited distribution in Bulgaria in 2019, mostly in the north and the east, along the Black Sea coast, of the country. Because heavily infested plants were found only in towns along the Danube, which is a natural border between Bulgaria and Romania for 470 km, this leafhopper is suspected to have been unintentionally introduced from Romania. As the survey was carried out in autumn, when adult populations in vineyards typically decrease (see Section 3.1.2), this species could be more widespread than reflected by this survey in Bulgaria (Tomov, 2020) (Figure 4b).

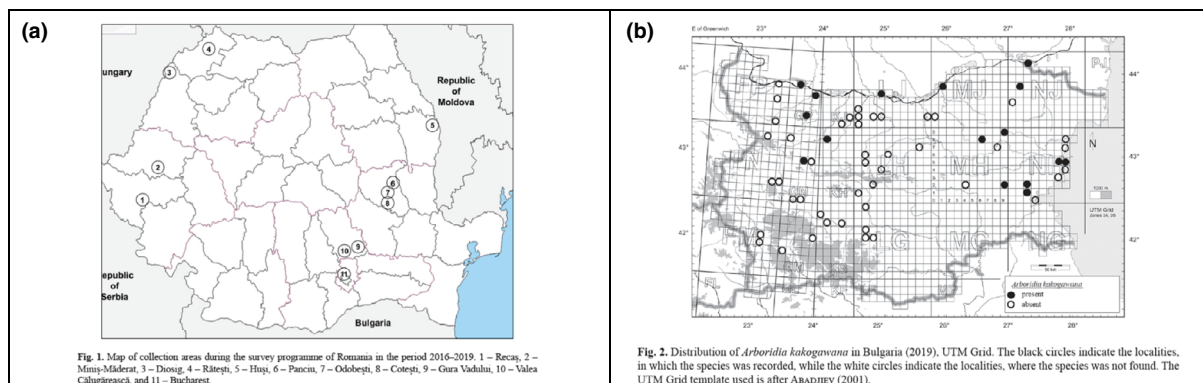


Figure 4: (a) Map of Romania showing the sites sampled for *Arboridia kakogawana* where the insect has been found (numbers 5 and 11 in the map) (Chireceanu et al., 2019, 2020). (b) Map of Bulgaria showing the sites sampled for *A. kakogawana* where the insect has been found (black dots) or not (white dots) (Tomov, 2020)

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

A. kakogawana 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

As specified in Annex VI of 2019/2072, *Vitis* L. plants other than fruit, which are *A. kakogawana* host plants (see Section 3.1.3), are prohibited from entering the EU as plants for planting (Table 2). Additionally, isolated bark of some deciduous trees which can be exploited by *A. kakogawana* adults to overwinter are also prohibited (Table 2).

Table 2: List of plants, plant products and other objects that are *Arboridia kakogawana* hosts whose introduction into the Union from certain third countries is prohibited (Source: Commission Implementing Regulation (EU) 2019/2072, Annex VI)

List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited			
	Description	CN Code	Third country, group of third countries or specific area of third country
4.	Isolated bark of <i>Castanea</i> Mill.	ex 1404 90 00 ex 4401 40 90	All third countries
5.	Isolated bark of <i>Quercus</i> L., other than <i>Quercus suber</i> L.	ex 1404 90 00 ex 4401 40 90	Canada, Mexico, United States
6.	Isolated bark of <i>Acer saccharum</i> Marsh.	ex 1404 90 00 ex 4401 40 90	Canada, Mexico, United States
7.	Isolated bark of <i>Populus</i> L.	ex 1404 90 00 ex 4401 40 90	The Americas
10.	Plants of <i>Vitis</i> L., other than fruits	0602 10 10 0602 20 10 ex 0604 20 90 ex 1404 90 00	Third countries other than Switzerland

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

Comment on plants for planting as a pathway

Yes, *A. kakogawana* has already entered into the EU territory (Bulgaria and Romania), most probably as a combination of natural and human-assisted dispersal (i.e. infested plants).

As a free-living organism, *A. kakogawana* adults can actively disperse. Infested plants for planting provide a longer distance dispersal mechanism both for entry and subsequent spread.

According to Gnezdilov et al. (2008a,b), *A. kakogawana* may have accidentally entered Southern Russia (Krasnodar kraikrai), where it was first detected in 1999, via movement of cargo ships. Further spread within southern Russia and Ukraine (Crimea) may have been a combination of natural and human-assisted dispersal. Similarly, the pest may have subsequently reached Romania (first detected in 2016), Bulgaria (first detected in 2019) and Serbia (first detected in 2020).

Colonies of *A. kakogawana* develop on leaves. Therefore, any stage, either sessile (i.e. egg) or mobile (nymph and adult), of *A. kakogawana* could be carried by plants with leaves. The import into the EU of *Vitis* L. plants is prohibited except from Switzerland (Annex VI, 10.). Because *A. kakogawana* is not known to occur in Switzerland, this entry pathway can be considered as closed. However, the import of *P. quinquefolia* plants from third countries where *A. kakogawana* is known to occur (Russia, Serbia, Ukraine) is permitted and regulated (Annex VII, 10.).

As adults can overwinter on bark of broad-leaved trees, dormant deciduous plants, wood with bark and isolated bark of such trees could provide additional pathways for the entry into the EU from autumn to spring.

The import of deciduous trees and shrubs, intended for planting, other than seeds and plants in tissue culture, from third countries other than [...] Russia [...] Serbia [...], and Ukraine, is regulated (Annex VII, 11.). Therefore, this pathway is regulated and remains open.

The import of bark of some deciduous plants, where *A. kakogawana* can overwinter, is prohibited from some third countries (Annex VI, 4., 5., 6., 7.). Therefore, this pathway is regulated but remains open. Moreover, the import of isolated bark of some plants where *A. kakogawana* can overwinter requires a phytosanitary certificate (Annex XI, Part A, 11.). Likewise, the import of wood also requires a phytosanitary certificate (Annex XI, Part A, 12.).

Because adults also look for buildings to overwinter (i.e. the greenhouse in Ahn et al. (2005) see 3.1.2), they could behave as stowaways on any commodity, even empty containers.

As *A. kakogawana* is associated with leaves (Ahn et al., 2005), in agreement with Biosecurity Australia (2011), grapes are not considered a pathway provided that they are traded free from any leaf.

In the period 2016–2020, $5.2 \cdot 10^6$ t of wood in the rough (CN code 4403; Table 3) and $4.7 \cdot 10^6$ t fuel wood (CN code 4401; Table 4) were imported annually into the EU from countries where *A. kakogawana* is known to occur (Figure 3). A search of interceptions in Europhyt and TRACES databases did not reveal any interception of *A. kakogawana* for the period January 1994 to October 2021 (accessed on 1.10.2021). Although *A. kakogawana* has never been notified to the EU (it should be highlighted that MSs have no obligation to report the occurrence of non-regulated pests), plants for planting, isolated bark and wood with bark are potential entry pathways for this leafhopper into the EU (Table 5).

Table 3: Total amount of wood in the rough (CN code 4403) imported (tons) into the EU (27) from countries where *Arboridia kakogawana* is known to occur

Country/Year	2016	2017	2018	2019	2020
China	5,622.5	2,308.0	1,298.0	1,047.4	2,465.1
Japan	48.1	15.3	47.1	107.5	16.5
Korea, Republic of (South Korea)		0	0		0
Russian Federation (Russia)	5,270,621.0	4,253,358.5	5,117,894.2	4,716,554.9	4,786,085.7
Ukraine	1,314,511.1	477,200.1	327,614.9	1,912.2	2,515.4
Serbia	17,358.2	14,201.5	10,762.8	8,463.9	7,097.1

Table 4: Total amount of fuel wood (CN code 4401) imported (tons) into the EU (27) from countries where *Arboridia kakogawana* is known to occur

Country/Year	2016	2017	2018	2019	2020
China	6,306.9	750.5	2,195.7	1,161.3	1,260.1
Japan	10.0	73.6	49.5	40.2	30.3
Korea, Republic of (South Korea)	63.8	7.9	260.4	0.2	2.6
Russian Federation (Russia)	2,688,984.2	3,217,153.1	3,415,327.1	4,306,393.2	4,623,058.3
Ukraine	1,099,836.9	996,760.9	1,178,284.3	997,599.5	892,604.6
Serbia	39,765.0	23,557.2	57,173.2	35,255.8	12,952.5

Table 5: Potential entry pathways for *Arboridia kakogawana* into the EU 27

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072]
Plants of <i>Vitis</i> L., other than fruits	Any stage (egg, nymph and adult)	Annex VI (10.) prohibits the introduction of plants of <i>Vitis</i> from third countries other than Switzerland. This should be considered as a closed pathway.
Plants of <i>Parthenocissus quinquefolia</i> L. (Planch.), other than fruits	Any stage (egg, nymph and adult)	Annex VII (10.) states the special requirements for introduction into the EU of trees and shrubs, intended for planting, other than seeds and plants in tissue culture, originating in third countries other than [...] parts of Russia, Serbia and Ukraine. These requirements include inspection prior to export. However, no specific requirements are set for <i>A. kakogawana</i> . Because Ukraine, Serbia and parts of Russia are excluded and the pest is known to occur in these countries, this pathway is regulated but not closed.

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072]
Deciduous trees and shrubs, intended for planting, other than seeds and plants in tissue culture	Overwintering adults	Annex VII (11.) requires an official statement that the plants are dormant and free from leaves and originate in third countries other than [...] parts of Russia, Serbia and Ukraine. These requirements include inspection prior to export. However, no specific requirements are set for <i>A kakogawana</i> . Because Ukraine, Serbia and parts of Russia are excluded and the pest is known to occur in these countries, this pathway is regulated but not closed.
Isolated bark	Overwintering adults	Annex VI (4., 5., 6., 7.) prohibits the import of bark of some deciduous plants from some third countries. Annex XI (Part A, 11.) requires a phytosanitary certificate for the import of isolated bark of some overwintering hosts of <i>A. kakogawana</i> . However, no specific requirements are set for <i>A kakogawana</i> . As a proportion of imported consignments but not all are liable to be physically inspected, this pathway is regulated but not closed.
Wood with bark	Overwintering adults	Annex XI (Part A, 12.) requires a phytosanitary certificate for the import of isolated bark of some overwintering hosts of <i>A. kakogawana</i> . However, no specific requirements are set for <i>A kakogawana</i> . As a proportion of imported consignments but not all are liable to be physically inspected, this pathway is regulated but not closed.
Stowaways	Overwintering adults	

Unless moved with plants for planting, there are uncertainties over the pests' ability to transfer to a suitable host following arrival into the EU. Uncertainties also include its ability to find a mate and other Allee effects (effects causing reduced survival of new founding colonies with a small number of individuals) (Tobin et al., 2011) as well as the impact of natural enemies in the EU.

3.4.2. Establishment

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

Yes, *A. kakogawana* would most probably be able to establish in the EU wherever *Vitis* plants are grown.

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 et al., 2000). 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

As noted above (Section 3.4.1), *A. kakogawana* has a restricted host range, which includes *Vitis* and *P. quinquefolia*. Table 6 shows the harvested area of grapes in the EU 27 in recent years. Appendix B provides production statistics for individual member states.

Table 6: Harvested area of grapes in EU 27, 2016–2020 (thousand ha). Source EUROSTAT (accessed 25/4/2021)

Crop	Code	2016	2017	2018	2019	2020
Grapes	W1000	3,136.04	3,134.93	3,137.17	3,160.68	NA

3.4.2.2. Climatic conditions affecting establishment

On the one hand, *A. kakogawana* is known to occur in countries where BSk (cold semi-arid), Cfa (humid subtropical), Cfb (oceanic), Csa (hot-summer Mediterranean), Csb (warm-summer Mediterranean), Dfb (humid-continental) and Dfc (subarctic) climate types also occurring in the EU can be found. On the other hand, vineyards are usually grown in areas where the average temperature during the ripening season ranges from 12°C to 22°C (Spellman, 1999; Cardell et al., 2019). Although grapevines can tolerate temperatures as low as –20°C during the early stages of growth, their production is especially vulnerable to frost during spring (Spellman, 1999; Cardell et al., 2019). Therefore, the subarctic climate (Dfc) would not be conducive for the establishment of this leafhopper. Consequently, climatic conditions would not limit the ability of *A. kakogawana* to establish in most of the EU territories, with Scandinavian and Baltic EU MS being mostly unsuitable (Figure 5).

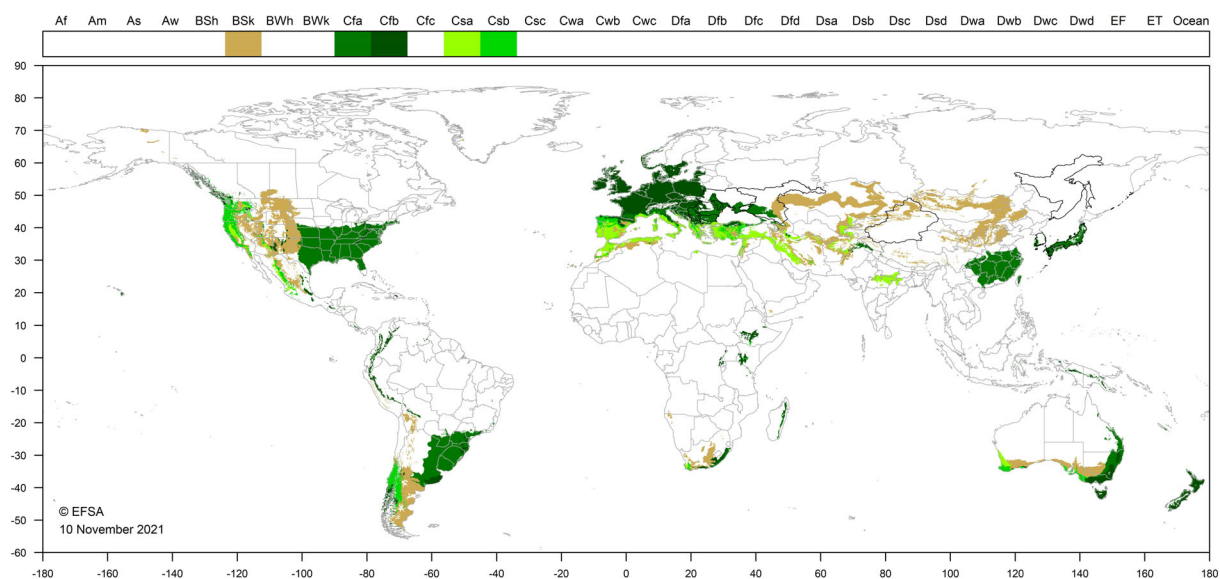


Figure 5: Occurrence of BSk, Cfa, Cfb, Csa and Csb climate types in the World

3.4.3. Spread

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

Adults of *A. kakogawana* can fly. Spread could be both active and passive, with human-assisted movement of infested plants, wood with bark, and isolated bark being the most important spread mechanisms.

Comment on plants for planting as a mechanism of spread

Plants for planting with leaves (*Vitis* and *P. quinquefolia*) or without them but with bark (dormant deciduous plants) could provide the main mechanism of spread for *A. kakogawana*.

According to Tomov (2020), the distribution pattern of *A. kakogawana* in Bulgaria suggests that its dispersal is most probably human-mediated, and the main means of spread are plants for planting and vehicles, where this species would behave as a stowaway.

3.5. Impacts

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

Yes, the introduction of *A. kakogawana* would most probably have an economic impact on the EU territory.

A. kakogawana is considered as a phytosanitary risk for grapevine production due to the feeding of nymphs and adults on leaves, which consequently affects grape maturation (Ahn et al., 2005; Gnezdilov et al., 2008b; Chireceanu et al., 2019). Damage is usually higher in leaves in the lower part of the canopy. The reduction of the photosynthesising leaf surface has an extremely negative effect on the quality of the grapes (Martynov et al., 2019). According to Martynov et al. (2019), the percentage of damaged leaves at the end of the summer may reach 80–99% of the total number of leaves. The severity of the damage depends on the grape cultivar, and this may be related to leaf pubescence, which may hamper the development of *A. kakogawana*. Based on the damage *A. kakogawana* causes in non-EU vineyards (including some cultivars grown in the EU, as Cabernet-Sauvignon), it can pose a serious threat to grapevine production in the EU.

Interestingly, this insect is not considered a pest in Japan (Tryapsin et al., 2020), where it was originally described (Matsumura, 1931, 1932).

3.6. Available measures and their limitations

Are there measures available to prevent the entry into the EU (and spread for pests already present) such that the risk becomes mitigated?

Yes, some plants for planting from third countries are banned from entering into the EU (see Sections 3.3.2 and 3.4.1). Other plants, as well as isolated bark and wood with bark require a phytosanitary certificate (see section 3.4.1) and could be further sourced from areas free of *A. kakogawana* (see section 3.6.1).

3.6.1. Identification of potential additional measures

Phytosanitary measures are currently applied to some plants for planting (see Section 3.3 for prohibitions). Therefore, this entry pathway can be considered as partly closed. However, current regulations applied to other plants for planting as well as to isolated bark and wood with bark (see Section 3.4.1), do not specifically consider *A. kakogawana*. As these pathways are currently not prohibited for import, potential additional measures are listed in Tables 7 and 8.

3.6.1.1. Additional potential risk reduction options

Potential additional control measures are listed in Table 7.

Table 7: 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 (<u>Blue underline</u> = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Require pest freedom	Used to mitigate likelihood of infestation by specified pest at origin, hence to mitigate entry. Imports of susceptible commodities could be sourced from <i>A. kakogawana</i> -free countries/areas	Entry/Spread
<u>Growing plants in isolation</u>	Description of possible exclusion conditions that could be implemented to isolate the crop from pests and if applicable relevant vectors. E.g. a dedicated structure such as glass or plastic greenhouses. Used to mitigate likelihood of infestation by specified pest in vicinity of growing site. Nurseries of potential hosts (i.e. grapevine, deciduous trees) could exploit mesh-houses and other exclusion methods to produce plants for planting free of <i>A. kakogawana</i> .	Entry (reduce infestation)/ Spread/Impact

Control measure/Risk reduction option (Blue underline= Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/establishment/ spread/impact)
Timing of planting and harvesting	<p>The objective is to produce phenological asynchrony in pest/crop interactions by acting on or benefiting from specific cropping factors such as: cultivars, climatic conditions, timing of the sowing or planting and level of maturity/age of the plant seasonal timing of planting and harvesting.</p> <p>Used to mitigate likelihood of entry of pests associated with particular phenological stages of host. Because <i>A. kakogawana</i> lives on leaves, dormant plants for planting of <i>Vitis</i> L. and <i>P. quinquefolia</i> without leaves could decrease the likelihood of infestation.</p>	Entry (reduce contamination/infestation)/Spread/Impact
Chemical treatments on crops including reproductive material	Used to mitigate likelihood of infestation of pests susceptible to chemical treatments. Farmers usually apply acaricides against <i>O. mangiferus</i> to reduce their densities in the field	Entry/Establishment/Impact
Chemical treatments on consignments or during processing	<p>Use of chemical compounds that may be applied to plants or to plant products after harvest, during process or packaging operations and storage.</p> <p>The treatments addressed in this information sheet are:</p> <ol style="list-style-type: none"> fumigation; spraying/dipping pesticides; surface disinfectants; process additives; protective compounds <p>Used to mitigate likelihood of infestation of pests susceptible to chemical treatments. Plants for planting, isolated bark and wood with bark could be subjected to this type of treatments.</p>	Entry/Spread
Physical treatments on consignments or during processing	<p>This information sheet deals with the following categories of physical treatments: irradiation/ionisation; mechanical cleaning (brushing, washing); sorting and grading, and; removal of plant parts (e.g. debarking wood). This information sheet does not address heat and cold treatment (information sheet 1.14); roguing and pruning (information sheet 1.12).</p> <p>Used to mitigate likelihood of infestation of pests susceptible to physical treatments. Plants for planting and, especially, both isolated bark and wood with bark could be subjected to this type of treatments (e.g. radiation, washing).</p>	Entry/Spread
Heat and cold treatments	<p>Controlled temperature treatments aimed to kill or inactivate pests without causing any unacceptable prejudice to the treated material itself. The measures addressed in this information sheet are: autoclaving; steam; hot water; hot air; cold treatment.</p> <p>Used to mitigate likelihood of infestation of pests susceptible to physical treatments. Plants for planting and, especially, both isolated bark and wood with bark could be subjected to this type of treatments.</p>	Entry/Spread

Control measure/Risk reduction option (<u>Blue underline</u> = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Controlled atmosphere	Treatment of plants by storage in a modified atmosphere (including modified humidity, O ₂ , CO ₂ , temperature, pressure). Used to mitigate likelihood of infestation of pests susceptible to modified atmosphere (usually applied during transport) hence to mitigate entry	Entry/ Spread

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 8.

Table 8: Selected supporting measures (a full list is available in EFSA PLH Panel et al., 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. Used to mitigate likelihood of infestation by specified pest at origin.	Entry/Establishment/Spread
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) Used to attest which of the above requirements have been applied	Entry/Spread
Certification of reproductive material (voluntary/official)	Plants come from within an approved propagation scheme and are certified pest free (level of infestation) following testing; Used to mitigate pests that are included in a certification scheme.	Entry/Spread

3.6.1.3. Biological or technical factors limiting the effectiveness of measures to prevent the entry (and spread when applicable) of the pest

This is a minute species which may be difficult to detect via visual examination when infestation is low/incipient, especially on bark.

3.7. Uncertainty

The main uncertainty refers to the fact that *A. kakogawana* is not considered a pest in Japan, the country where it was originally described. Because two additional *Arboridia* spp. (*A. apicalis* and *A. suzukii*) are considered major pests of Japanese grapes (Ahn et al., 2005), it would be interesting to ascertain the relationship between these three congeneric species, as well as that of populations of

A. kakogawana in Japan and elsewhere. This uncertainty, though, does not affect the conclusion of this categorisation.

4. Conclusions

A. kakogawana satisfies all criteria (Table 9) that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest (QP).

Table 9: 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 <i>A. kakogawana</i> has been properly established.	None
Absence/presence of the pest in the EU (Section 3.2)	<i>A. kakogawana</i> occurs in Romania since 2016 (present, few occurrences) and in Bulgaria since 2019 (present, restricted distribution).	The insect could be more widely distributed than thought
Regulatory status (Section 3.3)	<i>A. kakogawana</i> is currently not regulated in the EU.	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	<i>A. kakogawana</i> could further enter into, establish in, and spread within the EU territory. Main entry pathways are: <ul style="list-style-type: none"> Plants for planting (<i>Vitis L.</i>) (regulated, closed) Plants of <i>Parthenocissus quinquefolia</i> (regulated, open) Dormant plants of deciduous plants (regulated, open) Isolated bark (regulated, open) Wood with bark (regulated, open) 	None
Potential for consequences in the EU (Section 3.5)	The introduction of <i>A. kakogawana</i> into the EU may have an economic impact on grapevine production.	None
Available measures (Section 3.6)	There are measures to prevent the entry, establishment and spread of <i>A. kakogawana</i> within the EU territory, such as sourcing plants from PFA.	None
Conclusion (Section 4)	<i>A. kakogawana</i> satisfies all criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest (QP).	None
Aspects of assessment to focus on/scenarios to address in future if appropriate:	<i>A. kakogawana</i> was originally described from Japan, where this species is not considered a pest. Two additional <i>Arboridia</i> spp. (<i>A. apicalis</i> and <i>A. suzukii</i>) are considered major pests of Japanese grapes (Ahn et al., 2005). It would be interesting to ascertain the relationship between these three congeneric species, as well as that of populations of <i>A. kakogawana</i> in Japan and elsewhere.	

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Abbreviations

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
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, 2018)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2018)
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, 2018)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2018)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2018)
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, 2010).
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, 2018)
Pathway	Any means that allows the entry or spread of a pest (FAO, 2018)
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, 2018)
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, 2018)
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, 2018)

Appendix A – *Arboridia kakogawana* host plants/species affected

Source: EPPO Global Database (EPPO online)

Host	EPPO code	Reference(s)
<i>Family Vitaceae</i>		
<i>Parthenocissus quinquefolia</i>	PRTQU	Chireceanu et al. (2019)
<i>Vitis amurensis</i>	VITAM	Chireceanu et al. (2019)
<i>Vitis vinifera</i>	VITVI	Gnezdilov et al. (2008b)

Appendix B – Distribution of *Arboridia kakogawana*

Distribution records based on EPPO Global Database (EPPO, online).

Continent	Country	Subnational (e.g. State)	Status	Reference
Africa			No records, presumed absent	
America			No records, presumed absent	
Asia	China	Xinjiang	Present, restricted distribution	EPPO GD
	Japan	Honshu	Present	Matsumura (1932)
		Kyushu	Present, no details	EPPO GD
	Korea, Republic		Present, no details	EPPO GD
	Russia	Far East	Present, no details	EPPO GD
Europe	Bulgaria		Present, restricted distribution	EPPO GD
	Romania		Present, few occurrences	CABI, CPC
	Russia	Southern Russia	Present, no details	EPPO GD
	Serbia		Present, restricted distribution	EPPO GD
	Ukraine		Present	EPPO GD
Oceania			No records, presumed absent	

Appendix C – EU 27 and member state cultivation/harvested/production area of grape, the main host of *Arboridia kakogawana* (thousands ha)

Eurostat data accessed on 27/4/2021

Grapes (W1000)	2016	2017	2018	2019	2020
EU 27	3,136.04	3,134.93	3,137.17	3,160.68	:
Belgium	0.24	0.24	0.3	0.38	0.49
Bulgaria	36.55	34.11	34.11	30.05	:
Czechia	15.8	15.81	15.94	16.08	16.14
Denmark	0	0	0	0	0
Germany	:	:	:	:	:
Estonia	0	0	0	0	0
Ireland	0	0	0	0	0
Greece	98.09	101.75	100.34	101.85	101.85
Spain	935.11	937.76	939.92	936.89	931.96
France	751.69	750.46	750.62	755.47	758.86
Croatia	23.4	21.9	20.51	19.82	20.63
Italy	673.76	670.09	675.82	697.91	703.9
Cyprus	6.07	5.93	6.67	6.67	6.79
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	1.26	1.26	1.25	1.24	1.24
Hungary	68.12	67.08	66.06	64.92	62.9
Malta	0.68	0.68	0.42	0.42	0.42
Netherlands	0.14	0.16	0.17	0.16	0.17
Austria	46.49	48.05	48.65	48.72	48.06
Poland	0.62	0.67	0.73	0.74	0.76
Portugal	179.05	178.84	178.78	178.78	178.78
Romania	174.17	175.32	172.8	176.34	176.76
Slovenia	15.84	15.86	15.65	15.57	15.29
Slovakia	8.71	8.47	8.01	7.92	7.73
Finland	0	0	0	0	0
Sweden	0.05	0.04	0.05	0.05	0.06