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ALEUROCANTHUS CAMELLIAE KANMIYA & KASAI, 2011 (HEMIPTERA: ALEYRODIDAE), A NEWLY INTERCEPTED WHITEFLY SPECIES IN CROATIA

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The Camellia spiny whitefly *Aleurocanthus camelliae* Kanmiya & Kasai, 2011 (Hemiptera: Aleyrodidae) was intercepted for the first time during 2022 in consignments with ornamental *Camellia* spp. seedlings originating from Italy, in seven plant nurseries and garden centres in Croatia. This Eastern Palearctic whitefly species is an important pest, especially in tea cultivation of East Asia. However, in Croatia the species has been detected at very low population densities without any significant damage to the infested ornamental plants of the genus *Camellia* L. From the infested leaves collected on each location, whitefly puparia and pupal cases were slide-mounted and morphologically identified in laboratory as the species *A. camelliae*. It is assumed that in the case of spreading and domestication in Croatia, *A. camelliae* could potentially present a phytosanitary risk for the camellias planted in gardens and parks in the Kvarner area.

Key words: Aleyrodidae, *Aleurocatnhus camelliae*, camellia, interception, Croatia

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Kamelijin trnoviti štitasti moljac *Aleurocanthus camelliae* Kanmiya & Kasai, 2011 (Hemiptera: Aleyrodidae) je po prvi put nađen tijekom 2022. u pošiljkama sadnica ukrasnih vrsta *Camellia* spp. podrijetlom iz Italije u sedam rasadnika bilja i vrtnih centara u Hrvatskoj. Ova istočno-palearktička vrsta štitastog moljca je važan štetnik kultiviranog bilja, posebice u plantažama čaja na istoku Azije. U Hrvatskoj je vrsta zabilježena u vrlo niskoj gustoći populacije, bez značajnih šteta na napadnutim ukrasnim biljnim vrstama iz roda *Camellia* L. Pupariji i egzuviji štitastog moljca na prikupljenim napadnutim listovima sa svakog lokaliteta su preparirani i morfološki određeni u laboratoriju kao vrsta *A. camelliae*. Pretpostavlja se da bi u slučaju širenja i udomaćenja, vrsta *A. camelliae* mogla potencijalno predstavljati fitosanitarni rizik za kamelije posađene na okućnicama i u parkovima na području Kvarnera.

Ključne riječi: Aleyrodidae, *Aleurocanthus camelliae*, kamelija, prvi unos, Hrvatska

INTRODUCTION

The hemipteran insect group of Aleyrodidae (commonly known as whiteflies) includes 1556 described species placed in 161 genera (Martin & Mound, 2007). Aleyrodidae cause damage to plants directly by sucking sap and indirectly by transmitting plant viruses and excreting honeydew, which coats above-ground plant organs and leads to mould infection. The taxonomy of the group and the identification of the species is

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mainly based on the morphology of the fourth larval instar called "puparium". The paleotropical genus *Aleurocanthus* Quaintance & Baker, 1924 comprises 91 described species world-wide, feeding on both monocotyledonous and dicotyledonous host plants (Ouvrard & Martin, 2022). Only two species occur in Europe, *Aleurocanthus spiniferus* (Quaintance, 1903) and *Aleurocanthus camelliae* Kanmiya & Kasai, 2011. *A. spiniferus* originated in tropical Asia and has spread to Africa, Australia and the Pacific islands. In the EU the species has the status of a quarantine harmful organism. In Europe, it was reported for the first time in Italy (Porcelli, 2008). Since than it has been reported from Croatia, Greece, Montenegro and Albania (Eppo, 2022). In Croatia, it was first intercepted and eradicated in 2012 (Šimala & Masten Milek, 2013), and then found again in 2018 in a mandarin orange orchard and on surrounding wild flora along the southernmost coast of the country (Šimala *et al*., 2019). For the last five years the pest has continued to spread through the area of Konavle, on the islands of Hvar and Brač, as well as in surroundings of Dubrovnik and Makarska (Šimala *& al*., 2020). As a new member of the Croatian fauna, this invasive pest presents a high phytosanitary risk to various agricultural crops, in particular to citrus orchards in the Neretva valley. *A. spiniferus* is highly polyphagous insect that feeds on members of at least 38 plant families, with a preference for host plants from genera *Citrus* L., *Pyrus* L. and *Vitis* L. (Cioffi *& al*., 2013).

Species *A. camelliae* is probably native to China, and from there it was likely introduced into Japan and Indonesia. Apart from in these East Asian countries, *A. camelliae* has until now only been recorded in the Netherlands (Jansen & Porcelli, 2008) and in 2020 in Italy (Rizzo *& al*., 2021). This species is recorded from plants of the genera *Camellia* L., *Cleyera* Thunb., *Eurya* Thunb., *Illicum* L. and *Zanthoxylum* L. It is an important pest of tea plants *(Camellia sinensis* (L.) Kuntze) in East Asia (Rizzo *& al*., 2021). Since *A. camelliae* is a new whitefly species for the entomofauna of Croatia, in this publication we are providing a morphological description of the puparium as seen in the field and under a microscope, with original photos. There is also discussion regarding its distinction from the morphologically closely related species *A. spiniferus,* as well as the possibility of its domestication and potential phytosanitary risk for ornamental camellias.

MATERIALS AND METHODS

During visual surveys of camellia plants in plant nurseries and garden centres in Croatia in 2022, dark whitefly larvae were observed on the lower surfaces of inspected leaves. The leaf samples with preimaginal whitefly stages, collected on each location, were placed and stored dry in envelopes until laboratory analysis (Martin, 1987). In the laboratory, whitefly puparia and pupal cases were picked from the leaves with an entomological needle, bleached in a freshly prepared mixture of 30 % hydrogen peroxide and 30 % ammonium solution, placed in clove oil for about 15 minutes and finally slide-mounted in diluted Canada balsam as permanent microscopic slides, according to a modified method by Watson & Chandler (1999). Bleaching was stopped when black cuticle of puparia/pupal cases became brown and translucent by adding of a few drops of glacial acetic acid. Collected specimens of whiteflies were identified to the species level on the basis of morphological characters of puparium and/or pupal case according to keys provided by Kanmiya *& al.* (2011) and by Jansen & Porcelli (2018). For an accurate identification, a binocular dissecting microscope Olympus SZX

7 equipped with Olympus LC 20 digital camera and optical microscope Olympus BX 51 equipped with Olympus DP 25 digital camera were used. Confirmation of identification of whitefly species was done by specialists from Netherlands Institute for Vectors, Invasive plants and Plant health, Netherlands Food and Consumer Product Safety Authority National Reference Centre, Wageningen, The Netherlands. Slide-mounted specimens were deposited, after drying for about two months, in the collection of the Laboratory for zoology of the Centre for Plant Protection – CAAF.

RESULTS AND DISCUSSION

Infested leaves with specimens of *A. camelliae* were collected from potted camelias grown outdoors and in greenhouses in seven nurseries and garden centres in five counties (Fig. 1) during regular phytosanitary inspection of plant material as a part of a national survey of quarantine species: *Aleurocanthus woglumi* Ashby, 1915, *Aleurocanthus citriperdus* Quaimtance & Baker, 1916 and *A. spiniferus*.

Fig. 1. Localities where the species *Aleurocanthus camelliae* was recorded (red marks) (Google Earth).

The whitefly infestation of camellia plants was generally sparse. Infested plants did not show any significant damage. Only preimaginal stages of this whitefly species, scattered sporadically or as small colonies on the lower surface of a few leaves per plant, were observed (Fig. 2).

Some of the collected puparia were parasitized by an unknown species of endophagous parasitic wasp, showing the typical round emergence hole of an adult parasitoid. A very obscure amount of sooty mould, as a consequence of low whitefly infestation, was present on camellia plants. Not one adult *A. camelliae* was detected on any inspected plants. Adults of this species are dark, contrary to the vast majority of whitefly species whose adults are typically white. Infested seedlings of camellias on all localities (Tab. 1) were delivered from Italy, where the pest was reported for the first

time in 2020 (Rizzo *et al.*, 2021). Since *A. camelliae* is a non-regulated pest, no specific phytosanitary measures have been undertaken by importers of consignments of the infested plants.

Puparia of the genus *Aleurocanthus* are readily recognised by the presence of many stout conspicuous spines on the dorsal disc and submargin, the white marginal waxy fringes and the carriage of exuviae of earlier instars in a stack on the dorsum (Fig. 3). They are often sexually dimorphic, with male puparia much smaller than female. Their cuticle is usually dark, but in some species is pale (Martin, 1999; Dubey & ko, 2012).

Tab. 1. Faunistic data for findings of species *Aleurocanthus camelliae.*

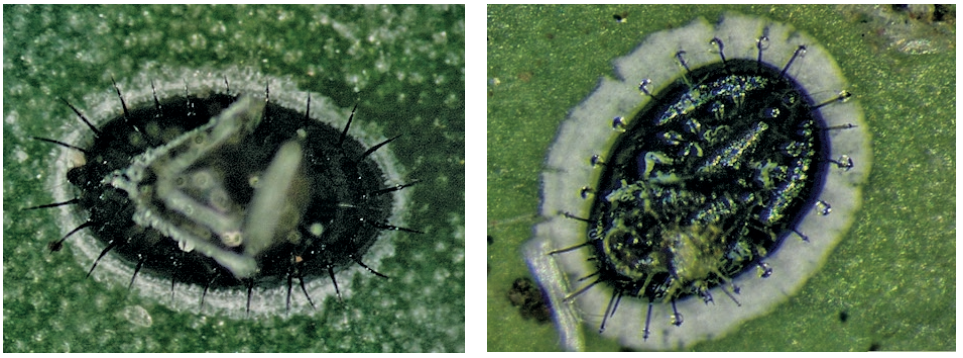
County	Locality (Geographic position)	Plant species	Plant family	Date of sampling
Zadar	Murvica 1 (44°8′28.10′′N 15°18′50.34′′E)	*Camellia japonica* L.	Theaceae	18.7.2022.
	Murvica 2 (44°8′12.45′′N 15°18′51.65′′E)	*Camellia sasanqua* Thunb.	Theaceae	18.10.2022.
Varaždin	Varaždin (46°18′39.47′′N 16°19′35.32′′E)	*Camellia japonica* L.	Theaceae	29.7.2022.
Split-Dalmatia	Split (43°30′57.1′′N 16°30′8.20′′E)	*Camellia japonica* L.	Theaceae	19.10.2022.
Šibenik-Knin	Šibenska Dubrava (43°44′6.22′′N 15°56′49.31′′E)	*Camellia japonica* L.	Theaceae	20.10.2022.
Istra	Žbandaj (45°12′35.8′′N 13°41′32.4′′E)	*Camellia japonica* L.	Theaceae	14.11.2022.
	Umag (45°25′34.7′′N 13°33′0.05′′E)	*Camellia japonica* L.	Theaceae	14.11.2022.

Fig. 2. *Aleurocanthus camelliae* larvae on the underside of *Camellia japonica* leaf (Photo by M. Pintar).

Fig. 3. Exuviae of the 2nd and 3rd larval instars attached to puparium of *Aleurocanthus camelliae* (Photo by M. Šimala).

A. camelliae is a cryptic species complex, morphologically near to *A. spiniferus*, described recently from Japan (Kanmiya *et al*., 2011; Andrianto & Kasai, 2022). Puparia of these two related species present in Europe are very similar in appearance in the field and microscopically. In the field, metallic black puparia of *A. camelliae,* fixed on the underside of leaves, are slightly smaller and narrower than *A. spiniferus,* with the white marginal wax fringe less developed and narrower (Fig. 4 and 5). However, the most significant difference is in the host plant acceptance, especially regarding citrus fruits. *Citrus* species are one of the preferred host plants for *A. spiniferus*, while *A. camelliae* prefers mostly plants from the family Theaceae and does not inhabit *Citrus* plants (Rutaceae). Nevertheless, according to Kanmiya *et al*. (2011), adult females of *A. camelliae* could lay eggs on citrus leaves, but larvae do not finish their development. This scientific knowledge is important for citrus fruit growers in Croatia, especially in the Neretva valley.

Based on the literature description (Kanmiya *et al*., 2011; Wang *et al*., 2014; Jansen & Porcelli, 2018) and our own microscopic observations, the main morphological characters of *A. camelliae* puparium (Fig. 6) are: length 0,98-1,23 mm in female and 0,65-0,85 mm in male, width 0,62-0,85 mm in female and 0,39-0,57 mm in male; cephalic eyespot ovoid, clearly defined with a distinct rim, located laterally and very close to the base



Figs. 4 and **5**. Puparium of *Aleurocanthus camelliae* (left) and *Aleurocanthus spiniferus* (right) (Photo by M. Šimala).

Fig. 6. Microscopic slide of *Aleurocanthus camelliae* puparium (arrows indicate cephalic eyespot) (Photo by M. Šimala).

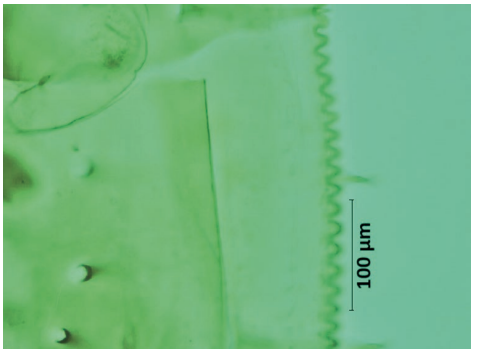


Fig. 7. Marginal teeth of *Aleurocanthus camelliae* puparium (Photo by M. Šimala).

of 3rd submarginal spine (Fig. 6); margin crenulated with 6-8 marginal teeth/100 μm (female) or 7-10 marginal teeth/100 μm (male) (Fig. 7); longitudinal and transverse moulting sutures reach the margin; cephalic, 8th abdominal and caudal setae present; 10-11 pairs of long glandular spines along the submargin, 16 pairs on the subdorsum (9 pairs in the cephalothorax and 7 pairs in the abdomen) and 3 pairs on the submedian part of abdominal segments I-III; sockets of 2nd to 5th submedian abdominal spines lined up roughly linearly (Fig. 8); 3-5 microscopic papillae lined outside submarginal spines between each two spines (Fig. 9); vasiform orifice distinctly elevated, obtuse, subcordate, fully occupied by the similarly shaped operculum, which conceals the lingula. The most noticeable microscopic diagnostic characters used to distinguish puparia of the species *A. camelliae* and *A. spiniferus* morphologically are position of cephalic eye spot, margin crenulation, arrangement of submedian abdominal spines and position of microscopic papillae on submargin.

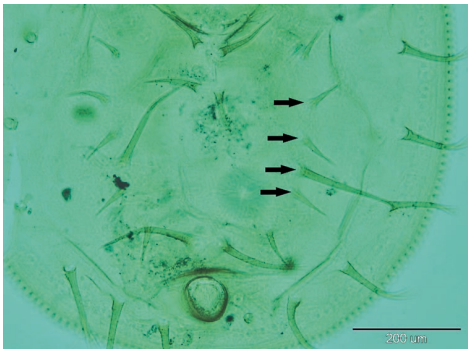


Fig. 8. Submedian abdominal spines on *Aleurocanthus camelliae* puparium (arrows indicate 2nd to 5th submedian abdominal spines) (Photo by M. Šimala).

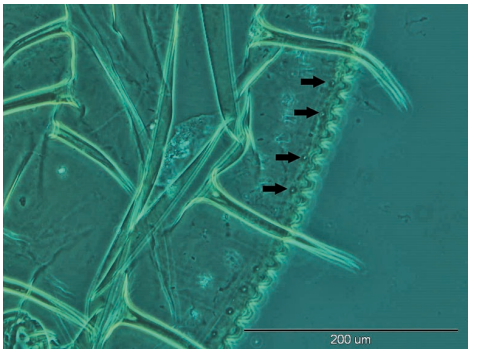


Fig. 9. Microscopic papillae on submargin of *Aleurocanthus camelliae* puparium (phase contrast) (Photo by M. Šimala).

Since adults of *A. camelliae,* like all whiteflies, cannot fly long distances, international trade and movement of their host plants is the main pathway for their spread. Worldwide dispersion of *A. camelliae* is strongly associated with mobility of plants from the family Theaceae through human activities, such as global trade of *C. sinensis, Camellia japonica* L., *Camellia sasanqua* Thunb. and *Eurya japonica* Thunb. (Andrianto & Kasai, 2022). Therefore, it is not surprising that *A. camelliae* was intercepted in Croatia, since large quantities of planting material are imported from Italy, where the pest was detected in 2020 (Rizzo *et al.*, 2021). The persistence of *A. camelliae* outdoors in Pistoia province (Tuscany), implies that the species could also survive in the similar climatic conditions of Croatia. In this case, the pest could also be transferred on infested seedlings and spread from nurseries to public greenery, parks and private gardens, especially in the Kvarner area, where camellia is one of the most recognizable botanical symbols of the destination, and could consequently cause some minor damage to the plants.

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