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FIRST RECORD IN EUROPE OF *CINARA SHINJII* INOUE (APHIDIDAE LACHNINAE) ON THE JAPANESE WHITE PINE, *PINUS PARVIFLORA* SIEBOLD & ZUCC.

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Scheurer S., Binazzi A., Roversi P.F., Binazzi F. – First record in Europe of *Cinara shinjii* Inouye (Aphididae Lachninae) on the Japanese white pine, *Pinus parviflora* Siebold & Zucc.

The Japanese *Cinara shinjii* Inouye, was occasionally collected in a private garden in Raddusch-Spreewald (Brandenburg), Germany, on an ornamental Japanese white pine, *Pinus parviflora* Siebold & Zucc. The species is redescribed providing morphological data of apterae, alatae virginoparae and oviparae females, in order to facilitate morphological identification. This finding, that represents the first record of *C. shinjii* in Europe, is evaluated in the context of the emerging issue represented by biological invasions. A brief overview of *Cinara* species alien to Europe is presented with a short critical analysis of their distribution as well as of their ecological and economic impact.

KEY WORDS: Japanese pines, aphids, new record, Germany, alien species

INTRODUCTION

Pinus parviflora Sieb. & Zucc., is widespread in either montane or subalpine zones of Japan and its range is fragmented in several discrete populations. This species, is part of the *P. parviflora* complex extending from Vietnam to the Hokkaido Island in Japan (MIROV, 1967), with *Pinus parviflora*, var. *pentaphylla* (Mayr) Henry and var. *parviflora*, being the two currently recognised geographical varieties (YAGASHIRA, 1964; OHWI & NAKAIKE, 1978). Although these varieties have been deeply investigated, no definitive consensus has been achieved on their taxonomic status (TANI *et al.*, 2003).

In its native range, characterized by abundant annual rainfall (1000-3000 mm), *P. parviflora* is a large pine growing up to 15–25 m in height. It is usually as broad as tall with a wide and dense crown. Needles are in bundles of five, 5 - 6 cm in length, and cones are 4–7 cm long bearing broad, rounded scales.

However, in other non-endemic regions of the world, where it has been introduced, a reduced growth has been generally reported. For this reason, in western countries, it is mainly used in parks and gardens as ornamental or bonsai tree. In particular, in the region of Brandenburg, it reaches at most 5-6 m in height due to low annual precipitations (only 500 mm) and adverse climatic conditions.

In October 2017, dense colonies of aphids were detected on a *P. parviflora* located in a garden of the Raddusch village in Spreewald, south-east Berlin, Germany. The colonized pine was about two meters in height. Aphids were noted because of the abundant and

glowing honeydew covering pine needles, as well as for the active presence of *Vespula vulgaris* (L.) flying around the colonies. Conversely, no ants were found to attend the aphids. Though intense feeding activity was observed on shoots and one-to-three years old branches, no damages were reported on the host tree. Specimens were identified as *Cinara shinjii* Inouye, 1938, according to the keys of INOUE (1970), EASTOP *et al.* (1998) and BLACKMAN & EASTOP (1994, 2017). *C. shinjii* is known to be associated with *Pinus parviflora* in Japan but it was also recorded on the same host pine in South Korea (SEO, 1994). Colonies have been reported to feed also on pine stems, avoiding, though, the most sun-exposed parts of the trunk and preferentially colonizing shadowy areas where they are often attended by *Lasius niger* L. (INOUE, 1938, 1970). This finding in Spreewald (Berlin) is the first record from Europe of *C. shinjii*.

MATERIALS AND METHODS

In October 17, 2017, 1 aptera vivipara, 7 apterae oviparae and 4 alatae viviparae were collected on a young *P. parviflora* ornamental tree located in a garden of the already mentioned site. The sample was collected by shaking twigs and branches over a white cotton towel. Specimens were stored in 80% ethanol and then mounted on 12 slides. All of them were suitable for examination and measurements. Specimens are deposited in the CREA Research Center collection.

INOUE (1938) provided a rather detailed description of the four biological morphs of *C. shinjii* (nomen

novum) previously described by SHINJI (1922) sub *Lachnus fasciatus* (nec Burmeister, 1835). Nevertheless, after these new records from Germany, the former work could be further improved with a short but detailed description of the species more focused on biometric parameters.

Cinara shinjii Inouye, 1938

APTEROUS VIVIPAROUS FEMALE (from 1 specimen)

(Fig. I)

Medium-sized body, 3.36 mm long, color unknown when alive, with four rows of roundish intersegmental sclerites on dorsal abdomen. Siphuncular cones dark brown and medium sized (.360-.366 mm) with marked apical flange. Head, pro-, meso- and metathorax slightly sclerotized. Abdominal tergites 1st - 2nd with a mesial sclerotized patch with uneven borders. Tergites 3rd to 7th with numerous fragmented sclerotized patches, some of them fused each other, the same color of siphuncular cones. Tergite 8th bears a well sclerified solid bar interrupted in the middle. Cauda, anal and genital plates dark brown the same color of cones. Antennae rather whitish except for darker segments I, II, the distal parts of III, IV and V and the whole VI. Rostrum with dark brown apical segments the same color of coxae. Legs with light brown basal half of femora, which have dark brown distal half, more marked in the hind ones. Knees and the short proximal part of tibiae blackish. Fore and middle tibiae whitish except for their end and tarsi, which are light brown. Hind tibiae with the distal half and tarsi light brown.

Length of antennal segments, III, .510-.516, IV, .180-.186, V, .228-.234, VI, .174-.180 mm long (p.t., .042-.054 with 4 subapical setae); secondary rhinaria, 1 on III, 1-2 on IV, 1 on V; rostral segments IV and V, .138 and .063; hind tibiae, 2.03 mm long; 1st hind tarsal segment, basal length, .042, dorsal length, .060, ventral length, .114; 2nd hind tarsal segment, .228 mm long.

Antennal hairs brown, those on segment III .102 mm long. Abdominal tergites 1st to 7th with numerous brown and strong hairs, those on tergites 5th and 7th, .126 and .132 mm long, respectively; tergite 8th and genital plate bearing 19 and 22 hairs, respectively; fourth rostral segment with 5 accessory hairs; hind tibiae with numerous strong, brown hairs, the longest .126 mm long, a little longer than the tibial diameter at the insertion point.

ALATA VIVIPAROUS FEMALE (from 4 specimens)

(Fig. II)

Body length 3.63-4.05 mm long, color unknown when alive, with four rows of roundish intersegmental sclerites on dorsal abdomen. Siphuncular cones brown and medium sized (.360-.420 mm) with marked apical flange. Head, pro- and pterothorax sclerotized. Abdominal tergite 1st with a mesial sclerotized patch. Tergites 2nd to 3th with several sclerites basal to hairs, while those of 4th to 7th bear sclerotized patches increasing in size, some of those of 7th fused each other, with the same color of cones. Tergite 8th bears a well sclerified solid bar interrupted in the middle. Cauda,

anal and genital plates brown. Antennae rather uniformly brown save darker the segments I, II, the distal parts of III and IV, the distal half of V and the whole VI. Rostrum with dark brown apical segments the same color of coxae. Legs with light brown basal end of fore and middle femora, which have dark brown the remaining part. Hind femora with light basal half and blackish the distal one, with the same color of both knees and the short proximal end of tibiae. Fore and middle tibiae whitish except for their distal end and tarsi, which are brown. Hind tibiae with light brown their basal half and brown the distal part and tarsi. Fore wings with media branched twice.

Length of antennal segments, III, .558-.600, IV, .198-.234, V, .240-.276, VI, .186-.210 mm long (p.t., .048-.054); secondary rhinaria, 9-14 on III, 2-3 on IV, 1-2 on V; rostral segments IV and V, .138-.144 and .060-.066; hind tibiae, 2.27-2.43 mm long; 1st hind tarsal segment, basal length, .042-.048, dorsal length, .060-.066, ventral length, .114-.120; 2nd hind tarsal segment, .234-.264 mm long.

Antennal hairs brown, those on segment III .108-.120 mm long. Abdominal tergites 1st to 7th with numerous brown rather fine hairs, those on tergites 5th and 7th, .138-.150 and .140-.156 mm long, respectively; tergite 8th and genital plate bearing 21-24 and 25-28 hairs, respectively; fourth rostral segment with 6 accessory hairs; hind tibiae with numerous fine, brown hairs, the longest .138-.156 mm long, 1.5 times longer than the tibial diameter at the insertion point.

APTEROUS OVIPAROUS FEMALE (from 7 specimens)

Body, 3.53-3.83 mm long, unknown in color when alive, with four rows of small intersegmental sclerites on dorsal abdomen. Siphuncular cones dark brown and larger than in vivipara (.360-.452 mm). Head, pro-, meso- and metathorax slightly sclerotized as in vivipara. Abdominal tergites 1st and 2nd each with four sclerotized patches with uneven borders. Tergites 3rd to 5th with numerous fragmented sclerotized patches, some of them fused each other, paler than the cones. Tergites 6th - 7th with smaller fragmented sclerotized patches sometimes fused in the latter. Tergite 8th with sclerified bar interrupted in the middle. Cauda, anal and genital plates dark brown the same color of cones. Antennae as in vivipara. Rostrum with dark brown apical segments the same color of coxae. Legs as in vivipara. Hind tibiae slightly inflated with very numerous small roundish pseudosensoria all along the segment save in both the ends.

Length of antennal segments, III, .462-.540, IV, .204-.234, V, .252-.270, VI, .192-.216 mm long (p.t., .042-.060); secondary rhinaria, 1 on III, 1 on IV, 1 on V; rostral segments IV and V, .138-.150 and .060; hind tibiae, 2.03 mm long; 1st hind tarsal segment, basal length, .042-.048, dorsal length, .060-.066, ventral length, .114-.126; 2nd hind tarsal segment, .258-.264 mm long.

Antennal hairs brown, those on segment III .096-.108 mm long. Abdominal tergites 1st to 7th with numerous brown and strong hairs, those on tergites 5th

Fig. I - Morphological details of *C. shinjii*, aptera vivipara: dorsal abdomen with antenna and hind tibia. Scales: 1 = 1 mm; 2 = 0.5 mm; 3 = 0.3 mm.

Fig. II - Morphological details of *C. shinjii*, alata vivipara. Scales: 1, 2 = 1 mm.

and 7th, .114-.132 and .114-.132 mm long, respectively; tergite 8th and genital plate bearing 24-32 and about 60 hairs, respectively; fourth rostral segment with 6 accessory hairs; hind tibiae with numerous fine, brown hairs, the longest .114-.126 mm long, a little longer than the tibial diameter at the insertion point.

TAXONOMY

Among the Japanese *Cinara* species, *C. shinjii* is considered similar to *C. pinidensisiflorae* (Essig & Kuwana, 1918) (*Lachnus*), “their separate identity requiring confirmation” (EASTOP *et al.*, 1998). The latter species is known to live on Pines in Japan, Taiwan, Korea and China (BLACKMAN & EASTOP, 1994, 2017). When compared with the European congeneric species, *C. shinjii* may resemble *C. laricis* (Hartig) in having dorsal sclerotized patches and strong hairs, which, nonetheless, in *shinjii* are slightly longer. Different, in *shinjii*, are also the antennal segments V/VI ratio, which is higher, and the host plants, *Larix* vs. *Pinus*.

DISCUSSION

Biological invasions represent a global emerging issue. Despite control measures, several alien organisms have been recorded worldwide, with southern Europe being a particularly critical area in terms of number of interceptions at the entry ports. In the last decades, several non-native species, accidentally introduced into new territories, easily spread, endangering local biodiversity and agriculture activities (INGHILESI *et al.*, 2013; BINAZZI *et al.*, 2019).

According to several authors such as COEUR D’ACIER *et al.* (2010), accidental introductions of aphids represent a growing concern for agriculture and forest environments.

It should be noted that the vast majority of invasive aphids belong to species native to temperate regions. Nonetheless, the exact identification of the vectors of introductions is often complex and, in many cases, countries of origin and possible preferential pathways have been deduced more from the biological requirements of each species than from actual evidence. Because most of Aphididae are species-specific in their feeding habits, many alien species were likely introduced into Europe through their host plants. However, as observed by COEUR D’ACIER *et al.* (2010), the hypothesis that some species native to regions close to Europe might be vectored into the continent by windstorms, wind or simply air streams cannot be completely excluded.

It is noteworthy, though, that variations in the number of species regarded as non-indigenous, reflect not only the increased diversity of the fauna recorded in each region, but also more conceptual differences related to the definition of what is actually ‘alien’. In a review of aphids alien to Switzerland, LAMPEL & GONSETH (2005) listed only species whose origin was not European whereas in a similar work, in Germany, GEITER *et al.* (2002) mentioned all species regarded as non-native to the country. More recently, COEUR

D’ACIER *et al.* (2010) based their revision of aphids alien to Europe on the list of European Aphididae provided by Nieto Nafria for the Fauna Europaea (NIETO NAFRÍA, 2007). In that survey, the authors categorize as invasive only those species whose human-mediated introduction can be clearly distinguished from natural expansion. In the same work it is evidenced that the vast majority of species non-native to Europe belong to the genera *Aphis*, *Illinoia* and *Tinocallis*. Interestingly, although the genus *Cinara* is very rich in species, most of which non-native to Europe, only some of them have been reported as alien to this continent (COEUR D’ACIER *et al.*, 2010). Among them, one of the most widespread is *Cinara cedri* Mimeur. According to several authors the native area of this species is likely to be the natural distribution range of *Cedrus atlantica*, in Morocco and northern Algeria. The introduction into Europe of *Cedrus* species for ornamental purposes and their extensive trade often resulted in the dispersal of cedar aphids, frequently associated with nursery material, outside their original range (COVASSI & BINAZZI, 1974; CARTER & MASLEN, 1982; NOTARIO *et al.*, 1984; BINAZZI *et al.*, 2015; MENDEL *et al.*, 2016; BINAZZI *et al.*, 2017; BINAZZI & ROVERSI, 2018; LEE *et al.*, 2020).

Another economically relevant species alien to Europe is *Cinara (Cedrobium) laportei* Remaudière. This species originated from the Atlas Mountains of North Africa (Morocco and Algeria) where it is associated with the Atlantic cedar *Cedrus atlantica* (REMAUDIÈRE, 1954). Since its first record, in the early 70s, in southeastern France and northern Italy, this aphid has proved to be very harmful to colonized cedar plants (EMMONOT *et al.*, 1967; COVASSI, 1971; FABRE, 1976). Equally worth mentioning among the *Cinara* species introduced into Europe through human activities, is the Nearctic *C. curvipes* (Patch), usually found in parks, gardens and forests (COEUR D’ACIER *et al.*, 2010). This aphid, has been recorded in Europe since the late 90s (HALAJ & OSIADACZ, 2015) but no relevant damages to the native *Abies* spp. have ever been observed (SCHEURER & BINAZZI, 2004).

The majority of aphid species alien to Europe is known as noxious to crops, ornamental plants and sometimes forest trees. Similarly to many other pests, the economic impact of these species has been investigated much more than the ecological one. In any case, regardless of the environment, aphids are often responsible for either direct (sap-feeding, deformation of their hosts) or indirect (transmission of plant diseases, deposition of honeydew) plant damages. Nonetheless, the overall ecological and/or economic impact caused by these organisms is not always easy to quantify. It is known, though, that forest environments are generally more resistant and resilient to the attack of alien species than agricultural and horticultural crops. In Europe, invasive Aphididae, with a few exceptions (e.g. *C. laportei*), have not been generally regarded as a serious threat to these ecosystems (COEUR D’ACIER *et al.*, 2010). However, even aphid species that are species-specific in their native regions may represent a matter of concern, once introduced in new territories, as they can sporadically adapt to congeneric host plants.

The newly recorded *Cinara shinjii* was introduced into Europe, Brandenburg (Germany), probably before 2017, through trade of oriental pines such as ornamental bonsai. So far, no information is available on the effective ability of this species to establish and potentially spread to the surrounding areas. In its native range, this aphid is harmless to forest ecosystems as it is fully adapted to local environments. However, the British DEPARTMENT FOR ENVIRONMENT, FOOD & RURAL AFFAIRS (2020) has included this *Cinara* species in its Plant Health Risk Register dealing with risks to crops, trees, gardens and ecosystems due to plant pests and pathogens. Even though still absent in either United Kingdom or continental Europe, *C. shinjii* is indicated in that register as having a relatively high likelihood of entry and eventual establishment in the UK. Therefore, even if future scenarios cannot be predicted at this stage, we believe that additional investigations on this newly recorded aphid are required to monitor its colonization patterns and possible behaviours that may endanger local biodiversity (e.g. pines native to Europe). In the light of the above, we further stress that prevention and control measures should be implemented as trade of live pines such as potted bonsai represent a very efficient pathway of potentially dangerous alien organisms.

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