

New armored scale insect (Hemiptera: Coccoomorpha: Diaspididae) species to Hungary on imported tropical fruits

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RESEARCH ARTICLE

Received: January 13, 2023 • Revised manuscript received: February 6, 2023 • Accepted: March 29, 2023

Published online: April 25, 2023

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ABSTRACT

Scale insect (Hemiptera: Coccoomorpha) fauna on imported tropical and subtropical fruits collected between 2013 and 2021 was investigated. The study revealed two armored scale insect (Diaspididae) species new to the fauna of Hungary (namely *Aonidiella citrina* (Coquillett) and *Lepidosaphes pin-naeformis* (Bouché)). Number of species of the Hungarian scale insect fauna increased to 279, while number of species collected on imported tropical and subtropical fruits changed to 16.

KEYWORDS

scale insect, new record, invasive alien species, agricultural pest, identification key

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INTRODUCTION

Scale insects (Hemiptera: Sternorrhyncha: Coccoomorpha) are small bodied obligate plant parasites, feeding on high variety of plant species and many of them are important agricultural pests (Gullan and Martin, 2009). Their body size is generally under 5 mm, and are often cryptic in habit, therefore scale insects are highly successful to escape detection during quarantine inspections and latent introduction to different regions of the world (Miller et al., 2005; Muniappan et al., 2009). Specifically, in the last years, several reports were published on intensive scale insect invasions throughout Europe, as the number of species detected both outdoor and indoor conditions, including greenhouses, commercial fruit stores and nurseries was strongly increasing (Kozár et al., 2012; Limonta and Pellizzari, 2018; Malausa et al., 2016; Malumphy and Badmin, 2012; Mazzeo et al., 2014; Mori et al., 2001; Pellizzari and Porcelli, 2014; Szita and Érsek, 2017).

The Hungarian scale insect fauna currently comprises 277 species (Bugaj-Nawrocka et al., 2021; Fetykó et al., 2013; Kozár et al., 2013; Szita and Érsek, 2017), while ScaleNet (García Morales et al., 2016) online database reports only 245 species. Kozár et al. (2013) grouped the scale insect species of Hungary into three categories: (i) true members of the Hungarian fauna – species found regularly outdoors and typically overwinter in outdoors condition, containing both native and introduced species; (ii) species occur in greenhouses and buildings – introduced species, mainly on ornamental plants, unable to overwinter outdoors; (iii) species found typically on imported tropical and subtropical fruits for consumption – introduced species, some of them have not been able to establish even in greenhouses.

The first survey of the scale insects introduced into Hungary on tropical and subtropical fruits was published by Kozár and Kienitz (1979). Their list already contained 13 species, and Kozár et al. (2013) reported one more species in this category, as a new record for the Hungarian fauna. Even though the huge number of pest species living on various fruits imported from the different regions of the World (Kondo and Watson, 2022), the number of species in this category is surprisingly low, due to the efforts made by exporting countries to prevent the spread of invasive pests. Moreover most of these species were unable to establish in Hungary even indoors in greenhouses or on ornamental plants in buildings, despite repeated introductions over more than one hundred years (Kozár et al., 2013). On the other hand, a partial overlap can be found with the two other categories, and three species are regular pests in greenhouses and buildings (*Aspidiotus nerii* Bouché, *Planococcus citri* (Risso) and *Pseudococcus viburni* (Signoret)) as well, while *Pseudaulacaspis pentagona* (Targioni Tozzetti) and *Carulaspis minima* (Signoret) are frequently found outdoors (Kozár, 1989).

According to the list of scale insects introduced into Hungary on tropical and subtropical fruits published in Kozár et al. (2013), recorded species belong to the family Pseudococcidae (4 species) and Diaspididae (10 species). In the present study two armored scale insect species are reported as new to the Hungarian fauna, and an identification key for scale insect species collected on imported tropical fruits in Hungary is also provided.

MATERIAL AND METHODS

This survey is based on the scale insect samples registered in the Plant Protection Institute after the publication of latest Hungarian checklist (Kozár et al., 2013). Altogether 2,352 scale insect



samples were recorded between 2013 and 2021 (PPI code 10836-13187), and 49 samples were collected on infested tropical and subtropical fruits in supermarkets and grocery stores throughout Hungary.

Specimens were slide mounted following the method described in Kosztarab and Kozár (1978, 1988). Slides of the specimens are deposited in the scale insect collection of Plant Protection Institute, Centre for Agricultural Research, Budapest, Hungary. Identification of scale insects is based on cuticular characters of adult females. For identification Miller and Davidson (2005), Gill (1997) and Williams (2004) were used. Identification key of scale insects on imported fruits in Hungary was compiled using Danzig and Gavrilov-Zimin (2014), Granara de Willink and González (2018), Williams (2004) and Williams and Granara de Willink (1992) for Pseudococcidae, while Gill (1997), Kosztarab and Kozár (1988) and Miller and Davidson (2005) for Diaspididae.

RESULTS

Among the 49 samples collected on imported tropical fruits, 43 samples contained female specimens which were suitable to identify to species level (Table 1). Six samples proved to be unsuitable to identify to species level, since these were only immature specimens or adult females with high fungal infection. Two armored scale insect species proved to be new for the Hungarian fauna, namely *Aonidiella citrina* (Coquillett) and *Lepidosaphes pinnaeformis* (Bouché). A mealybug species, *Pseudococcus longispinus* (Targioni Tozzetti), was found first time on subtropical fruits (*Diospyros kaki*), although it was collected time to time on ornamental plants and in greenhouses in Hungary previously. The most commonly detected species at inspection of imported tropical and subtropical fruits were *Aonidiella aurantii* (Maskell), *P. citri* (Risso) and *Lepidosaphes becki* (Newman).

Table 1. List of scale insect species collected on imported tropical and subtropical fruits between 2013 and 2021 in Hungary

Family/Species	Nr. of samples	Typical hostplants and comment
Diaspididae		
<i>Aonidiella aurantii</i> (Maskell)	17	<i>Citrus</i> spp.
<i>Aonidiella citrina</i> (Coquillett)	2	New to fauna of Hungary, recorded on <i>Citrus sinensis</i> and <i>Persea americana</i> .
<i>Aspidiotus nerii</i> Bouché	1	<i>Citrus</i> spp., <i>Mangifera indica</i>
<i>Lepidosaphes becki</i> (Newman)	9	<i>Citrus</i> spp.
<i>Lepidosaphes pinnaeformis</i> (Bouché)	1	New to fauna of Hungary, recorded on <i>Citrus limon</i> .
<i>Parlatoria pergandii</i> Comstock	1	<i>Citrus</i> spp.
<i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti)	1	<i>Actinidia deliciosa</i>
Pseudococcidae		
<i>Planococcus citri</i> (Risso)	10	<i>Citrus</i> spp,
<i>Pseudococcus longispinus</i> (Targioni Tozzetti)	1	Previously it was recorded only on ornamental plants and greenhouses, first time found on tropical fruits (<i>Diospyros kaki</i>) in Hungary.



A. citrina (Coquillett), yellow scale

Two samples proved to be infested with *A. citrina*. Collecting data of specimens: 1 ♀ – Budapest, HÜVI shopping mall, 03.12.2019, orange (*Citrus sinensis*) imported from Greece, leg. É. Szita; 1 ♀ – Budapest, Újpest Market, 11.01.2019, avocado (*Persea americana*) imported from Israel, leg. É. Szita.

Body of the adult female yellow, scale cover 1.5–2.0 mm, flat, circular, semi-translucent, lemon yellow in colour. Male scale cover oval, smaller than females', same in colour. Polyphagous species, feeding on over 70 plant species belonging to 29 families and 45 genera (García Morales et al., 2016). *Citrus* species are its most common hostplants by far, but occurs also on *Viburnum*, *Mangifera*, *Agave*, *Hedera*, *Ilex*, *Buxus*, *Cornus*, *Ficus*, *Ligustrum*, *Rosa*, etc. (Kondo and Watson, 2022; Miller and Davidson, 2005). Usually feeds on leaves and fruits of the hostplants, rarely on trunk and stems.

A. citrina is originated in Asia, but has been accidentally spread throughout the world through trade of infested plant material (Kondo and Watson, 2022). *A. citrina* was first reported in Europe from Italy in 1994 (Longo et al., 1994), EFSA reported (2014) it only from Italy, France and Greece, while by this time it became as serious pest as *A. aurantii* for citrus growers throughout Europe and the World (Kondo and Watson, 2022). It has quarantine status or on A1/A2 alert status in a few countries (EPPO, 2023), but *A. citrina* have little chance for the establishment in outdoor conditions in Hungary.

L. pinnaeformis (Bouché), cymbidium scale

A single sample was found infested with *L. pinnaeformis*. Collecting data of the specimen: 1 ♀ – Bicske, Tesco supermarket, 22.11.2016, bio *Citrus limon* imported from Italy, leg. NÉBIH (National Food Chain Safety Office, Hungarian abbrev.).

Body of the adult female mussel shaped, white to light violet, scale cover oyster-shell shaped, 2.5–3.5 mm in size, curved, moderately convex, brown. Male cover smaller and narrower than female cover, same in colour. Polyphagous species, feeding on over 60 plant species belonging to 21 families and 35 genera (García Morales et al., 2016). Infestations are mostly found on hostplants belonging to the family Orchidaceae, but occur also on *Cinnamomum*, *Lindera*, *Croton*, *Cycas*, *Magnolia*, *Ficus*, *Citrus*, *Prunus*. Feeds on aerial parts of the hostplants (Miller and Davidson, 2005; Watson, 2002).

L. pinnaeformis is most probably originated from Asia (Watson, 2002). It is a regular pest on orchids in greenhouses worldwide (Danzig, 1993; Malumphy et al., 2012; Miller and Davidson, 2005; Pellizzari and Porcelli, 2014), and occasionally became serious pests in orchid plantations in India (Meena et al., 2018) and in the United States (Gill, 1997).

DISCUSSION

Altogether with the currently discovered species, number of species of the Hungarian scale insect fauna increased to 279. According to Kozár et al. (2013) and the present survey, 72 species can be regarded as non-indigenous species. Data reveals that Hungarian scale insect fauna consist of 25.8% introduced alien species, which corresponds to the results of



Identification key for scale insects on imported fruits in Hungary based on microscopic characters

- 1 – Ostioles and cerarii present, pygidium absent (*Pseudococcidae*) 2
 - Ostioles and cerarii absent, pygidium present (*Diaspididae*) 6
- 2 – Oral rim tubular ducts present, each with well-developed rim 3
 - Oral rim tubular ducts absent 5
- 3 – Multilocular pores distributed throughout of venter of abdomen and thorax 4
 - Multilocular pores restricted to around vulva *Pseudococcus longispinus* (Targioni Tozzetti)
- 4 – Eyes associated with discoidal 1-3 pores on a membranous area *Pseudococcus viburni* (Signoret)
 - Eyes associated more than 4 discoidal pores on a sclerotized area *Pseudococcus elisae* Borchsenius
- 5 – Anal lobe bar present, number of cerarii 18, translucent pores present on hind coxa and tibia *Planococcus citri* (Risso)
 - Anal lobe bar absent, number of cerarii 17, translucent pores present on hind femur and tibia *Dysmicoccus brevipes* (Newstead)
- 6 – With at least 1 pore near anterior or posterior spiracles 7
 - Without pores near spiracles 13
- 7 – Body elongate, length usually 2 times more than greatest width, widest part of body usually located at metathorax or abdomen 8
 - Body oval, length usually less than 2 times of greatest width, widest part of body located at head, prothorax or mesothorax 10
- 8 – Lateral spurs or sclerotized lobes conspicuous on abdominal segments 2 to 4, cicatrices absent 9
 - Lateral spurs absent (or rarely small on abdominal segment 4), cicatrices present *Lepidosaphes beckii* (Newman)
- 9 – Sclerotized dermal sockets absent on pro- and mesothorax, eyes represented by conspicuous sclerotized spur, prepygidial microducts present on venter near antennae *Lepidosaphes pinnaeformis* (Bouché)
 - With sclerotized dermal sockets on pro- and mesothorax, eyes normal, prepygidial microducts absent on venter near antennae *Lepidosaphes gloverii* (Packard)
- 10 – Perivulvar pores in 4 clusters 11
 - Perivulvar pores in 5 clusters 12
- 11 – With conspicuous ear-like lobe on body margin, laterad of anterior spiracle *Parlatoria ziziphi* (Lucas)
 - Without conspicuous ear-like lobe on body margin *Parlatoria pergandii* Comstock
- 12 – With more than 5 perispiracular pores associated with each anterior spiracle, median notch without gland spines *Pseudaulacaspis pentagona* (Targioni Tozzetti)
 - With less than 5 perispiracular pores associated with each anterior spiracle, median notch with two gland spines *Carulaspis minima* (Signoret)
- 13 – With perivulvar pores 14
 - Without perivulvar pores 16
- 14 – Dorsal macroducts of one-barred type, their length at least 6 times long as their diameter 15
 - Dorsal macroducts of two-barred type, rarely longer than 3 times as their diameter *Aspidiotus nerii* Bouché
- 15 – With cluster of macroducts on submarginal areas of abdominal segment 2 *Chrysomphalus aonidium* (Linnaeus)
 - Without cluster of macroducts on submarginal areas of abdominal segment 2 *Chrysomphalus dictyospermi* (Morgan)
- 16 – With two conspicuous scleroses associated with prevulvar apophysis *Aonidiella aurantii* (Maskell)
 - Without scleroses associated with prevulvar apophysis *Aonidiella citrina* (Coquillett)



Pellizzari and Germain (2010), concluding ca. 30% alien scale insect species to Europe, and regarding scale insects to one of the largest alien invader group to the European fauna. This high proportion of alien species and the current trends in climate change might result in increased number of new invader species establishing in outdoor conditions (Dawson et al., 2011; Huang et al., 2011), which highlights the importance of further studies on the distribution of alien species.

ACKNOWLEDGEMENTS

This work is devoted to Ferenc Kozár as study of scale insects on imported fruits was one of his favourite topics. The authors wish to thank to colleagues Attila Haltrich and Jenő Kontschán for their enthusiastic help in collecting samples. The study was financially supported by NKFIH (FK131550) and National Laboratory for Health Security, Plant Protection Institute, Centre for Agricultural Research (RRF-2.3.1-20-2022-00006).

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