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The First Record of Tulip Tree Aphid, *Illinoia liriodendri* (Hemiptera: Aphididae), from Slovakia – Short Communication

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Abstract

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The tulip tree aphid, *Illinoia liriodendri*, is reported in Slovakia for the first time. Colonies of *I. liriodendri* were found on tulip trees, *Liriodendron tulipifera*, in two locations of south-western Slovakia in 2014 and 2015. Colonies of nymphs and viviparous females fed on the underside of leaves with no significant symptoms of damage to tulip trees. In this short study, the first report of the aphid from Slovakia is presented and original illustrations with results of morphometric analysis of alate viviparous females are provided.

Keywords: alate females; *Liriodendron tulipifera*

About 4700 species of Aphididae have been described worldwide (Remaudière & Remaudière 1997) and about 1590 of them are present in Europe (Nieto Nafria *et al*. 2013). Accelerating trade relations, tourism, and transport over the past century unintentionally led to the increased introduction of non-native species, including insects, which was followed by their successful establishment and spread among countries in many cases. As many as 102 alien aphid species are currently detected in Europe and most of them originate from temperate regions of Asia and North America (Cœur d'acier *et al*. 2010). The genus *Illinoia* Wilson 1910 includes taxa mainly in North America (45 species) and in the Caucasus mountains (one species). Until now, seven species of this genus have been introduced into Europe (Cœur d'acier *et al*. 2010) and two species, *I. lambersi* (MacGillivray 1960) and *I. rhododendri* (Wilson 1918), have already been recorded in Slovakia (Nieto Nafria *et al.* 2013). The majority of *Illinoia* species feed on *Ericaceae*, but the remaining taxa are associated with various plants, including trees (Blackman & Eastop 1994). *Illinoia liriodendri* (Monell in Riley & Monell 1879), the tulip tree aphid, is native to the eastern United States, but invaded also northern California and other parts of the western United States (Van Driesche *et al*. 1996). On the European continent, this species was first detected in France in 1998 (Rabasse *et al*. 2005) and has since been reported in other European countries, including Italy, UK, Germany, Slovenia, Luxemburg, Greece, Hungary, and Portugal (Blackman & Eastop 1994; Limonta 2001; EPPO 2007; Jucker *et al*. 2008; Bozsik 2012; Bella 2013). Besides Europe, the tulip tree aphid has already been reported from East Asia, in Japan (Sugitomo 1999) and South Korea (Kim *et al*. 2011).

The tulip tree aphid is monoecious holocyclic species and lives solely on the tulip tree, *Liriodendron tulipifera* L. (Kim *et al*. 2011), however the North American magnolia, *Magnolia grandiflora* L., is also

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reported as a host of this aphid (EPPO 2005). Adults are winged or wingless depending on the need for migration and reproduction. Eggs that are laid on twigs near buds for overwintering are pale greenish. Fundatrices hatch from overwintered eggs at the end of March and appear on the underside of new leaves. The aphid develops in colonies on leaves during summer and several parthenogenetic overlapping generations may develop annually. The colonies can be detected on trees until October–November (Regan & Fisher 1986; Rabasse *et al*. 2005). Alate males and oviparous females occur in late autumn (Dreistadt & Dahlsten 1988). Symptoms of damage include mildly distorted buds and foliage of host plants in about mid-June. Heavy infestations occur mainly on the leaves, and the aphids excrete considerable quantities of honeydew, which causes sooty mould on the leaves of host plants (Alford 2012; Bozsik 2012). Black sooty mould associated with the honeydew is only an aesthetic problem, but if it is very severe, it may limit photosynthesis (Dreistadt & Dahlsten 1988). Tulip trees that are highly infested may prematurely drop leaves as early as in August (Regan & Fisher 1986).

Aphid populations are often maintained below economic thresholds by parasites, predators, and pathogens (Regan & Fisher 1986). The most common parasitoid genera associated with *I. liriodendri* are *Praon* sp., *Ephedrus* sp. and *Aphidius* sp. (Krombein *et al*. 1979; Zuparko & Dahlsten 1993). Bozsik (2012) mentioned that *I. liriodendri* colonies were attacked by *Harmonia axyridis* (Pallas, 1773).

This paper briefly informs about the first observation of *I. liriodendri* in Slovakia. Morphology and biometric measurements of alate viviparous females are provided. Natural enemies, symptoms and damage of tulip trees are shortly discussed.

MATERIAL AND METHODS

The infested host trees, *L. tulipifera*, grow in the city park of Nitra (48°19'7"N, 18°4'55"E, 144 m a.s.l.) and the Mlyňany Arboretum in Vieska nad Žitavou (48°19'20"N, 18°22'16"E, 187 m a.s.l.) in southwestern Slovakia.

Collected aphids were stored in small polystyrene tubes (10 × 70 mm) filled with 70% ethanol (Eastop & van Emden 1972). All samples described in this study are deposited in the Mlyňany Arboretum of the Institute of Forest Ecology SAS. Samples of parasitoids from the aphid colonies were collected as well and preserved in 70% ethanol. Aphid samples were identified using taxonomic features of alate adults. Clearing procedures for mounting the aphid individuals on slides were performed according to Eastop and van Emden (1972) and Heikinheimo (1988). The specimens were identified by the key of Blackman and Eastop (1994). To assess the biometry of alate aphid morphology, 32 major characteristics and ratios (Table 1) were taken with a Dino-Eye digital camera (AM4023X model; AnMo Electronics Corp., New Taipei City, Taiwan) and all measurements were performed on the images using the DinoCapture 2.0 software (AnMo Electronics Corp., Taiwan).

RESULTS AND DISCUSSION

The first finding of tulip tree aphid was made in Nitra's city park, where aphid colonies were observed on the underside of tulip tree leaves on September 22, 2014. Another infestation of tulip trees by the aphid was observed in the same locality on June 4, 2015 and in the Mlyňany Arboretum on June11, 2015. The presence of small colonies of yellowish aphids was documented on four tulip trees in Nitra. The colonies could be found on numerous leaves of the trees and viviparous females with nymphs were present in the colonies. In the Mlyňany Arboretum aphid colonies were found on two tulip trees. These colonies were less developed than those in Nitra's city park and they occurred only on a few leaves. The tulip tree aphids were present mainly on leaves in the lower parts of tree crowns in both localities. Symptoms of damage on leaves were not prominent. In late summer a mild discoloration of leaves and the presence of honeydew were observed. However,

Figure 1. An alate viviparous female of *I. liriodendri* collected in Slovakia (the bar = 1 mm)

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Table 1. Biometric measurements of alate viviparous females of *I. liriodendri* collected in Slovakia

Part of body	Mean ± SD (n = 20)	Min	Max
Length (mm)			
Body	3.091 ± 0.095	2.850	3.321
Whole antenna	3.787 ± 0.305	3.532	4.679
ANT I	0.158 ± 0.011	0.137	0.183
ANT II	0.182 ± 0.268	0.087	0.980
ANT III	0.830 ± 0.029	0.775	0.887
ANT IV	0.723 ± 0.037	0.653	0.781
ANT V	0.739 ± 0.035	0.657	0.787
ANT VIb	0.172 ± 0.010	0.156	0.196
Processus terminalis	0.982 ± 0.081	0.825	1.149
Hind femur	1.228 ± 0.036	1.133	1.296
Hind tibia	2.491 ± 0.144	2.158	2.753
HT II	0.149 ± 0.008	0.132	0.168
Cauda	0.340 ± 0.023	0.285	0.384
Siphunculus	0.930 ± 0.066	0.785	1.037
URS	0.128 ± 0.002	0.125	0.133
Ratios			
Whole antenna/body	1.227 ± 0.111	1.116	1.552
Processus terminalis/ ANT VIb	5.728 ± 0.606	4.435	6.864
Processus terminalis/ ANT III	1.185 ± 0.119	0.930	1.424
URS/HT II	0.866 ± 0.043	0.792	0.947
URS/ANT VIb	0.749 ± 0.039	0.663	0.814
Siphunculus/body	0.301 ± 0.023	0.251	0.333
Siphunculus/ANT III	1.121 ± 0.078	0.957	1.268
Siphunculus/hind femur	0.757 ± 0.044	0.657	0.826
Siphunculus/cauda	2.746 ± 0.261	2.193	3.281
Number of setae on			
ANT I	5 ± 0.587	4	6
ANT II	4 ± 0.444	3	4
ANT III	15 ± 1.673	13	19
Cauda	6 ± 0.523	5	7
URS	5 ± 0.967	4	6
Number of rhinaria on			
ANT III	17 ± 2.179	14	21
ANT IV	0		
ANT V	0		

SD – standard deviation of the mean; ANT I–VI – antennal segments I–VI; HT II – the second segment of the hind tarsus, URS – the ultimate segment of the rostrum

neither sooty leaf moulds nor other significant symptoms were noted. The colonies of *I. liriodendri* were not detected on specimens of *Magnolia grandiflora*, which grow in both localities.

The *I. liriodendri* colonies were attacked by *H. axyridis* in both places and this predator was also reported from tulip tree aphid colonies in Hungary (Bozsik 2012). In Nitra's city park mummified aphids parasitised by *Praon* sp. were also detected. Parasitoids of *I. liriodendri* were well studied in North America (Krombein *et al*. 1979; Zuparko & Dahlsten 1993), but this information is missing from Europe. There is just a note on an undetermined parasitoid of the genus *Aphelinus* in Hungary (Bozsik 2012). During our observations of tulip tree aphid colonies, an activity of ants and soldier beetle, *Malthinus flaveolus* (Herbst 1786), attracted by honeydew occurred on infested tulip trees.

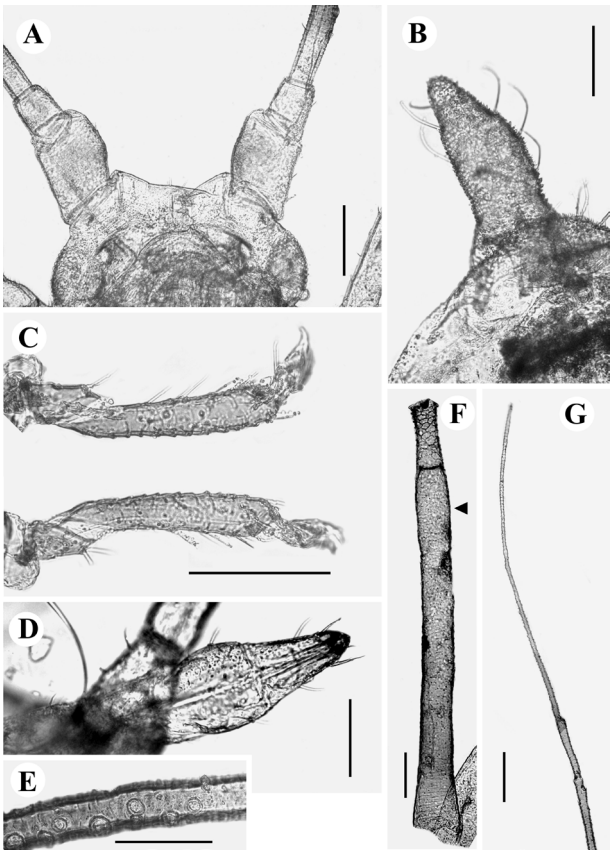

Figure 2. *I. liriodendri,* an alate viviparous female (bars = 0.1 mm): **A** – head; **B** – cauda; **C** – hind tarsi; **D** – an ultimate rostral segment; **E** – rounded secondary rhinaria on ANT III; **F** – cylindrical siphunculus, moderately clavate in the apical third (arrow) with constricted region and a few rows of polygonal reticulation at the distal end; **G** – antennal segment VI

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Morphology of alate viviparous female

The colour of the body in life is green with yellowish brown head and thorax. Eyes are reddish. Body length is 3.091 mm measured from antennal tubercles to the end of the cauda. Lateral frontal (antennal) tubercles developed with diverging inner margins, median frontal tubercle indistinct. Six-segmented antennae are darker towards their apices, longer than the body (1.227× body length). Secondary rhinaria, rounded in shape, are present only on antennal segment III (14–21) along its whole length. Processus terminalis is 5.728× longer than the basal part (ANT VIb) of antennal segment VI. Ultimate rostral segment (URS) triangular short and blunt at apex, 0.866× as long as the second segment of hind tarsus (HT II). Femora are rather pale but darker at the apical parts. Tibiae and tarsi are darker than femora. Siphunculi very long (0.301× body length) cylindrical with thickened base, slightly swollen at the apical third, with constricted region and 5–7 rows of polygonal reticulation at the apex just under the well-developed flange. Cauda is elongate tongue-shaped, pale in colour with six setae. Fore wings have two-forked median vein. Biometric measurements on alate viviparous females are summarised in Table 1.

L. tulipifera is associated with four aphid species in its native area, including *Myzus persicae* (Sulzer, 1776), *Aphis fabae* Scopoli 1763, *Macrosiphum euphorbiae* (Thomas, 1878), and *I. liriodendri* (Blackman & Eastop 1994). The first three species are common and well-known polyphagous pests of grown cultures in Slovakia. *M. persicae* and *A. fabae* are easy to distinguish from the genera *Macrosiphum* or *Illinoia*. To discriminate *I. liriodendri* from *M. euphorbiae*, the following morphological features are considered: siphunculi of *I. liriodendri* are clearly darker than the cauda and usually slightly swollen on the distal half; the siphunculus/cauda length ratio is 2.4–2.8 for *I. liriodendri* and 1.9–2.3 for *M. euphorbiae* (Heie 1992, Blackman & Eastop 1994); the number of setae on the cauda of alate viviparous female is 5–8 in *I. liriodendri* (Kim *et al.* 2011), but 10–12 in *M. euphorbiae* (Heie 1992).

CONCLUSIONS

The tulip tree aphid, *I. liriodendri*, may have been introduced into Slovakia, possibly with imported infested tulip tree saplings from areas where the aphid has already established itself or the aphids might have migrated by active flight of alate individuals from Hungary. Symptoms of damage by sucking on tulip trees at observed localities in Slovakia were slight and control measures were not necessary.

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