JOURNAL OF PLANT PROTECTION RESEARCH Vol. 56, No. 2 (2016)
DOI: 10.1515/jppr-2016-0022

Rapid communication

Stephanitis takeyai and *S. rhododendri* (Heteroptera: Tingidae) in Slovakia: first record and economic importance

Marek Barta, Tomáš Bibeň*

Mlyňany Arboretum, Institute of Forest Ecology, Slovak Academy of Sciences, Vieska nad Žitavou 178, 951 52 Slepčany, Slovak Republic

Received: January 8, 2016
Accepted: May 6, 2016

Abstract: This is the first report on the occurrence of andromeda lace bug, *Stephanitis* (*Stephanitis*) *takeyai* Drake and Maa, 1955, and rhododendron lace bug, *Stephanitis* (*Stephanitis*) *rhododendri* Horvath, 1905, in Slovakia. Syntopic colonies of both species were found on rhododendron shrubs (*Rhodedendron* sp.) in south-western Slovakia in 2015. The feeding of the lace bugs resulted in damage to infested rhododendrons. Leaves turned yellow and brown, prematurely dropped what led to continuous drying up of twigs and the whole plants. Details on morphology of adult stages of the two species, description of damage symptoms and economic importance of these pests are presented and discussed.

Key words: alien species, lace bugs, new records, rhododendrons, Slovakia, *Stephanitis*

Introduction

Lace bugs are a specific group of insects of the Hemipteran family Tingidae, which contains 2,351 phytophagous species in about 300 genera of cosmopolitan distribution (Froeschner 1996; Guilbert 2016). Until now, as many as 182 tingids comprising six species of *Stephanitis* genus have been recorded in Europe (Aukema 2013). Out of the six *Stephanitis* species only three are indigenous and the other three have been introduced to Europe. Two non-native species, *Stephanitis* (*Stephanitis*) *takeyai* Drake and Maa, 1955, the andromeda lace bug, and *Stephanitis* (*Stephanitis*) *rhododendri* Horvath, 1905, the rhododendron lace bug, were introduced to Europe on imported ornamental plants during the last century. While *S. takeyai* is native to Japan, where it was described as *Tingis globulifera* Matsumura 1905 (Drake and Ruhoff 1965), *S. rhododendri* is native to North America (Bailey 1950), but was first described in Boskoop (the Netherlands) at the beginning of the 20th century (Horváth 1905). *Stephanitis takeyai* was introduced into the USA from Japan in about 1945 and became a serious pest of *Pieris japonica* (Thunb.) D. Don *ex* G. Don and other ornamental Ericaceae (Dunbar 1974). In Europe, the species was first recorded in the Netherlands (Boskoop) in 1994 and followed soon by the reports about its occurrence in other countries. It has already been observed in Great Britain (1995), Poland (1998), Italy (2000), Germany (2002), Belgium (2003), France (2004), the Czech Republic (2008), Hungary (2011) and Austria (2011) (Soika and Labanowski 1999; Colombo and Limonta 2001; Homes *et al*. 2003; Streito 2006; Hradil *et al.* 2008; Friess 2011; Vétek *et al*. 2012). The findings in Europe were mostly recorded on *P. japonica* and azaleas. *Stephanitis rhododendri* was introduced to Europe on rhododendrons from North America more than 100 years ago and has been spread to eleven countries of Western Europe including British Isles and Scandinavia (Drake and Ruhoff 1965; Jones 1993; Aukema 2013).

Some tingids restrict their feeding to a single host or a group of related plants, while others are highly polyphagous. A broad spectrum of plant species within families of Hippocastanaceae, Magnoliaceae, Pinaceae, Rosaceae, Saxifragaceae and Styracaceae are reported as hosts for *S. takeyai* (Drake and Ruhoff 1965; Mead 1967; Wheeler 1977; Watanabe 1983; Soika and Labanowski 1999). On the contrary, *S. rhododendri* has narrower host spectrum limited only to genera of Ericaceae family (Drake and Ruhoff 1965; Mead 1967). From the economic point of view, both species can cause a significant damage to ornamental Ericaceae mainly because of their high density population occurring on the host plants. There are no serious insect pests of rhododendrons and andromeda in Slovakia, but a spread and establishment of these lace bugs might pose a threat to the nursery industry and growers of the ornamental or fruit Ericaceae. Moreover, the polyphagous nature of *S. takeyai* can become a serious concern in regards to extending range of plant taxa including the domestic flora.

This paper briefly informs about the first observation of *S. takeyai* and *S. rhododendri* in Slovakia. Morphology and biometric measurements of adults are provided and symptoms with plant damage are shortly discussed.

*Corresponding address:
marek.barta@savba.sk

Materials and Methods

Colonies of lace bugs were accidentally discovered on three shrubs of *Rhododendron* sp. grown in a local cemetery (48°00'33.09"N 18°09'16.42"E, 115 m a.s.l.) in the town of Nové Zámky in May 2015. Symptoms of brownish to rusty coloured foliage of the shrubs were noticed from the distance and indicated a nutrient deficiency chlorosis, sunburn damage, or other type of physiological disorder. However, detailed investigation of leaves revealed a presence of numerous colonies of lace bugs on the lower side. Both adults and nymphs were feeding together and oily black spots with cast-off skins could be seen along with the lace bug colonies on the leaves. The shrubs were 40–50 cm tall and grew together in one group. The samples of insects were taken together with the twigs of the shrubs on May 21 in 2015, transported in plastic boxes to the laboratory and stored in 70% ethanol in 2.0 ml plastic microtubes. The location with these findings was visited again four weeks later (June 20, 2015) and the shrubs had already dropped majority of their leaves. Since no live lace bugs were observed on the remaining leaves, few other rhododendron shrubs grown in pots were inspected at the place, but lace bugs were not detected. At the third visit of the site in the autumn (October 2015) the damaged shrubs had already been removed and nearby rhododendron plants showed no signs of lace bug infestation.

The specimens of lace bugs were identified by the keys of Mead (1967), Stonedahl *et al*. (1992) and Streito (2006). To assess the biometry of lace bugs morphology, 21 characteristics (Table 1) were taken by a digital camera Dino-Eye (model AM4023X, AnMo Electronics Corp., Taiwan) and all measurements were performed on the digital images using DinoCapture 2.0 software (AnMo Electronics Corp., Taiwan).

The material examined in the morphology study is as follow:
Stephanitis takeyai – 22 adults, 21/05/2015, Nové Zámky, Slovakia, host: *Rhododendron* sp., coll. M. Barta, deposited in collections of the Mlyňany Arboretum, Vieska nad Žitavou, Slovakia.
Stephanitis rhododendri – 15 adults, 21/05/2015, Nové Zámky, Slovakia, host: *Rhododendron* sp., coll. M. Barta, deposited in collections of the Mlyňany Arboretum, Vieska nad Žitavou, Slovakia.

Table 1. Morphometric parameters of adult lace bugs collected in Slovakia

Parameters	Mean±SD* [mm]	
	Stephanitis takeyai	*Stephanitis rhododendri*
Body length	2.61±0.14 (n = 20)	2.47±0.09 (n = 14)
Body length including hemelytra	3.88±0.21 (n = 20)	3.63±0.20 (n = 15)
Hood		
length	0.84±0.08 (n = 22)	0.64±0.03 (n = 15)
height	0.54±0.04 (n = 22)	0.31±0.01 (n = 15)
width	0.67±0.04 (n = 22)	0.33±0.03 (n = 15)
width/length ratio	0.81±0.10 (n = 22)	0.52±0.04 (n = 15)
Median carina		
length	0.76±0.04 (n = 22)	0.81±0.04 (n = 15)
height	0.31±0.04 (n = 22)	0.39±0.01 (n = 15)
Median carina height/hood height ratio	0.59±0.10 (n = 22)	1.28±0.06 (n = 15)
Lateral carina – length	0.25±0.02 (n = 22)	0.53±0.02 (n = 15)
Lateral carina length/1st antennal segment	0.81±0.05 (n = 22)	2.01 ± 0.07 (n = 15)
Distance between lateral carinae	0.51±0.04 (n = 18)	0.48±0.07 (n = 15)
Hemelytron		
length	3.02±0.20 (n = 40)	2.76±0.09 (n = 28)
width	1.20±0.07 (n = 40)	1.35±0.08 (n = 28)
length/width ratio	2.51±0.21 (n = 40)	2.05±0.07 (n = 28)
Elytron – length	2.58±0.08 (n = 20)	1.63±0.07 (n = 24)
Antenae		
1st segment length	0.30±0.01 (n = 24)	0.27±0.01 (n = 24)
2nd segment length	0.12±0.01 (n = 24)	0.13±0.01 (n = 24)
3rd segment length	1.32±0.18 (n = 23)	1.47±0.08 (n = 20)
4th segment length	0.84±0.06 (n = 20)	0.48±0.05 (n = 22)
total length	2.58±0.23 (n = 20)	2.34±0.09 (n = 20)

*SD – standard deviation of the mean

Results and Discussion

Morphology

Adults are 3.88 mm (*S. takeyai*) and 3.63 mm (*S. rhododendri*) long on average, oval in shape, with wings held flat over the body giving a flattened appearance, creamy coloured with distinct black or light brown patches (Figs. 1 and 2). A typical dark X-shaped mark is apparent on the wings of *S. takeyai* but missing on *S. rhododendri*. The tops of the front wings, head and thorax are membranous, composed of many raised ridges, which give a lace-like appearance. Adults of both species are characteristic of having a hood-like bulb formed dorsally on the pronotum expanding over the head. Nymphs are spiny and much darker than the adults (Fig. 3D). Morphometric parameters of adults collected in Slovakia are shown in Table 1. Specific details on morphology to distinguish the andromeda and rhododendron lace bugs are indicated below.

Stephanitis takeyai: Colour of body is darker with dark brown patches. The X-shaped band on the apical third of hemelytrae is distinct and dark brown. Pronotal membranous hood is compressed in front and bulbous behind (ratio of hood width to length is 0.81) and it is wider than distance between lateral carinae. Lateral carinae are abbreviated and their length is shorter than length of 1st antennal segment. Membrane of hood is brown, veins on hood are dark brown and hood is about twice as high as uniseriate median carina. Paranota are almost vertical.

Stephanitis rhododendri: Colour of adults is generally lighter and the X mark on the front wings is indistinct or absent. Pronotal hood is compressed on both sides throughout its length (ratio of hood width to length is 0.52) and narrower than distance between lateral carinae. Lateral carinae are entire and twice as long as 1st antennal segment. Membrane of hood is hyaline, veins on hood are straw yellow and biseriate median carina is slightly higher than hood. Paranota are broader and projecting laterally from thorax.

Host plants and bionomics

Stephanitis takeyai is reported to be polyphagous in Japan and other countries where it has spread, attacking host plants of several unrelated genera including *Aperula*, *Azalea*, *Cinnamomum*, *Diospyros*, *Illicium*, *Lindera*, *Lyonia*, *Pieris*, *Pinus*, *Rhododendron*, *Salix*, *Sassafras* and *Styrax* (Drake and Ruhoff 1965; Mead 1967; Wheeler 1977; Watanabe 1983; Tsukada 1994; Wang *et al*. 1998). In Japan, *S. takeyai* is known to exhibit non-obligate seasonal host alternation between *P. japonica*, the winter host, and the other major host, a deciduous shrub *Lyonia ovalifolia* (Wall.) Drude var. *elliptica* (Siebold and Zucc.) Hand.-Mazz., the summer host. If *L. ovalifolia* is scarce, *S. takeyai* may continue to feed on *P. japonica* throughout the year (Tsukada 1994). A spectrum of host species and preference to specific plants was studied in the USA, where the andromeda lace bug became a serious pest of Ericaceae. A preferred host was *P. japonica*, but non-significant damage also occurred on *Rhododendron* spp. and *Vaccinium* spp. that could serve as reservoirs for the pest (Nair *et al*. 2012). On the contrary, *S. rhododendri* has narrower host spectrum limited only to genera of Ericaceae family like *Rhododendron*, *Azalea*, *Kalmia* and *Pieris* (Drake and Ruhoff 1965). In the USA, it has been reported on many species of *Rhododendron*, but it is primarily a pest of *R. maximum* L. and its varieties and of *Kalmia* spp. (Mead 1967).

The lace bugs colonise mostly the lower surface of leaves. Eggs are laid on leaves along the midrib coated with an adhesive material that soon hardens and forms a protective coating. After hatching, nymphs begin to feed in small clusters near empty eggshells and adults. During early nymphal stages they move very little, remain grouped in small colonies and feed on the leaves. Their development passes through four (*S. rhododendri*) or five (*S. takeyai*) nymphal instars and one generation develops within 25–70 days. Several generations are produced each year and the exact number of generations depends on the length of growing season. They overwinter in the egg stage on broad-leaved evergreens and hatch from late April through May (Dickerson 1917; Drake and Ruhoff 1965; Hoover 2003; Hradil *et al*. 2008).

Damage of plants and economic importance

Symptoms of both lace bugs species on infested rhododendron shrubs were conspicuous with a serious aesthetic impairment of foliage accompanied with a total loss of plant vigour. The shrubs were heavily infested and most leaves were yellowish to whitish discoloured on the adaxial side (Fig. 3A) with drops of blackish or brownish excrements (Fig. 3B–C) and nymphal exuviae (Fig. 3G) on the abaxial side. Colonies of adults and nymphs of lace bugs could be found clustered on the lower leaf surfaces. As the infestation progressed the foliage colour changed to brownish or rusty and leaves prematurely dropped leading to continuous drying up of twigs and the whole plants.

Several host plants of the lace bugs belong to popular evergreen ornamental shrubs, therefore their expansion to new areas might present a significant threat to commercial trade of plants. Both of the lace bugs are important pests for nursery industry in countries where they appear regularly (Mead 1967; Schread 1968; Johnson and Lyon 1991; Nair *et al*. 2012). Evergreen ornamentals are usually appreciated for their showy foliage and even slight damage caused by leaf feeders, like lace bugs, can seriously affect the market value of plants prior to their sale and can make the plants unattractive. Many Ericaceae are also important ornamentals in Slovakia and for that reason the occurrence of these pests should be considered with concern. The lace bugs can be categorised among those insect invaders that are passively dispersed over long distances via a transport of infested plant material. This can also be the case of our discovery, since graves are often decorated with potted plants including Ericaceae ornamentals. Imported potted plants can serve as an excellent pathway for the lace bugs introduction due to a sheltered way of their life during initial stages of development, when the pests can be easily overlooked. The affected rhododendron shrubs in Slovakia were removed,

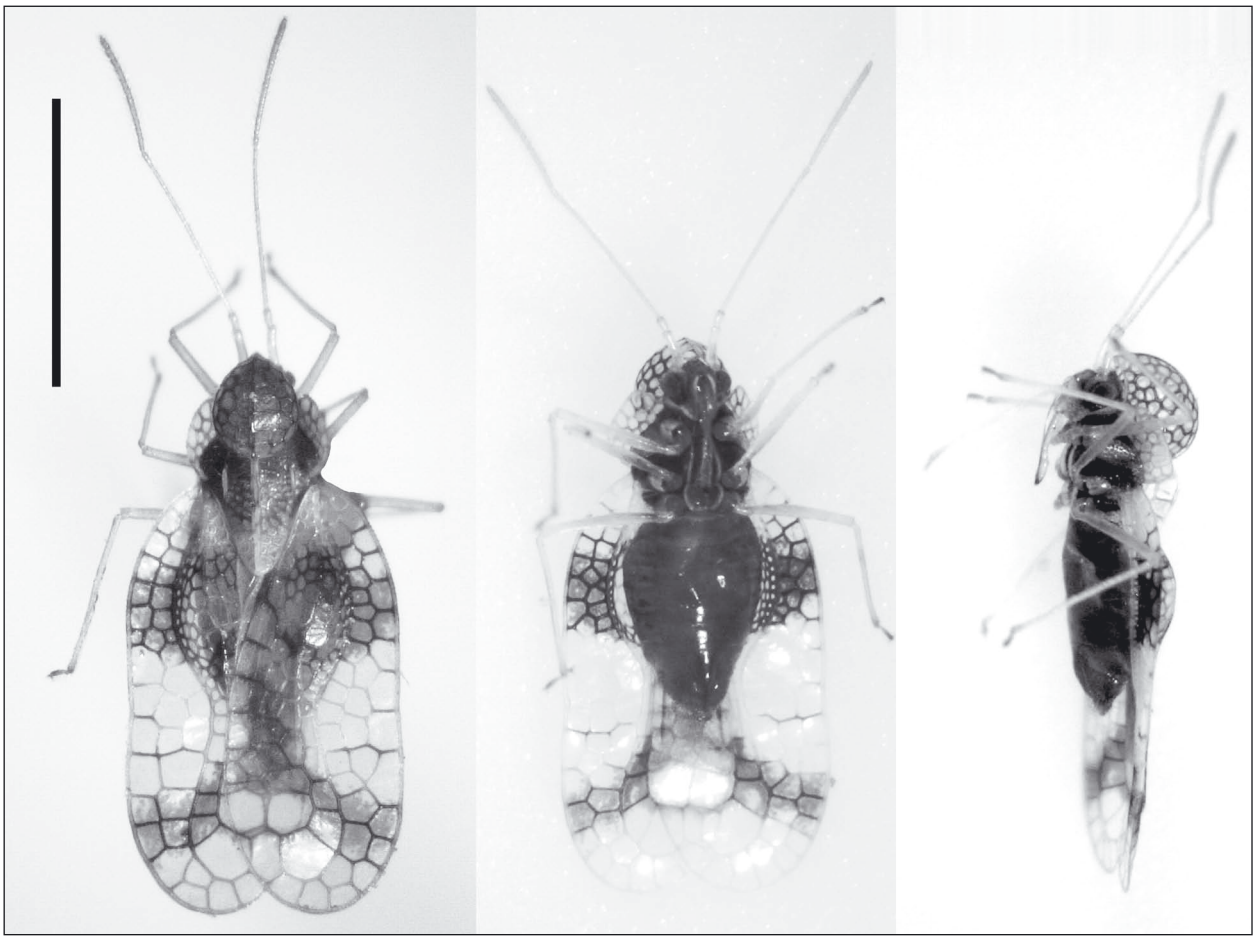

Fig. 1. Adult of *Stephanitis takeyai* (bar = 2 mm)

Fig. 2. Adult of *Stephanitis rhododendri* (bar = 2 mm)

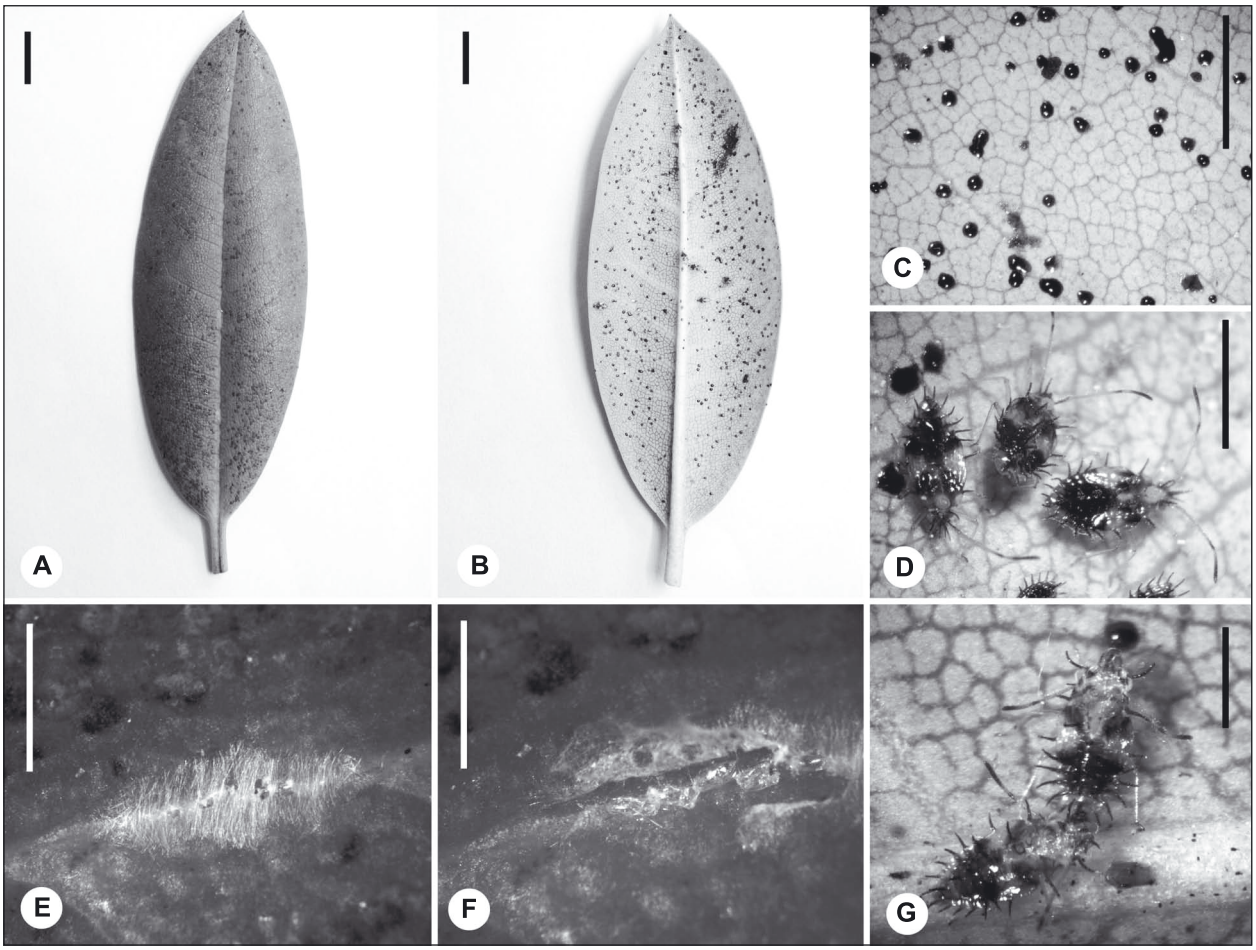

Fig. 3. General symptoms of rhododendros infestet by *Stephanitis takeyai*: A – an upper side of damaged leaf with typical light brown speckles; B, C – a lower side of infested leaf with black spots of excrements; D – nymphs of *S. takeyai*; E – an egg mass covered with protective material on the upper leaf surface; F – empty eggshells after nymphal hatching; G – nymphal exuviae of *S. takeyai* on the leaf surface (bars: A, B = 10 mm, C = 5 mm, D–G = 2 mm)

but with high probability it was carried out after the lace bugs had already left the damaged shrubs. The fact that we found no infected shrubs in the vicinity does not mean that the pests became extinct or were eradicated. Such a case occurred in the Netherlands where *S. takeyai* was first found on a *P. japonica* plant in a private garden in Boskoop in 1994, then was assumed to be effectively eradicated, but was found again in the same area in 1999 (Anonymous 2001). Despite that the lace bugs are important pests of ornamental Ericaceae in the USA (e.g. Mead 1967; Johnson and Lyon 1991; Hoover 2003), they are not considered as economically significant pests in Europe. For example, shortly after *S. takeyai* was reported from Europe, it was added to EPPO Alert list (in 1998), however it was removed from the list in 2004 since the pest risk analysis (PRA 04-10798) concluded that the pest did not have the characteristics of a quarantine pest (MacLeod 2000). *Stephanitis rhododendri* originally became a common and widespread pest of rhododendrons in England, Wales and southern Scotland after it was introduced at the beginning of the 20th century, however today it is less common and is only a local pest (MacLeod 2000).

In Europe, there are other three morphologically similar *Stephanitis* species, which confine their attacks to plants of the Ericaceae family, but have not yet been recorded in Slovakia. They are *S. pyrioides* (Scott, 1874) originally described from Japan and present in Europe (e.g. the Netherlands, the UK, Germany, Italy), *S. oberti* (Kolenati, 1857) of European origin, and *S. chlorophana* (Fieber, 1861) a Mediterranean species only known from Spain and Morocco (Drake and Ruhoff 1965; Péricart and Golub 1996; Bene and Pluot-Sigwalt 2005; Aukema 2013).

Acknowledgements

This work was financially supported by the Slovak Grant Agency VEGA (projects 2/0183/14 and 2/0052/15).

References

Anonymous 2001. News from the Diagnostic Centre of the Dutch NPPO. EPPO Reporting Service, No. 2001/188. Available on: http://archives.eppo.int/EPPOReporting/2001/Rse-0111.pdf [Accessed: January 7, 2016]

Aukema B. 2013. Hemiptera: Heteroptera. Fauna Europaea version 2.6.2. Available on: http://www.faunaeur.org [Accessed: December 29, 2015]

Bailey N.S. 1950. An asiatic tingid new to North America (Heteroptera). Psyche 57 (4): 143–145.

Bene G., Pluot-Sigwalt D. 2005. *Stephanitis pyrioides* (Scott) (Heteroptera Tingidae): a lace bug new to Italy. Bollettino di Zoologia Agraria e di Bachicoltura, Ser. II 37 (1): 71–76.

Colombo M., Limonta L. 2001. Record of *Stephanitis takeyai* Drake & Maa (Heteroptera Tingidae) on *Pieris japonica* (Thunb.) D. Don introduced in Italy. Bollettino di Zoologia Agraria e di Bachicoltura, Ser. II 33 (2): 139–142.

Dickerson E.L. 1917. Notes on *Leptobyrsa rhododendri* Horv. Journal of the New York Entomological Society 25 (2): 105–112.

Drake C.J., Ruhoff F.A. 1965. Lacebugs of the World. A Catalog (Hemiptera: Tingidae). United States National Museum Bulletin 243. Washington D.C., Smithsonian Institution Press, Washington, USA, 634 pp.

Dunbar D.M. 1974. Bionomics of the andromeda lacebug, *Stephanitis takeyai*. p. 277–289. In: "25th Anniversary Memoirs" (R.L. Beard, ed.). Connecticut Entomological Society, New Haven CT, USA, 322 pp.

Friess T. 2011. Tag der Artenvielfalt – Wanzen (Insecta: Heteroptera) im Botanischen Garten Graz. [Biodiversity day – true bugs (Insecta: Heteroptera) in the Botanical Garden Graz]. Mitteilungen des naturwissenschaftlichen Vereines für Steiermark 141: 221–233. (in German, with English summary)

Froeschner R.C. 1996. Lace Bug Genera of the World, I: Introduction, Subfamily Cantacaderinae (Heteroptera: Tingidae). Smithsonian Contributions to Zoology No. 574. Smithsonian Institution Press, Washington D.C., USA, 43 pp.

Guilbert E. 2016. Lace Bugs Database (Hemiptera: Tingidae) (version Feb. 2015). In: "Species 2000 & ITIS Catalogue of Life, 23 December 2015" (Y. Roskov, L. Abucay, T. Orrell, D. Nicolson, T. Kunze, C. Flann, N. Bailly, P. Kirk, T. Bourgoin, R.E. DeWalt, W. Decock, A. De Wever, eds.). Available on: http://www.catalogueoflife.org/col [Accessed: January 27, 2016]

Hommes M., Westhoff J., Melber A. 2003. Andromeda-Netzwanze, *Stephanitis takeyai* Drake et Maa (Heteroptera: Tingidae) erstmals für Deutschland nachgewiesen. [First verification of the Andromeda lacebug, *Stephanitis takeyai* Drake et Maa (Heteroptera: Tingidae) for Germany]. Nachrichtenblatt des Deutschen Pflanzenschutzdienstes 55 (8): 174–177. (in German, with English summary)

Hoover G.A. 2003. Lace bugs on broad-leaved evergreen ornamental plants. Entomological Notes. Department of Entomology. The Pennsylvania State University, USA, 2 pp.

Horváth G. 1905. Tingitidae novae vel minus cognitae e regione palaearctica. [Tingitidae new or less known from the Palaearctica region]. Annales Historico-Naturales Musei Nationalis Hungarici 3: 556–572. (in Latin)

Hradil K., Kment P., Bryja J., Roháčová M., Baňař P., Ďurčová, K. 2008. New and interesting records of true bugs (Heteroptera) from the Czech Republic and Slovakia IV. Klapalekiana 44: 165–206.

Johnson W.T., Lyon H.H. 1991. Lace bugs of broad-leaved evergreens and sages. p. 424–429. In: "Insects that Feed on Trees and Shrubs". 2nd ed. (W.T. Johnson, H.H. Lyon, eds.), Ithaca, Comstock Publishing Associates, 560 pp.

Jones R.A. 1993. The rhododendron lace bug, *Stephanitis rhododendri* Horvath, rediscovered in south-east London. British Journal of Entomology and Natural History 6: 139–140.

MacLeod A. 2000. *Stephanitis takeyai* Pest Risk Analysis for PHSC. Central Science Laboratory, York, UK, 5 pp.

Mead F.W. 1967. *Stephanitis* lace bugs of the United States (Hemiptera: Tingidae). Florida Department of Agriculture, Division of Plant Industry, Entomology Circular 62: 2.

Nair S., Braman S.K., Knauft D.A. 2012. Host plant utilization within family Ericaceae by the andromeda lace bug *Stephanitis takeyai* (Hemiptera: Tingidae). Journal of Environmental Horticulture 30 (3): 132–136.

Péricart J., Golub V.B. 1996. Superfamily Tingoidea Laporte, 1832. p. 3–83. In: "Catalogue of the Heteroptera of the Palaeartic Region" Vol. 2. Cimicomorpha I. (B. Aukema, C. Rieger, eds.). The Netherlands Entomological Society, Amsterdam, The Netherlands, 359 pp.

Schread J.C. 1968. Control of lace bugs on broadleaf evergreens. The Connecticut Agricultural Experiment Station Bulletin 684: 1–7.

Soika G., Labanowski G. 1999. Prześwietlik pierisowiec – nowy szkodnik w Polsce. [Takeya lace bug – a new pest in Poland]. Ochrona Roślin 43 (3): 14. (in Polish)

Stonedahl G.M., Dolling W.R., duHeaume G.J. 1992. Identification guide to common tinged pests of the world (Heteroptera: Tingidae). Tropical Pest Management 38 (4): 438–449.

Streito J.C. 2006. Note sur quelques espèces envahissantes de Tingidae: *Corythucha ciliata* (Say, 1932), *Stephanitis pyrioides* (Scott, 1874) et *Stephanitis takeyai* Drake & Maa, 1955 (Hemiptera Tingidae). [Note on some invasive species of Tingidae: *Corythucha ciliata* (Say, 1932), *Stephanitis pyrioides* (Scott, 1874) and *Stephanitis takeyai* Drake & Maa, 1955 (Hemiptera Tingidae)]. L'Entomologiste (Paris) 62 (1–2): 31–36. (in French)

Tsukada M. 1994. Seasonal host alternation by the Andromeda lace bug, *Stephanitis takeyai* (Heteroptera: Tingidae) between its two main host-plant species. Researches on Population Ecology 36: 219–224.

Vétek G., Kondorosy E., Maráczi L. 2012. A babérhanga-csipkéspoloska (*Stephanitis takeyai* Drake et Maa) (Heteroptera: Tingidae) megjelenése Magyarországon. [First record of the Andromeda lace bug (*Stephanitis takeyai* Drake et Maa) (Heteroptera: Tingidae) in Hungary]. Növényvédelem 48 (1): 21–26. (in Hungarian, with English summary)

Wang Y., Robacker C.D., Braman S.K. 1998. Identification of resistance to azalea lace bug among deciduous *Azalea* taxa. Journal of Environmental Horticulture 123: 592–597.

Watanabe H. 1983. Effects of repeated aerial applications of insecticides for pine-wilt disease on arboreal arthropods in a pine stand [Japanese red pine and black pine]. Journal of the Physical Society of Japan 65: 282–287.

Wheeler, Jr A.G. 1977. Spicebush and sassafras as new North American hosts of andromeda lace bug, *Stephanitis takeyai* (Hemiptera: Tingidae). Proceedings of the Entomological Society of Washington 79: 168–171.