

The first record of the Asian elm aphid *Tinocallis (Sappocallis) takachihoensis* Higuchi, 1972 (Hemiptera: Aphididae) in the European part of Russia

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Abstract

The Asian elm aphid *Tinocallis (Sappocallis) takachihoensis* Higuchi, 1972 (Hemiptera: Aphididae) was recorded for the first time in the European part of Russia. Adults and nymphs were observed in Donetsk and Rostov-on-Don in 2021, in Mariupol in 2023, in Feodosia and Berdyansk in 2024. The aphids were found in two elm species: the introduced *Ulmus pumila* L. and the native *U. glabra* Huds. These findings provide insight into the geographical expansion of this aphid species and its association with specific host plants in these regions. The overall harmfulness of the species is generally low; however, in certain cases, it has the potential to form localized populations with high densities, resulting in significant suppression of host plants.

Keywords

Aphid, *Tinocallis takachihoensis*, first record, invasion, European part of Russia, Donbass, Rostov Region, Zaporozhye Region, Crimea, *Ulmus*

Introduction

According to modern systematic concepts, the Asian genus *Tinocallis* Matsumura, 1919 (Hemiptera: Aphididae: Calaphidinae) includes 20 species (Quednau 2001, 2003; Blackman & Eastop 2013; Lee & Lee 2017). Most species of the genus are associated with plants from the family Ulmaceae (*Ulmus* L., *Zelkova* Spach), while some species develop in Lythraceae (*Lagerstroemia* L., *Duabanga* Buch.-Ham.), Betulaceae (*Corylus* L.), Fabaceae (*Dalbergia* L.f.) and Sapindaceae (*Sapindus* L.) (Casiraghi et al. 2022).

In Europe, six species of the genus are currently known: *Tinocallis nevskyi* Remaudière, Quednau & Heie, 1988, *T. platani* (Kaltenbach, 1843), *T. saltans* (Nevsky, 1929), *T. takachihoensis* Higuchi, 1972, *T. ulmiparvifoliae* Matsumura, 1919 and *T. zelkowae* (Takahashi, 1919) (Casiraghi et al. 2022). It is probable that all species within the genus entered European territory through the import of host plants from East Asia. Following their introduction, as they adapted to the new environment, these species probably expanded further through transportation networks and independently.

In 2021, the Asian elm aphid *T. takachihoensis* was registered for the first time in Donetsk. This is the third alien species of the genus *Tinocallis* in the European part of Russia.

The Siberian elm (*Ulmus pumila* L.), native to the southern regions of Central Asia, East Asia, and the Far East, is seen as the most extensively cultivated tree plant in temperate and subarid zones in Eurasia. In addition to its resistance to dust, gas, and drought, this species is also resistant to Dutch elm disease, which nearly eradicated populations of native elms (especially *U. minor* Mill.) in Europe in the middle of the last century. Currently, Europe is experiencing a resurgence of Dutch elm disease, now identified as a panphytopathy of combined bacterial and fungal origin (Cherpakov 2019). This resurgence underscores the increasing importance of studying the complex factors that negatively impact the phytosanitary condition of elm plantations.

Materials and methods

Elm plantations were conducted in Donetsk and Rostov-on-Don in 2021, in Mariupol in 2023, in Feodosia and Berdyansk in 2024. Adult samples and nymphs were collected in plastic tubes containing 70% ethanol. For species identification, temporary microscope slides were prepared in the laboratory. The identification process was carried out using the taxonomic keys provided by Blackman & Eastop (2013) and Kanturski et al. (2018).

The aphids in their natural habitat were photographed using a Nikon D7200 camera equipped with a Nikon 105mm f/2.8G IF-ED AF-S VR Micro-Nikkor lens and a Raynox DCR-250 converter. All samples are preserved in the author's research collection.

Results

Order Hemiptera Linnaeus, 1758

Family Aphididae Latreille, 1802

Subfamily Calaphidinae Oestlund, 1919

Genus *Tinocallis* Matsumura, 1919

Subgenus *Sappocallis* Matsumura, 1919

Tinocallis (Sappocallis) takachihoensis Higuchi, 1972

Figures 1A–E

Material examined. Winged viviparae and nymphs, Russia, Donetsk People's Republic, Donetsk, Donetsk botanical garden, 48°00'33"N 37°52'34"E, on the leaves of *Ulmus pumila* L., 18.06.2021, A.I. Gubin leg.; winged viviparae and nymphs, same locality, 48°00'42"N 37°52'42"E, on the leaves of *U. pumila*, 30.06.2021, A.I. Gubin leg.; winged viviparae and nymphs, Donetsk, 48°01'31"N 37°49'11"E, on the leaves of *U. pumila*, 25.06.2021, A.I. Gubin leg.; winged viviparae and nymphs, Donetsk, 47°59'08"N 37°43'29"E, on the leaves of *U. pumila*, 01.07.2021, A.I. Gubin, V.V. Martynov, T.V. Nikulina leg.; winged viviparae and nymphs, Mariupol, 47°05'55"N 37°31'21"E, on the leaves of *Ulmus glabra* Huds., 13.09.2023, A.I. Gubin, V.V. Martynov, T.V. Nikulina leg.; winged viviparae and nymphs, Rostov Region, Rostov-on-Don, 47°14'44"N 39°39'23"E, on the leaves of *U. pumila*, 11.08.2021, A.I. Gubin leg.; winged viviparae, Republic of Crimea, Feodosia Municipality, Kurortnoe, 44°55'03"N 35°11'08"E, on the leaves of *U. pumila*, 02.06.2024, V.V. Martynov, T.V. Nikulina leg.; winged viviparae and nymphs, same locality, 44°54'35"N 35°11'27"E, on the leaves of *U. pumila*, 12.06.2024, V.V. Martynov, T.V. Nikulina leg.; winged viviparae and nymphs, Zaporozhye Region, Berdyansk District, Berdyansk, 46°45'06"N 36°47'04"E, on the leaves of *U. pumila*, 22.08.2024, V.V. Martynov, T.V. Nikulina leg.

Distribution. The Asian elm aphid *T. takachihoensis* was found in Japan (Higuchi 1972), also subsequently recorded in China (Tao 1999) (originally reported as *T. hemipteleae* Zhang, 1980 (Zhang & Zhong 1980)), Primorsky Krai of Russia (as *T. ussuriensis* Pashchenko 1988) (Pashchenko 1988) and on the Korean Peninsula (Park & Ahn 1994; Lee & Lee 2017; Lee et al. 2018). In Europe, it was first found in France in 1984 (Leclant & Remaudière 1986) and later in Italy (Tuscany and Sicily) in 1995 (Barbagallo et al. 2011; Sinacori & Mineo 1998). Since 1997 it has been regularly recorded in the UK on bonsai plants imported from China but began to occur outdoors only in 2007 (Döring 2007). In 1997 it was registered in Andorra (Mier Durante & Pérez Hidalgo 2002), in 2003 – in Spain (Lumbierres et al. 2004), in 2006 – in Greece (Papapanagiotou et al. 2012) and in the Netherlands (Piron

2013), in 2007 – in Germany (Döring 2007), in 2008 – in the Balearic Islands (Pérez Hidalgo et al. 2013), in 2009 – in Malta (Mifsud et al. 2009), in 2017 – in Poland, Czech Republic, Denmark (Kanturski et al. 2018) and Serbia (Petrović-Obradović et al. 2018). Outside of Europe *T. takachihoensis* was found in 1996 in the USA (Maryland) (Footitt et al. 2006), in 2008 – in the Asian part of Turkey (Görür et al. 2011), in 2013 – in Algeria (Laamari et al. 2013) (Fig. 2). In the Barcode of Life Data System database also contains information about the species records in 2017 and 2022 in the Republic of South Africa (BOLD 2024).

The discovery of *T. takachihoensis* in the 2021 in Donetsk People's Republic and the Rostov region was the first record of the species in the European part of Russia. In 2023 the species was also registered in Mariupol, in 2024 – in Feodosia (Republic of Crimea) and Berdyansk (Zaporozhye region).

Biology. The Asian elm aphid is a holocyclic, nonmigratory species. Oligophagous, trophically associated with the Ulmaceae family, primarily with the species of the genus *Ulmus* L. (Kanturski et al. 2018). Within its natural range, it feeds on *Ulmus parvifolia* Jacq., *U. japonica* (Rehder), Sarg. (= *U. davidiana* var. *japonica* (Rehder) Nakai; = *Ulmus propinqua* (Koidz.)), *U. glabra* Huds., *U. laciniata* (Trautv.) Mayr, *U. macrocarpa* Hance, and also on *Zelkova serrata* (Thunb.) Makino and *Hemiptelea davidii* (Hance) Planch. (Zhang & Zhong 1980; Pashchenko 1988; Park & Ahn 1994; Pérez Hidalgo et al. 2013; Lee et al. 2018). In Europe, the following are noted as host plants: *U. minor* (including *U. minor* var. *canescens* Melville and *U. minor* 'Plotii'), *U. glabra*, *U. × hollandica* Mill., *U. pumila*, *U. americana* L. (Döring 2007; Mifsud et al. 2009; Papapanagiotou et al. 2012; Pérez Hidalgo et al. 2013; Piron 2013; Kanturski et al. 2018; Petrović-Obradović et al. 2018), as well as *Z. serrata* (Döring 2007). In the southwest of the European part of Russia, we recorded feeding of *T. takachihoensis* only on *U. pumila* and *U. glabra*, while these species could not be found on *U. laevis* Pall. despite targeted searches.

The life cycle of the species has not been studied sufficiently. The colonies consist of winged viviparae and nymphs on the underside of the leaves (Fig. 1C), with no ant attendance observed. Although fundatrices have not been documented in Europe, alate males and oviparae have only been recorded in Sicily (Patti & Barbagallo 1997). Piron (2013) suggests an anholocyclic mode of reproduction for the species, involving the overwintering of winged viviparae and nymphs. However, sexual forms of *T. takachihoensis* have been recorded in France and Great Britain (Quednau 2003), indicating the possibility of holocyclic reproduction in at least some populations.

In the southwest of the European part of Russia only winged viviparae (Fig. 1A) and nymphs (Fig. 1B) were observed; neither fundatrices nor amphigonous generations were detected. In most locations, the aphids formed small colonies on the abaxial side of young leaves, often cohabiting with *T. saltans*, another invasive phytophagous species of Asian origin that has been present in the region since the late 20th century (Kolomoets 1995). Single densely populated colonies were recorded only in street plantings in Mariupol (Figs. 1C–E) and Berdyansk.

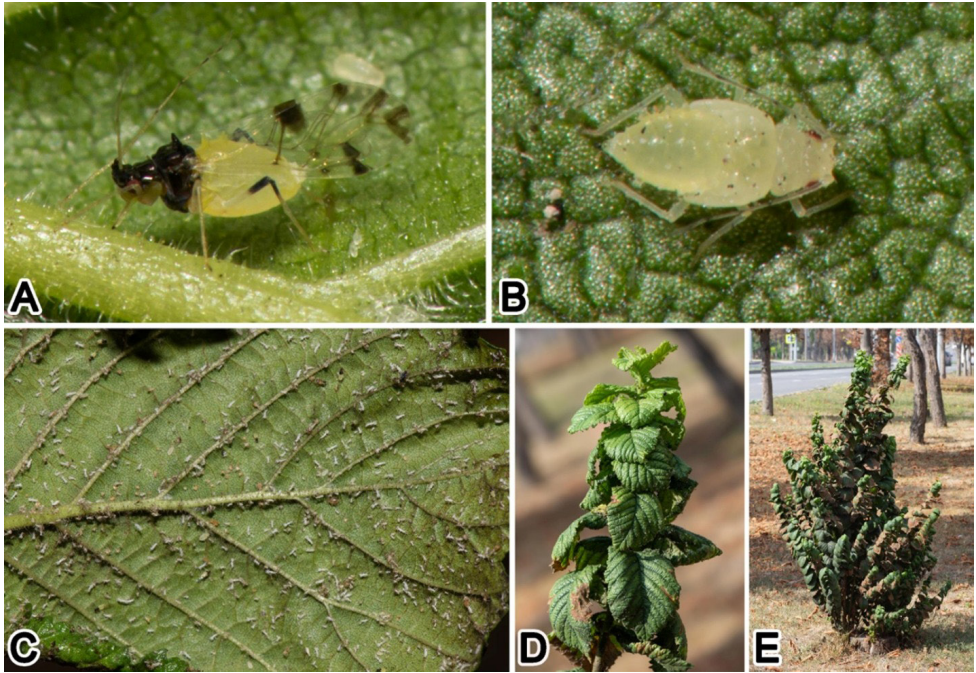


Figure 1. *Tinocallis (Sappocallis) takachihoensis* Higuchi, 1972: **A** – winged vivipara; **B** – last instar nymph; **C** – colony on the abaxial side of *Ulmus glabra* Huds. leaf; **D–E** – damage to *U. glabra*.

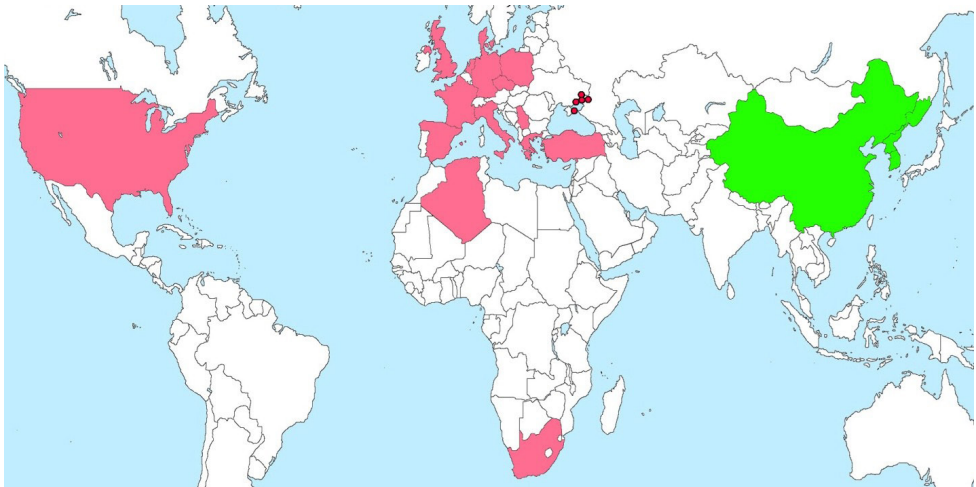


Figure 2. Distribution of *Tinocallis (Sappocallis) takachihoensis* Higuchi, 1972. The primary range is marked by green, and the secondary range – by pink, and new records are indicated with red circles.

Damage. Numerous studies have noted that *T. takachihoensis* produces large amounts of honeydew, which serves as a substrate for the growth of sooty fungi, but does not directly damage host plants (Pérez Hidalgo et al. 2013; Piron 2013). In most of the locations identified in the southwest of the European part of Russia, the colonies of *T. takachihoensis* were small and did not significantly affect the elms. However, in Mariupol, extensive damage was observed to the young shoots of *U. glabra*, leading to leaf deformation and a noticeable inhibition of plant growth (Figs. 1D–E). A similar situation occurred in *U. pumila* in Berdyansk. As a result, in the context of the emerging complex of phytopathogens and phytophagous pests that affect elms (Martynov et al. 2022), *T. takachihoensis* has the potential to become a significant pest, possibly due to synergistic interactions with other factors.

Parasitoids and predators. In Europe, a specialized parasitoid of the Asian elm aphid, *Trioxys ulmi* Črkić & Tomanović, 2021 (Hymenoptera: Braconidae: Aphidiinae), was recorded and described in 2021 based on specimens from Serbia. Although likely of Asian origin, this species remained undescribed until its accidental introduction to Europe (Črkić et al. 2021). Furthermore, a parasitoid from the genus *Aphidius* was reported in Algeria (Laamari et al. 2013). In aphid colonies observed in Mariupol, we identified unknown parasitoids from the Aphidiinae subfamily. On the Iberian Peninsula, *Oenopia conglobata* (Linnaeus, 1758) (Coleoptera: Coccinellidae) has been recorded as a predator of *T. takachihoensis* (Lumbierres et al. 2004). In Donetsk, adult aphids and nymphs were eaten by larvae and imagoes of *Harmonia axyridis* Pallas, 1773; in Mariupol, aphids were eaten by imagoes of *Coccinella septempunctata* (Linnaeus, 1758).

Discussion

In eastern Europe, elms support a diverse community of phytophagous, covering more than 300 species. This diversity ranks elms third only after oaks, which host approximately 850 species, and poplars, with around 700 species, among broad-leaved trees (Martynov & Nikulina 2015). In the European part of Russia, the alien phytophagous complex affecting elms includes six species of Asian origin: the leafhopper *Tautoneura polymitusa* Oh & Jung, 2016; the aphids *Tinocallis saltans*, *T. platanii*, and *T. takachihoensis*; the weevil *Orchestes steppensis* Korotyaev, 2016; and the zigzag sawfly *Aproceros leucopoda* Takeuchi, 1939 (Shaposhnikov 1964; Martynov & Nikulina 2017; Gubin et al. 2020; Arzanov et al. 2021). Despite the introduction of these pests, elm species demonstrate considerable resilience to both biotic and abiotic factors, making them valuable for forestry and ornamental gardening. However, ongoing monitoring is essential to manage potential additions to the complex of pests and diseases that affect these important forest species.

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References

- Arzanov YuG, Martynov VV, Nikulina TV (2021) A contribution to the fauna of weevil beetles (Coleoptera: Curculionoidea) of the Central Donbass. *Caucasian Entomological Bulletin* 17(1): 5–44. <https://doi.org/10.23885/181433262021171-544>
- Barbagallo S, Binazzi A, Pennacchio F, Pollini A (2011) An annotated checklist of aphids surveyed in the Italian regions of Tuscany and Emilia Romagna. *REDIA – Journal of Zoology* 94: 59–96.
- BOLD: The Barcode of Life Data System v4 (2024) <https://v4.boldsystems.org/>
- Blackman RL, Eastop VF (2013) *Aphids on the World's Plants*. An online identification and information guide. <https://aphidsonworldsplants.info/>
- Casiraghi A, Moreno-González V, Umaran A, Pérez Hidalgo N (2022) First record of *Tinocallis zekowae* (Takahashi, 1919) (Hemiptera: Aphididae: Calaphidinae) in the Iberian Peninsula. *REDIA – Journal of Zoology* 105: 3–10. <http://dx.doi.org/10.19263/REDIA-105.22.01>
- Cherpakov VV (2019) Nature of the Dutch elm disease: new aspects of diagnostics, pathogenesis, and etiology. *Izvestia Sankt-Peterburgskoj Lesotehničeskoj Akademii* 228: 266–293. <http://dx.doi.org/10.21266/2079-4304.2019.228.266-293> [In Russian]
- Čkrkić J, Petrović A, Kocić K, Tomanović Ž (2021) Insights into phylogenetic relationships between *Trioxys* Haliday, 1833 and *Binodoxys* Mackauer, 1960 (Hymenoptera, Braconidae, Aphidiinae), with a description of a new species of the genus *Trioxys*. *Zoosystema* 43(8): 145–154. <https://doi.org/10.5252/zoosystema2021v43a8>
- Döring TF (2007) Colonies of the Asian elm aphid *Tinocallis takachihoensis* Higuchi (Hemiptera: Aphididae) in Britain. *The Entomologist's record and Journal of Variation* 119(5): 226–227.
- Footitt RG, Halbert SE, Miller GL, Maw E, Russell LM (2006) Adventive aphids (Hemiptera: Aphididae) of America north of Mexico. *Proceedings of the Entomological Society of Washington* 108(3): 583–610.
- Görür G, Akyildirim H, Akyürek B, Olcabey G (2011) A contribution to the knowledge of the Turkish aphid (Hemiptera: Aphidoidea) fauna. *EPP0 Bulletin* 41(2): 185–188. <https://doi.org/10.1111/j.1365-2338.2011.02467.x>

- Gubin AI, Martynov VV, Nikulina TV (2020) *Tautoneura polymitusa* Oh & Jung, 2016 (Hemiptera: Auchenorrhyncha: Cicadellidae): a new alien leafhopper species in the fauna of Eastern Europe. Russian Journal of Biological Invasions 11 (4): 310–313. <https://doi.org/10.1134/S2075111720040037>
- Higuchi H (1972) A taxonomic study of the subfamily Callipterinae in Japan. Insecta Matsumurana 35 (2): 19–126.
- Kanturski M, Lee Y, Depa Ł (2018) New records of an alien aphid species *Tinocallis* (*Sappocallis*) *takachihoensis* from countries in central and northern Europe (Hemiptera, Aphididae, Calaphidinae). ZooKeys 730: 1–17. <http://dx.doi.org/10.3897/zookeys.730.21599>
- Kolomoets TP (1995) Pests of the green spaces in the industrial Donbass. Naukova Dumka, Kiev, 214 pp. [In Russian]
- Laamari M, Coeur d'Acier A, Joussein E (2013) New data on aphid fauna (Hemiptera, Aphididae) in Algeria. ZooKeys 319: 223–229. <https://doi.org/10.3897%2Fzookeys.319.4340>
- Leclant F, Remaudière G (1986) Aphids new to France and Europe. Aphidologist's Newsletter 21: 8.
- Lee Ye, Lee S (2017) A review of the *Tinocallis* Matsumura (Hemiptera: Aphididae) on the Korean peninsula, with description of one new species. Journal of Asia-Pacific Entomology 20(3): 1019–1031. <https://doi.org/10.1016/j.aspen.2017.07.005>
- Lee S, Lee Ye, Kim S (2018) Insect Fauna of Korea 9 (5). Calaphidinae (Arthropoda: Insecta: Hemiptera: Aphididae: Calaphidinae). National Institute of Biological Resources, Incheon, 246 pp.
- Lumbierres B, Pons X, Starý P (2004) Parasitoids and predators of aphids associated with public green areas of Lleida (NE Iberian Peninsula). Advances in Horticultural Science 19(2): 69–75.
- Martynov VV, Nikulina TV (2015) Insects of Donetsk forests. In: Forests of Donetsk region. Scientific and Informational Guide. Initial, Lutsk, 351–364. [In Ukrainian]
- Martynov VV, Nikulina TV (2017) Population surge of zigzag elm sawfly (*Aproceros leucopoda* (Takeuchi, 1939): Hymenoptera: Argidae) in the Northern Cis-Azov Region. Russian Journal of Biological Invasions 8(2): 135–142. <https://doi.org/10.1134/S2075111717020059>
- Martynov VV, Orlaty AA, Nikulina TV, Gubin AI (2022) Preliminary review of the complex of phytophagous arthropods of elm species in the Donbass. In: Modern challenges in zoological studies in Russia and adjacent territories. Materials of Russian Scientific Conference (Ulyanovsk, April 14–15, 2022). Ulyanovsk, 114–120. [In Russian]
- Mier Durante MP, Pérez Hidalgo N (2002) Dos especies de Panaphidini (Hemiptera, Aphididae: Calaphidinae), propias de árboles ornamentales, introducidas en la Península Ibérica. Boletim da Sociedade Portuguesa de Entomologia 6: 213–219.

- Mifsud D, Pérez Hidalgo N, Barbagallo S (2009) Aphids (Hemiptera: Aphidoidea) associated with native trees in Malta (Central Mediterranean). *Bulletin of the Entomological Society of Malta* 2: 81–93.
- Papapanagiotou AP, Nathanailidou M, Taylor M, Zarpas KD, Voudouris K, Tsitsipis JA, Margaritopoulos JT (2012) New records of aphid species (Hemiptera: Aphididae) in Greece. *Entomologia hellenica* 21: 54–68. <https://doi.org/10.12681/eh.11518>
- Park HQ, Ahn HS (1994) New and little known species of subfamily Drepanosiphinae from Korea (Drepanosiphidae: Aphidoidea: Homoptera). *Korean Journal of Zoology* 37 (3): 297–303.
- Pashchenko NF (1988) Suborder Aphidinea – Aphids. In: *Key to insects of the Far East of the USSR. Vol. II. Homoptera and hemiptera*. Nauka, Lenindrad, 546–686. [In Russian]
- Patti I, Barbagallo S (1997) Recenti acquisizioni faunistiche sugli Afidi della Sicilia. *Bollettino del Laboratorio di Entomologia agraria Filippo Silvestri* 53: 29–84.
- Pérez Hidalgo N, Sánchez I, Umaran A (2013) Nuevas citas de *Tinocallis takachioensis* (Hemiptera: Aphididae) en la España peninsular e Islas Baleares. *Boletín de la Sociedad Entomológica Aragonesa (S.E.A.)* 53: 323–326.
- Petrović-Obradović O, Radonjić A, Jovičić I, Petrović A, Kocić K, Tomanović Ž (2018) Alien species of aphids (Hemiptera: Aphididae) found in Serbia, new to the Balkan Peninsula. *Phytoparasitica* 46(5): 653–660. <https://doi.org/10.1007/s12600-018-0693-3>
- Piron PGM (2013) Appearance of *Tinocallis takachioensis* (Homoptera: Aphididae) in The Netherlands. *Entomologische Berichten* 73 (6): 251–256.
- Quednau FW (2001) World review of the genus *Tinocallis* (Hemiptera: Aphididae, Calaphidinae) with description of a new species. *The Canadian Entomologist* 133(2): 197–213. <https://doi.org/10.4039/Ent133197-2>
- Quednau FW (2003) *Atlas of the Drepanosiphine aphids of the world. Pt. II: Panaphidini Oestlund, 1923 – Panaphidina Oestrund, 1923* (Hemiptera: Aphidinae: Calaphidinae). The American Entomological Institute, Florida, 301 pp.
- Shaposhnikov GK (1964) Suborder Aphidinea – Aphids. In: *Key to insects of the European part of Russia. Vol. I. Apterygota, Palaeoptera, Hemimetabola*. Nauka, Moscow, 498–616. [In Russian]
- Sinacori A, Mineo N (1998) *Pyrrhalta luteola* e *Tinocallis takachioensis* sugli olmi in Sicilia occidentale. *Informatore Fitopatologico* 48: 58–62.
- Tao CC (1999) List of Aphidoidea (Homoptera) of China. *Taiwan Agricultural Research Institute Special Publication* 77: 1–144.
- Zhang GX, Zhong TS (1980) Six new species of *Tinocallis* Matsumura and a new species of *Sinotherioaphis* Zhang, gen. nov. from China (Aphidoidea: Callaphididae). *Zoological Research* 1(4): 429–442.