

Determined aphid species from Ardahan Province with three new records for Türkiye aphid (Hemiptera: Aphidoidea) fauna

Türkiye afit faunasına (Hemiptera: Aphidoidea) üç yeni kayıtlı Ardahan ilinin afit türlerinin belirlenmesi

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Abstract

Aphids extend their distribution by reaching large numbers in a short time, thanks to their characteristic feature of both cyclical parthenogenesis and telescoping generations. Also, aphid has a close relationship with their host plants and any changes in host plant features effect aphid distribution. Thus recently, aphid species have been distributed outside their original geographical areas. The study conducted in Ardahan province in June-July, 2022 and fifteen aphid species and one subspecies were recorded. *Chaitophorus hokkaidensis* Higuchi, 1972, *Macrosiphoniella subterranea* (Koch, 1855) and *Macrosiphoniella (Sinosiphoniella) yomogicola* (Matsumura, 1917) were determined as new records for Türkiye aphid fauna. The number of the aphid species was risen to 678 with these new records. The findings of this study, in accordance with the predictions made by aphid researchers, are an indication that it will not be a surprise if more species are added to the Turkish aphid fauna with more detailed faunistic research.

Özet

Afitler hem döngüsel partenogenez hem de teleskopik jenerasyon özellikleri sayesinde kısa sürede çok fazla sayıya ulaşarak dağılım alanlarını genişletirler. Ayrıca, afitler konağı ile yakın ilişki içerisinde ve konak bitki özelliklerindeki herhangi bir değişiklik afitlerin dağılımlarını etkileyebilmektedir. Bu sebeple son zamanlarda afitler orijinal coğrafi bölgelerinin dışına dağılmışlardır. 2022 yılı Haziran-Temmuz aylarında Ardahan ilinde gerçekleştirilen çalışmada 15 afit türü ve bir alt tür kayıt altına alınmıştır. *Chaitophorus hokkaidensis* Higuchi, 1972, *Macrosiphoniella subterranea* (Koch, 1855) ve *Macrosiphoniella (Sinosiphoniella) yomogicola* (Matsumura, 1917) Türkiye afit faunası için yeni kayıt olarak belirlenmiştir. Bu yeni kayıtlarla afit türlerinin sayısı 678'e yükselmiştir. Bu çalışmanın bulguları, araştırmacılarının öngörülerini doğrultusunda, daha detaylı faunistik araştırmalarla Türkiye afit faunasına daha fazla türün eklenmesinin sürpriz olmayacağını bir göstergesidir.

INTRODUCTION

Aphids (Hemiptera: Aphidoidea) can be considered one of the major phytophagous insect groups due to their close relationships with their host plant, polymorphism, host alternation, rapid reproduction and short development time due to their unique reproductive and adaptive potential. They are obligatory phytophagous insects and therefore while damaging to the host plant directly by feeding on phloem sap, they also cause indirect damage by carrying over 300 of the plant viruses (Ng and Perry 2004, Oğuzoğlu and Avcı 2019). As aphids has a close relationship with their host plant, heavily colonizing causes and decrease in the quality and yield of agricultural products, thus causing serious economic losses (van Emden and Harrington 2017). Additionally, some characteristics of aphids, such as host alternation

and cyclical parthenogenesis, allows them to extend their distribution ranges and to increase their number very quickly (Vilcinskis 2016, Görür et al. 2023a). Moreover, aphids also increase damages to host plant throughout benefiting from the global warming (Görür et al. 2023b).

Aphids are considered as one of the most serious pest species around the world, by causing huge amount of crop losses in agricultural production (van Emden and Harrington 2017). As agricultural activity play important role in Türkiye, it is important to find out current composition of aphid fauna. Recently, there are a lot of studies have been conducted on aphids that feeding on herbaceous-woody plants, ornamental plants and agricultural plants. Currently, 675 aphid species have been listed for Türkiye aphid fauna (Görür et al. 2012, Kök and Özdemir 2021, Kök 2021, Görür et al. 2023c, Görür et

al. 2024). There are still discussion going on whether presented number reflects real composition or not due to floristic richness of Türkiye (Akyıldırım Beğen et al. 2023, Görür 2023). Considering the different climatic conditions and rich plant diversity of Türkiye, it is thought that these data do not reflect the real. Therefore, carrying out detailed faunistic research, especially in unstudied regions, will make an important contribution to the aphid fauna of Türkiye. The purpose of this study is to obtain prior knowledge about the aphids that distributed in Ardahan Province and to discuss the future of the aphid fauna of Türkiye.

MATERIAL AND METHOD

This study was carried out in June-July 2022 to determine aphid and host plant species of Ardahan province. Ardahan is a high and hilly city in the northeast of Türkiye, close to the Georgian border. There are mountains in the area that exceed 3000 meters. Ardahan has a humid mid-latitude climate with cold winters, warm summers and rainy seasons. The annual average temperature is 3.8°C, and the average temperature is below 0°C for five months of the year. The average temperature is 16.3°C, and the maximum temperature is 35°C in August and July. In field studies, samples were taken from 17 different host plants. Permanent slides of the samples were studied under laboratory conditions according to the method offered by Martin (1983). Species were identified according to internationally accepted identification key provided by Blackman and Eastop (2024) and last taxonomical status of the species was checked by Favret (2024). Voucher samples stored at the Biotechnology Department of the Niğde Ömer Halisdemir University.

RESULTS

As a result of the examination of the aphid sampled from 17 host plants in different localities, 15 species and one subspecies were recorded from Ardahan province. Among them, *Chaitophorus hokkaidensis* Higuchi, 1972 *Macrosiphoniella subterranea* (Koch 1855) and *Macrosiphoniella* (*Sinosiphoniella*) *yomogicola* (Matsumura 1917) are recorded as new records for the aphid fauna of Türkiye and marked with an asteriks.

Aphidoidea Latreille, 1802

Aphididae Latreille, 1802

Aphis Linnaeus, 1758

Aphis (*Aphis*) *craccivora* Koch, 1854

General characteristics. Adult apterae individuals are shining black, usually ant-attended; BL (Body length) is 1.4-2.2 mm. Generally, this species shows an anholocyclic life cycle. It is a worldwide and is considered as a major pest of leguminous crops (Blackman and Eastop 2023).

Material examined. Ten apterae adult individuals (♀) were taken on *Antirrhinum* sp. from Ardahan/Ardahan University Campus, XX.VII.2022. Apterae individuals were shining black, ant-attended. Adult wingless individuals were heavily colonized on the line extending from the plant stem to the flower base of the host plant. Cauda was tongue-shaped and black like siphunculi. BL 1.40 mm, TAL (Total antennal length) 0.32 mm, URS IV+V (Length of the ultimate rostral segment VI+V) 0.11 mm. PT/BASE (Vith antennal segment processus terminalis/Vlth antennal segment Base) 2.20 mm.

Acyrtosiphon Mordvilko, 1914

Acyrtosiphon (*Acyrtosiphon*) *pisum* (Harris, 1776)

General characteristics. Apterae individuals are green or pink. BL is 2.5-4.4 mm. It has been recorded in many herbaceous, woody plants, shrubs and also trees (*Albizia julibrissin*, *Robinia pseudoacacia* and *Sesbania grandiflora*). *Acyrtosiphon pisum* is considered a cosmopolitan species (Blackman and Eastop 2023).

Material examined. 12 adult aphids were sampled on leaves of the *Trifolium* sp. from Ardahan-Çıldır highway/Cemal Tural Nature Park, XX.VII.2022. Adult apterae individuals were pink and green in color on stem of the host. BL 3.90 mm, PT/BASE 3.85 mm, URS IV+V 0.13 mm and TAL 1.31 mm.

Brachycaudus Van der Goot, 1913

Brachycaudus (*Brachycaudus*) *helichrysi* (Kaltenbach, 1843)

General characteristics. In flowerheads and on stems of numerous plant species (esp. Compositae/Asteraceae

and Boraginaceae). It is a major pest that can be seen widely all over the world (Blackman and Eastop 2023).

Material examined. 10 adult apterous individuals (♀) were sampled from Ardahan/Ardahan University Campus, XX.VII.2022. The brownish apterae individuals generally fed on stems of *Cirsium* sp. BL 1.68 mm, TAL 0.37 mm, PT/BASE 2.70 mm, URS IV+V 0.12 mm. SIPH (Siphunculi) was pale and without subapical polygonal reticulation, 0.25 mm.

***Brachycaudus (Appelia) prunicola schwartzi* (Börner, 1931)**

General characteristics. Apteræ are shiny black, dark green. BL is 1.4-2.4 mm. They are widespread in continental Europe, Siberia, east to Irkutsk, Iran, Kazakhstan and Pakistan (Blackman and Eastop 2023).

Material examined. 14 apterae specimens (♀) were collected on *Tragopogon* sp. from Ardahan City Center (Ardahan Castle, next to Kura River), XX.VII.2022. Adult individuals were shiny black and dark brownish. BL 1.67, TAL 0.25, PT/BASE 2.10, URS IV+V 0.12 mm.

Corylobium Mordvilko, 1914

***Corylobium avellanae* (Schrank, 1801)**

General characteristics. Cauda is finger-shaped. SIPH is long and tubular, with subapical polygonal reticulation. It

shows monoecious holocyclic life cycle. It is distributed from Europe to Türkiye, Ukraine, Iran and Canada (Blackman and Eastop 2023).

Material examined. 12 individuals (♀) were collected from Ardahan/Ardahan University Campus, XXI.VII.2022. Adult apterae were green and spindle-shaped. Dense colonies form particularly along the main veins on the underside of young leaves of the *Corylus* sp. BL 0.90 mm, PT/BASE 0.50 mm, TAL 0.15 mm and URS IV+V 0.14 mm.

Hyadaphis Kirkaldy, 1904

***Hyadaphis coriandri* (Das, 1918)**

General characteristics. Mainly suck on numerous species of Umbelliferae/Apiaceae, living mainly in the umbels. Apteræ are dirty greenish in colour with dark green, 1.3-2.1 mm. The Asian originated, distributed in Spain, Portugal, the Mediterranean region, the Middle East, Pakistan, India, Central Asia, USA, Africa, South America, Iran and Kazakhstan (Blackman and Eastop 2023).

Material examined. Ten adult aphid individuals (♀) were sampled from Ardahan/Ardahan University Campus, XXI.VII.2022. Collected specimens were dirty greenish in colour, and it was seen densely in the umbels of the *Daucus* sp. BL 1.75 mm, PT/BASE 3.12 mm, TAL 0.33 mm and URS IV+V 0.12 mm.



Figure 1. Colony appearances of the aphid species reported as new records: a) *Macrosiphoniella subterranea* on *Chrysanthemum* sp., b) *Macrosiphoniella (Sinosiphoniella) yomogicola* on *Artemisia* sp., c) *Chaitophorus hokkaidensis* on *Salix* sp.

Macrosiphoniella Del Guercio, 1911

***Macrosiphoniella (Macrosiphoniella) subterranea (Koch, 1855)**

General characteristics. Adult wingless individuals are reddish brown covered with greyish wax except around bases of siphunculi. Both cauda and siphunculi are black; BL 2.6-3.5 mm. *M. subterranea* is widely distributed in Europe, Kazakhstan, Iran and in North America (Blackman and Eastop 2023).

Material examined (Figures 1a, 2a, b, c, d, e, f). 16 adult individuals (♀) were collected from Ardahan/Posof, XXII.VII.2022. Collected wingless aphids are faint green covered with greyish wax. Legs, cauda and siphunculi of collected materials were dark black. Adult individuals were sampled from the young shoots and under the leaves of *Chrysanthemum* sp. BL 2.17 mm, TAL 0.86 mm, URS IV+V 0.15 mm and PT/BASE 3.09 mm. SIPH was 0.87 x cauda and with distal zone of polygonal reticulation on distal 0.5-0.6 of length. This species has been recorded for the first time from Türkiye.



Figure 2. *Macrosiphoniella subterranea* under the microscope: a) general appearance, b) polygonal reticulation of SIPH, c) rostrum, d) hair appearance on ANT III (Antennal segment III) and rostrum, e) cauda and SIPH, f) last segment of the antenna (base + processus terminalis)

***Macrosiphoniella (Sinosiphoniella) yomogicola (Matsumura, 1917)**

General characteristics. Wingless adults are grey-green to reddish brown or blackish. The cauda, antennae, legs, and siphunculi are all darkly coloured. BL is 2.0-3.2 mm, PT/BASE often less than 4.2. On *Artemisia* spp., attended by ants under earthen. Previously, *M. yomogicola* was recorded from Japan, China (Blackman and Eastop 2023).

Material examined (Figures 1b, 3a, b, c, d). 15 adult apterae aphids (♀) were sampled on *Artemisia* sp. from Ardahan/Posof, XXII.VII.2022. Apterae were rust brown, and antennae, legs, siphunculi and cauda were dark blackish. BL 2.00 mm, PT/BASE 3.05 mm, URS IV+V 0.15 mm, TAL 0.69 mm. Cauda was finger-like with 24 setae and cauda length was 2.5 times its basal width. Also, while sampling, many ants and a few ladybirds were detected. With this definition, *M. yomogicola* is a new record for Türkiye aphid fauna.

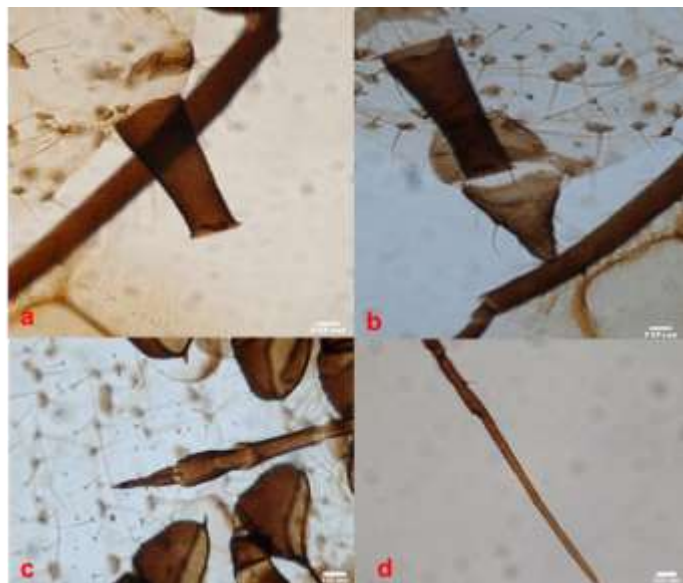


Figure 3. *Macrosiphoniella (Sinosophoniella) yomogicola* under the microscope: a) SIPH; b) SIPH and cauda; c) rostrum; d) last segment of the antenna (base + processus terminalis).

***Macrosiphum* Passerini, 1860**

***Macrosiphum (Macrosiphum) euphorbiae* (Thomas, 1878)**

General characteristics. Adult wingless individuals are broadly spindle-shaped, usually green, pink or magenta, sometimes yellowish and BL 1.7-3.6 mm. With a sexual stage on *Rosa* sp., heteroecious holocyclic. It originated in North America, but is now an agricultural pest that spreads all over the world (Blackman and Eastop 2023).

Material examined. 13 adult individuals (♀) were collected from Ardahan-Çıldır highway/Cemal Tural Nature Park, XX.VII.2022. Apterae were broadly spindle-shaped, green-blackish. Siphunculi and femora are only slightly darker towards apices. It was a colony of winged and wingless adults and nymphs on *Cephalaria* sp. BL 3.49 mm, PT/BASE 5.83 mm, TAL 1.23 mm, URS IV+V 0.16 mm.

***Macrosiphum (Macrosiphum) rosae* (Linnaeus, 1758)**

General characteristics. Adult apterae individuals are generally green or sometimes pink to red-brownish. Body length ranges from 1.7 to 4.2 mm. It is on new shoots of cultivated and wild *Rosa* spp. in spring. And it can also occasionally be found in the summer on different plants, particularly those in the Rosaceae family. Host alternation is facultative. It is distributed in Europe, UK and Ireland,

Germany, Switzerland, Japan, Korea, China, India, Central and East Asia, North and South America (Blackman and Eastop 2023).

Material examined. Twelve and sixteen mature wingless aphids (♀) were taken from *Cephalaria* sp., *Rosa* sp., respectively, from Ardahan/Ardahan University Campus, XX.VII.2022. BL 2.95 mm, TAL 1.27 mm, PT/BASE 6.05 mm, URS IV+V 0.16 mm.

***Microlophium* Mordvilko, 1914**

***Microlophium sibiricum* (Mordvilko, 1914)**

General characteristics. Colonize the upper regions of *Urtica* spp. stems or the undersides of their leaves. Adult apterae are brownish green or dark green and BL is 3.4-4.4 mm. It is distributed in parts of Europe, from Asia to eastern Siberia and also in Japan, USA (Blackman and Eastop 2023).

Material examined. 14 adult apterae aphids (♀) were sampled from Ardahan/Posof, XXII.VII.2022. The undersides of *Urtica* sp. leaves were covered in green or dark green apterae. BL 3.41 mm, TAL 1.59 mm, PT/BASE 5.91 mm, URS IV+V 0.17 mm.

***Nasonovia* Mordvilko, 1914**

***Nasonovia (Nasonovia) ribisnigri* (Mosley, 1841)**

General characteristics. Adult wingless individuals are shiny pale green to apple-green and BL 1.3-2.7 mm. It can be found in Europe, Africa, the Middle East, Central Asia, Tasmania, New Zealand, and North and South America. (Blackman and Eastop 2023).

Material examined. 15 adult apterae individuals (♀) were collected from *Pilosella* sp. in Ardahan/Ardahan University Campus, XX.VII.2022. Apterae individuals were shiny pale green and some dark reddish, crowded on the line extending from host plant stem to the flower base. BL 2.43 mm, TAL 0.96 mm, PT/BASE 9.66 mm, URS IV+V 0.17 mm.

***Uroleucon* Mordvilko, 1914**

***Uroleucon (Uromelan) aeneum* (Hille Ris Lambers, 1939)**

General characteristics. Individuals of this species are generally shiny metallic bronze-black and BL is 3.0-4.3 mm. Mainly colonize on thistles upper regions (*Carduus*, *Silybum*, *Cirsium*, *Galactites*, *Onopordon*). Distributed in North Africa, Europe, Central Asia (including Türkiye), Armenia, east and west Siberia, Iran and South America, especially Chile and Argentina. It shows monoecious holocyclic life cycle, winged and oviparae males appearing in autumn (Blackman and Eastop 2023).

Material examined. 12 adult apterae individuals (♀) were collected from Ardahan City Center (Ardahan Castle, next to Kura River), XX.VII.2022. Apterae individuals were shiny metallic bronze-black and pale green with long legs. On upper parts of stems of thistle *Cirsium* sp., it formed very large colonies. BL 2.34 mm, TAL 1.03 mm, PT/BASE 4.72 mm, URS IV+V 0.21 mm.

***Uroleucon (Uroleucon) cichorii* (Koch, 1855)**

General characteristics. Adult apterae individuals have black siphunculi and antennae, and they are metallic brown in colour. Body length ranges from 2.7 to 4.7 mm. It is located in the upper parts of *Cichorium* sp. stems. It is commonly distributed in Asia, Europe, Mongolia, Eritrea, east Siberia, Korea. Monoecious holocyclic life cycle, with wingless males (Blackman and Eastop 2023).

Material examined. Sixteen adult apterous individuals (♀) were collected from Ardahan/Ardahan University Campus, XX.VII.2022. Adult apterae were shiny-metallic brown with black siphunculi and antennae. It was determined on *Cichorium* sp., on stem-upper parts of the host. BL 1.45 mm, TAL 1.0 mm, PT/BASE 7.00 mm, URS IV+V 0.18 mm.

***Uroleucon (Uroleucon) sonchi* (Linnaeus, 1767)**

General characteristics. Apterae aphids that are mature are glossy brown. Legs are mostly pale, although antennae are mostly dark in coloration. Cauda is pale yellow and siphunculi black. Range of body length is 2.9-4.5 mm. Generally prefer *Sonchus* species and other

genera belonging to the Cichoriaceae tribe, but also sometimes reported from other Compositae/Asteraceae family members, as in our sample. It has a nearly worldwide distribution (Blackman and Eastop 2023).

Material examined. 10 adult individuals (♀) were collected on *Crepis* sp. from Ardahan City Center (Ardahan Castle, next to Kura River), XX.VII.2022. Apterae specimens were shiny dark brown, antennae mainly dark and siphunculi black, had long legs. BL 1.74 mm, PT/BASE 5.41 mm, TAL 0.79 mm, URS IV+V 0.19 mm.

***Chaitophorus* Koch, 1854**

****Chaitophorus hokkaidensis* Higuchi, 1972**

General characteristics. Adult apterae are elongate oval, black, with legs paler; BL is 1.3-1.8 mm. Previously, records from Japan and Korea on different species of *Salix* have been reported (Blackman and Eastop 2023). It is reported as a new record for Türkiye aphid fauna.

Material examined (Figures 1c, 4a, b, c, d). 14 adult individuals (♀) were sampled on *Salix* sp. from Ardahan City Center (Ardahan Castle, next to Kura River), XX.VII.2022. Apterae were elongate oval, greenish, with legs paler and described from undersides of leaves of *Salix* sp. BL 1.66 mm, PT/BASE 3.33 mm, URS IV+V 0.11 mm. TAL 0.39 mm, about nine setae have been detected on Antennal segment III which was in accordance with Higuchi 1972.

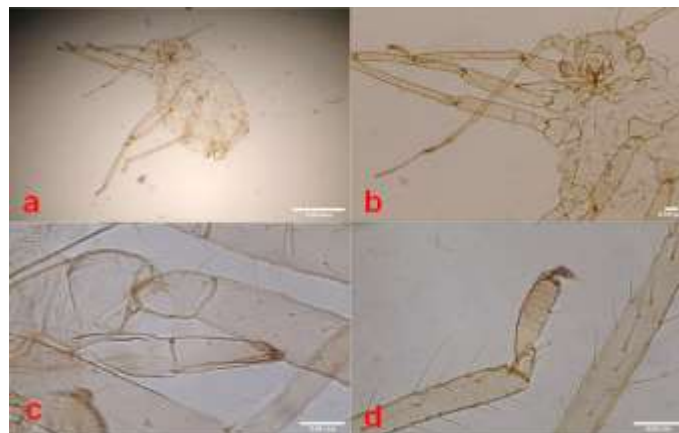


Figure 4. *Chaitophorus hokkaidensis* under the microscope: a) general appearance, b) legs and the antenna, c) rostrum, d) hind tarsus I and II.

DISCUSSION

While there are environmental and climatic problems adversely influences most of the living organisms during recent years, aphids increase the population size in a very short time thanks to the their unique cyclic parthenogenetic reproduction, phenotypic plasticity and telescoping generations (Görür et al. 2023c). Benefiting from global warming enable aphid species to invade new geographical areas and new host plant, in turn let them to increase their damages to all host plant, especially agriculturally important plant species. Sap-sucking aphids cause both poor quality and yield in agricultural products and serious economic losses (van Emden and Harrington 2017). Due to the thought that the negative effects of aphids will be more effective in the near future, it results in great attention by researchers (Oğuzoğlu and Avcı 2019). Recent research on the aphid fauna of Türkiye has shown that the probability of detecting new additions is high due to the geographical characteristics of Türkiye. To date, 675 species have been reported from Türkiye (Çanakçıoğlu 1975, Remaudière et al. 2006, Kök et al. 2016, Şenol et al. 2019, Patlar et al. 2021, Başer et al. 2024, Tayat and Özder 2024). In 2022, the exotic aphid species *Eucerafis gillettei* was identified as a new addition to the aphidofauna of Türkiye (Görür 2022). Then, Özdemir (2022) was described the new aphid species, *Lipaphis (Lipaphis) erdemi* Özdemir, 2022 from Central Anatolia on *Sisymbrium* sp. (Brassicaceae). In 2023, a significant number of aphid species have been Turkish aphid fauna, and associations with new host plants have also been detected (Görür et al. 2023abcd, Başer et al. 2023, Akyıldırım Beğen et al. 2023). In recent study, the number of aphid species was found to be 678, with three of them being identified as new records for the Turkish aphid fauna. It is thought that the number of aphid species in Türkiye will gradually increase with the aphid fauna studies to be carried out at the different regions and locality of the country. Since research has not been conducted to determine the aphid fauna in some parts of Türkiye, it would not be surprising to find new records and new species. Although the climatic features of Ardahan are not considered as much more feverable for aphids, 15 aphid species and one subspecies with 3 new records were determined in a short time where no

faunistic studies on aphids have been carried out. Findings of the study is in accordance with the preview studies conducted in a similar geography. Başer and Tozlu (2020) and Başer et al. (2024) also added new records from Erzurum province which has asimilar climatic conditions and geography. The study's findings firmly support the theory that, with further investigation, Türkiye's aphid fauna could include a greater number of species.

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