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Research Article

NEW RECORDS OF APHIDS (HEMIPTERA: *APHIDOIDEA*) FROM TURKIYE WITH NEW HOST PLANT AND ANT INTERACTIONS

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ABSTRACT. Aphids are one of the most important pest group since they invade new zoogeographical regions and new host plants, increase their damages to agricultural crops and benefited from global warming in contrast to most of the species. In turn, the determination of the aphid composition of any geographical area becomes much more important. In accordance with given general prospects, five aphid species, *Aphis* (*Aphis*) *cisticola* Leclant & Remaudière, 1972; *Brachycaudus (Prunaphis) malvae* Shaposhnikov, 1964; *Pemphigus* (*Pemphigus*) *fuscicornis* (Koch,1857); *Tinocallis* (*Orientinocallis*) *himalayensis* Ghosh, Ghosh & Raychaudhuri, 1971; *Chaitophorus capreae* (Mosley, 1841) were added to Türkiye aphid fauna and number of the species listed increased to 675. There are also new host plant relations and ant attendance was determined for the first time. Among the identified species, the oriental region originated *T. himalayensis* was recorded as the alien aphid species for Türkiye aphid fauna.

Keywords: *Aphid, Alien, new records, Tinocallis himalayensis, Türkiye.*

INTRODUCTION

World aphid fauna include more than 6000 species [1]. Türkiye's aphid fauna is currently represented by 670 species [2]. Aphids, obligate phytophagous insect, have fascinated researchers for a long time since they are one of the most important pest worldwide by causing severe damage on crops. Both adult and nymph aphids can suck plant sap and cause direct damage, whereas indirect damage includes pathogen-virus transmission and inducing sensitivity to other stress factors that make plants to more susceptible. Feeding on host plants has significant adverse effects on the physiological contents, growth, flowering rate and appearance of plants. The heavy infestation by the aphid population might cause to seedling death, stunting, tiller or flower deformation and decreased seed number and size, finally limiting crop production [3]. The seriousness of

aphids effects is mostly being neglected by most of the researchers and farmers as they thought to connect aphid damages with their size. Actually, aphid species might look small and soft, but do not be deluded by their minute appearance as they can result in significant amount of damage if they are not handled accurately. In fact, aphids cause an average of 35-40% product loss [4]. In addition to the direct and indirect damages caused by aphids to the host plants, cyclical parthenogenesis and telescoping generations let them to get benefit from global warming and increase their range and damages. With the effect of warming, aphids can give an average of 2-6 more generations and more damages to the host plants [5]. Global warming is an important threat in Türkiye as well as in the world. Agricultural production has a significant role in Türkiye economy. Despite the recent additions, there was an interesting result that total aphid fauna of Türkiye was sampled on only about 1100 plant species while there are more than12.000 plant species with a 31% endemism ratio [6,7] and there is large geographical area that is not been studied. As a result of the contributions of recent studies, the species in Türkiye aphid fauna was increased to 670 [8, 9, 10, 11, 12, 13,14, 15, 16]. Even though many species have been added during last 20 years, the number of the species listed in Türkiye aphid fauna do not reflect real composition due to floristic richness, climatic variability and tremendous agricultural production of Türkiye. In the context of the unique characteristics of the Türkiye that are available for aphid species, presented findings made contribution to the Türkiye aphid fauna with five new species additions.

The aim of this study is to take an attention to the importance of the determination of Türkiye aphid fauna by giving information about the new records, new aphid-host plant relations and ant attendance information.

MATERIALS AND METHODS

Study area

Some of the aphid populations were sampled from different provinces (Van, Nigde, Kırşehir, Antalya) from March 2022 to July 2023.

Preparation and Identification Process

Samples were processed in laboratory technics offered by Martin [17]. Species preserved on permanent slides were identified with an Olympus BX51 microscope based on the key proposed by Blackman and Eastop [18] and recent species status was proved by Favret [1]. For each identified species, worldwide distribution, host plant range, and colony appearances on host plants were provided [18, 19, 20].

Measurements

Various distinguishing characters were measured for each defined sample individually as much as possible. These characters are; Body length(BL), Body width (BW), Total antennal length (TAL), VI^{th} antennal segment processus terminalis (PT)/VI^{th} antennal segment BASE (PT/BASE), Length of the ultimate rostral segment VI+V(URS IV+V), Length of the hind Tarsus II (HT II) , URS IV+V/HT II ratio, Siphunculi length (SL), BL/SL ratio, Siphunculi width (SW), SL/SW ratio, Number and Length of the hairs on ANT III. The voucher samples were stored at the Biotechnology Department of Nigde Ömer Halisdemir University.

RESULTS AND DISCUSSION

As a result of the evaluation of the samples, five aphid species were identified as a new addition to the Türkiye aphid fauna. For each identified species, general information, synonyms and observed properties of the determined species were given.

Aphidinae Latreille, 1802
Aphis Linnaeus, 1758
Aphis* (*Aphis*) *cisticola Leclant & Remaudière, 1972

General features: Palearctic (Europe) originated, distributed in southern France, Corsica, Italy, Spain. Mostly feed on young leaves of *Cistus* spp. (*incanus*, *corsicus, ladanifer*, *monspeliensis*) especially *Cistus salviifolius* also have been recorded on *Halimium alyssoides, H. halimifolium, H. ocymoides, H. umbellatum, Helianthemum cinereum, H. hirtum, H. violaceum* forming dense colonies on leaves shoot and flower stems. Apterae individuals are yellow to bluish green, BL 1.0-1.8mm [18, 19].

Material examined (Fig. 1): 10 apterae individuals (♀) were collected on the flower stem and flower bud of the *Cistus salviifolius* L. (1753) (Cistaceae) on 20.IV.2022 from Antalya-Manavgat-Köprülü canyon. Adult apterae individuals are dark green, blackish, visited by ants. Even though they heavily colonized the sampled host plant, it has not been widely encountered on *C. salviifolius* in the study area where it's host plant is widely distributed. BL is 1.07mm, SL is about 0.26 mm, URS IV+V/HT II is 1.05, SL/BL is 0.24, SL/SW is about 3.38.

Fig.1: *General appearances of the Aphis cisticola under the microscope*

Macrosiphini Wilson, 1910
Brachycaudus van der Goot, 1913
Brachycaudus (Prunaphis) malvae Shaposhnikov 1964

General features: Palearctic (Europe) originated, distributed in England, Spain, Italy, Southern Russia, Ukraine and introduced to China. Generally, feed on base of stem and lower leaves of *Malva* spp. (*neglecta, parviflora, sylvestris*) with an ant attended and also records had been given on *Lavatera cretica* L. (1753) (Malvaceaea). Adult apterae individuals are pale green with separate black cross bars on thoracic segments and an extensive shining black sclerotic shield on the dorsum. BL is 1.8-2.3 mm. *B. malvae* lives all year feeding on mallow (*Malva*) species with no host alternation [19,20].

Material examined (Fig.2a, b): 12 apterae individuals (♀) were collected on lower leaves, the base of the stem and even some individuals on roots of *Malva neglecta* Wallroth (1824) (Malvaceaea) with an ant attendance on 28.VI.2023 from Niğde-Sazlıca. Adult apterae individuals are pale green, and yellowish with distinctive separate black thoracic cross bars and blackish sclerotic abdomen (Fig.2a). BL is 2.01, TAL is 1.2mm, PT/BASE is 3.2 and URS IV+V/HT II is 1.51.

Fig.2. *A) The colony of the Brachycaudus malvae on Malva neglecta, B) General appearances of the Brachycaudus malvae under the microscope*

Eriosomatinae Baker, 1920
Pemphigini Herrich-Schaeffer, 1854
Pemphigus Hartig, 1839
Pemphigus* (*Pemphigus*) *fuscicornis (Koch, 1857)

General features: Palearctic (Europe) originated, widely distributed in Europe, also recorded in Iran and Central Asia. Most of the records have been given on the roots of various species (*Aegopodium podagraria, Atriplex cana, A. tatarica, A. verrucifera, Beta vulgaris, Bidens tripartite, Chenopodium album, C. ambrosioides, C. vulvaria, Matricaria perforate, M. inodora, Sonchus arvensis*) where possibly show an anholocyclic life cycle. Apterae individuals are pale yellow or greyish, BL 1.4-2.2 mm. Even records had been given on *Populus pyramidalis*, life cycle of the species are not clearly known [18, 19, 21].

Material examined (Fig.3a, b): 8 apterae individuals (♀) were collected on root of the *Chenopodium album* L. (1753) (Amaranthaceae) on 22.X.2022 from Kırşehir-Mucur-Yazıkınık Village. Adult apterae individuals are pale yellow, and pale orange (Fig.3a), and it is the first time ant attendance was detected. BL 1.34 is mm, TAL is about 0.30 mm, URS IV+V/HTII is 0.69, PT/BASE is 0.25.

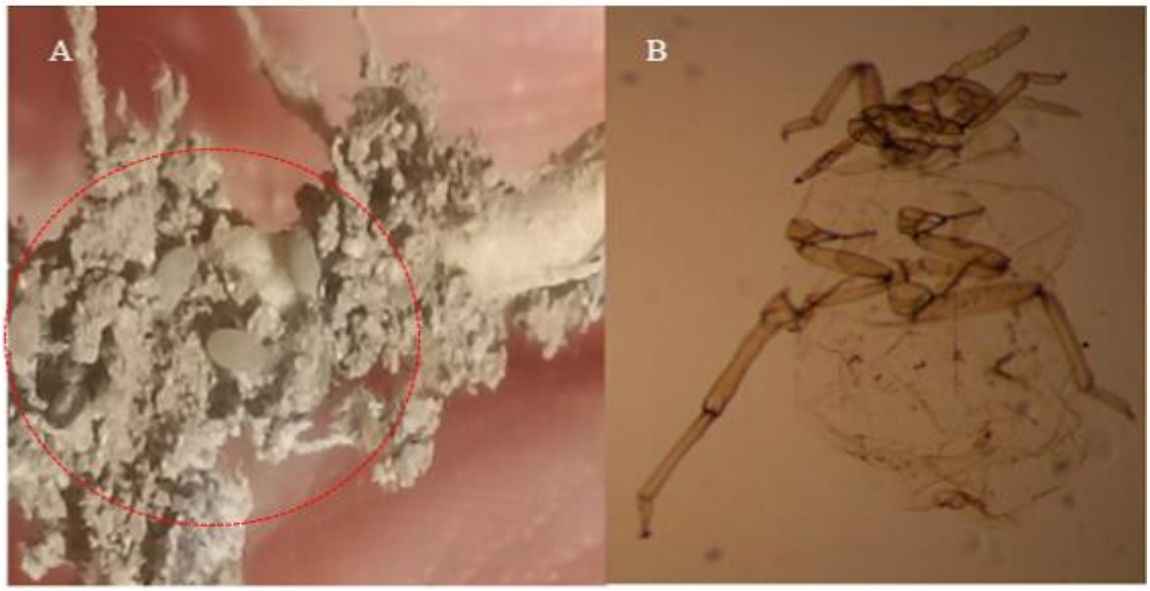

Fig.3. *A) The colony of the Pemphigus fuscicornis on the root of Chenopodium album, B) General appearances of the Pemphigus fuscicornis under the microscope*

Calaphidinae Oestlund, 1919
Therioaphidini Börner, 1944
Tinocallis Matsumura, 1919
Tinocallis* (*Orientinocallis*) *himalayensis Ghosh, Ghosh & Raychaudhuri, 1971

General features: Oriental (India) originated, distributed in India, Bangladesh, Tailand, Malaya, Singapore. Feed on *Duabanga sonneratioides*, *Peltophorum fleragineum, Lagerstroemia macrocarpa*, *L. flos-reginae*. All adult individuals are alatae which are greyish or greenish, BL is 1.2-2 mm. The life cycle of the species has not been clarified yet even alatae viviparae and apterous oviparae had been determined at the same time, males are not recorded [18, 19].

Material examined (Fig.4a, b, c. d): 5 alatae individuals (♀) were collected on undersides of leaves of *Lagerstroemia indica* L. 1759 (Lythraceae) which has been added to host plant list of the species on 18.IX.2020 from Antalya-Akdeniz University Campus. Heavily colonized undersides of the leaves, all adult individuals are alatae and dirty green, greyish (Fig.4a). BL is 0.90 mm, with 5-6 rhinaria on ANT III, PT/BASE is 0.95, URS IV+V/HTII is about 1. Alatoid individuals are pale yellowish, and greyish. As *T. himalayensis* was introduced from Oriental zoogeographic region, it was evaluated as an invasive aphid species for Türkiye. One of the possible reason to record *T. himalayensis*

in Türkiye is that the species is closely associated with its host plant, *L. indica,* which is widely marketed and cultivated as an ornamental plant worldwide including Türkiye and aphid species may follow the host plant.

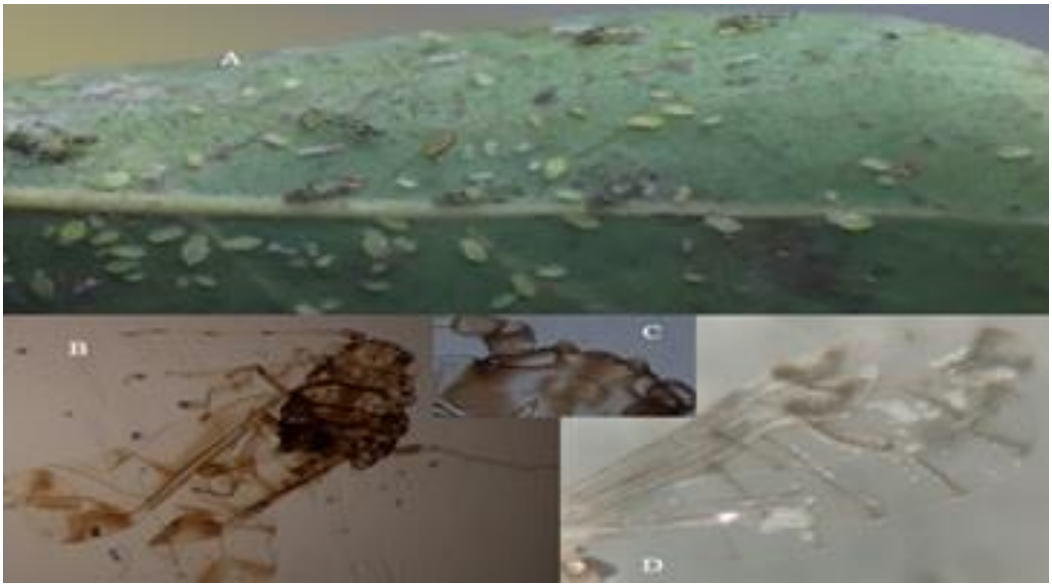

Fig.4. *A) The colony of the Tinocallis himalayensis on underside leaves ofLagerstroemi indica, B) General appearances of the Tinocallis himalayensis under the microscope, C) Characteristic spinal tubercles on head, D) Characteristic wing appearance*

Chaitophorinae Mordvilko, 1909
Chaitophorini Mordvilko, 1909
Chaitophorus Koch, 1854
Chaitophorus capreae (Mosley, 1841)

General features: Palearctic (Europe) originated, distributed in Europe and eastward to Central Asia. Mostly feed on undersides of *Salix* spp., particularly on *S. alba, S. aurita, S. caprea, S. cinerea*, they are not attended by ants. Apterae individuals are white, yellowish white, BL 0.8-1.9 mm. [18, 19, 20].

Material examined (Fig. 5a, b, c): 15 apterae individuals (♀) were collected on upper sides of leaves of *Salix caprea* L. 1753 (Salicaceae) on 15.IX.2022 from Van-Özalp. In contrast to previous observation, individuals colonized the upper sides of the leaves, rarely scattered on undersides of leaves. Adult apterae individuals are green, yellowish green (Fig.5a), BL 1.55mm, the longest hair on ANT III is 35µm, PT/BASE 2.5, The number of the hairs on ANT III is 4, BL/BW is 1.93.

Fig.5. *A) The colony of the Chaitophorus capreae on leaves of Salix caprea, B) General appearances of the Chaitophorus capreae under the microscope, C) Characteristics hairs on ANT III.*

CONCLUSION

Aphids are one of the most important agricultural insect group because of their tremendous damages to agricultural products and other host plants with various mechanisms. They also can be considered as a model group for studying global warming effects on insect-plant interactions due to their unique features such as cyclical parthenogenesis, adaptive phenotypic plasticity and telescopic generations. Above given characteristics of the aphids encouraged researchers to carry out more detailed study especially in the country where agriculture play important role in country economy like our country. Recently, studies carried out by different researchers made great contribution to the Türkiye aphid fauna, and in turn number of aphid species listed was increased to 670 [8, 9, 10, 11, 12, 13, 14, 15, 16, 22,23, 24, 25]. The floristic composition, agricultural richness and climatic variability of the Türkiye clearly indicates that the number of the aphid species do not show existed diversity compared with some other countries. For example, while Italy has 6000 plant species there are 925 aphid species identified [26], Iran has 6500 plant species and 543 aphid species [27] and there are about 2600 plant and 680 aphid species were listed for the United Kingdom [20]. With this study, five aphid species were added to Türkiye aphid fauna and the number of the species was updated to 675. Also new host plant relations and ant attendance was determined during the conducted study. It is the first time ant attendance with both *Pemphigus fuscicornis* was determined, *Lagerstroemi indica* was added to host plant range of the *Tinocallis himalayensis.* Moreover, aphids are considered as one of the insect group that have a higher invasion ability to new geographical area and new host plant. Akyıldırım et al. [28] and Kök and Özdemir [29] clearly indicated how higher possibility to meet with invasive aphids in Türkiye. Kök and Özdemir [29] pointed out that the average introduction rate of alien aphids into the aphid fauna of Türkiye was calculated as 0.48 species per year based on about 120 years' data, even it was evaluated higher with other studies [13,14]. In parallel with expectation, among the defined new records, *Tinocallis himalayensis*, was described as an invasive species for Türkiye aphid fauna.

Findings of the presented study strongly supports the approaches that there is going to be more contribution to the country aphid fauna as long as more detailed study was conducted in different locality and the region of Türkiye where there is no study carried out.

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Conflict of Interest. The authors declared that there is no conflict of interest.

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