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Research article

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A new species of *Plagiognathus* (Heteroptera: Miridae) associated with the locally endemic *Phlomis leucophracta* (Lamiales: Lamiaceae) from Karaman, Turkey

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Abstract. *Plagiognathus ozgurkocaki* sp. nov. is described based on a long series of specimens from Karaman, Turkey. The new species is remarkable among its congeners in Palearctic Region due to the combination of following characters: remarkably small size, dense and unicolorous pale yellow vestiture, darkened cuneus and yellow first antennal segment with a basal ring and pre-apical dots. The new species is associated with the endemic *Phlomis leucophracta* P.H.Davis & Hub.-Mor. (Lamiaceae) which makes it unique among all its congeners. Additionally, *Plagiognathus bipunctatus albicans* (Reuter, 1901) and *Plagiognathus marivanensis* Linnavuori, 2010 are recorded from Karaman, former constitutes a new record for Turkey.

Key words. *Plagiognathus*, *Phlomis leucophracta*, new species, new records, Karaman, Turkey.

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Introduction

Miridae Hahn, 1831 is the largest family of the suborder Heteroptera Latreille, 1810 (Hemiptera) with more than 11 000 known species worldwide (Schuh & Slater 1995; Cassis & Schuh 2012; Schuh 2013). The second largest subfamily of Miridae is Phylinae Douglas & Scott, 1865, currently represented in the Palearctic Region with more than 1200 species (Aukema n.d.; Kerzhner & Josifov 1999). The genus *Plagiognathus* Fieber, 1858, classified in the tribe Phylini, subtribe Oncotyliina (Schuh & Menard 2013), includes more than 100 species distributed worldwide, of which only 23 species are known from the Palearctic Region (Aukema n.d.; Wagner 1975; Kerzhner & Josifov 1999; Duwal *et al.* 2010; Aukema *et al.* 2013). So far, seven species of *Plagiognathus* were found in Turkey: *P. arbustorum arbustorum* (Fabricius, 1794), *P. bipunctatus* Reuter, 1883, *P. chrysanthemi* (Wolff, 1804), *P. fulvipennis* (Kirschbaum, 1856), *P. marivanensis* Linnavuori, 2010, *P. raphani* Wagner, 1963, and *P. reuterellus* Schuh, 2001 (Önder 1976; Kerzhner & Josifov 1999; Lodos *et al.* 2003; Önder *et al.* 2006; Matocq *et al.* 2014; Carapezza & Kment 2018). Species of *Plagiognathus* are mostly phytophagous and associated with a wide variety of host plants (Wagner & Weber 1964). Schuh (2001) listed 39 different plant

families that were associated with North American species of *Plagiognathus*. Similarly, species of *Plagiognathus* in Western Palearctic region have been collected from many different hosts (Wagner & Weber 1964; Önder 1976). Although several species of *Plagiognathus* both in North American and Western Palearctic regions have been collected from different species of Lamiaceae, no species of *Plagiognathus* have so far been associated with a species of *Phlomis* L. (Wagner & Weber 1964; Wagner 1975; Önder 1976; Ribes 1978; Schuh 2001). Here, a new species of *Plagiognathus*, *P. ozgurkocaki* sp. nov., is described from Southern Turkey that is associated with *Phlomis leucophracta* P.H.Davis & Hub.-Mor., an endemic species in Southern Turkey (Davis *et al.* 1982). The new species also shows some remarkable distinguishing features that easily allow it to be described as a distinct new species below.

Material and methods

Collected specimens were examined with a Celestron 44125 Microscope. Photographs were taken with a Nikon D3300 DSLR Camera combined with an 68 mm extension tube and a Lomo 3.7X 0.11 Microscope objective. Stacking of images were done by CombineZM. The map was prepared using SimpleMappr (<https://www.simplemappr.net/>). The holotype and most of the paratypes are deposited in the Lodos Entomological Museum, Turkey (LEMT). The rest of the paratypes is preserved in the private collection of the author (BCIT).

Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Hemiptera Linnaeus, 1758
Suborder Heteroptera Latreille, 1810
Family Miridae Hahn, 1831
Subfamily Phylinae Douglas & Scott, 1865
Genus *Plagiognathus* Fieber, 1858

Plagiognathus ozgurkocaki sp. nov.

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Figs 1–3, 4A, 5; Table 1

Diagnosis

The new species is diagnosed by the combination of following characters: size remarkably small, 2.6–3.0 mm, general coloration yellowish brown to orange, outer margin of endocorium darkened along its length, cuneus largely darkened except its basal margin and apex, vestiture dense and pale yellow, first antennal segment yellow with a basal ring and pre-apical dots, second antennal segment yellow with a basal ring and rest of antennae unicolorous yellow.

Etymology

The new species is named after Özgür Koçak (Karaman, Turkey), a nature photographer and naturalist who dedicated himself to observe and discover the unnoted natural biodiversity of Karaman province. He also discovered and collected the new species described here.

Type material

Holotype

TURKEY • ♂; Karaman, Ermenek, Evsin köyü; 36°37'26" N, 33°00'55" E; alt. 1000 m; 25 May 2021; Ö. Koçak leg.; *Phlomis leucophracta*; LEMT.

Table 1. Characteristic features of *Plagiognathus ozgurkocaki* sp. nov. and similar congeners [Information about other species is based on (Wagner 1975; Putshkov 1978; Linnavuori 2010; Pagola-Carte 2010)].

	<i>P. ozgurkocaki</i> sp. nov.	<i>P. zuvandiensis</i> Putshkov, 1978	<i>P. marivanensis</i> Linnavuori, 2010	<i>P. bipunctatus</i> <i>albicans</i> (Reuter, 1901)	<i>P. reuterellus</i> Schuh, 2001	<i>P. fusciloris</i> Reuter, 1878	<i>P. olivaceus</i> Reuter, 1880
General coloration	Yellowish brown to orange	Yellowish brown	Whitish yellow	Whitish yellow	Dark brown to black	Whitish yellow to green	Dark greyish green to blackish
Size	2.6–3.0 mm	3.3–4.2 mm	3.5–4.0 mm	3.0–3.6 mm	3.2–3.6 mm	2.2–3.3 mm	2.4–3.2 mm
Vestiture	Pale yellow	Black and pale yellow	Pale yellow	Pale yellow and black or only pale yellow	Pale yellow	Black	Black
First antennal segment	Yellow with basal ring and pre-apical dots	Yellow with basal and apical rings	Unicolorous yellow	Unicolorous yellow	Unicolorous black	Black with apical white ring	Unicolorous black
Pattern of hemelytra	Dark stripe along outer margin of endocorium, cuneus largely darkened	Unicolorous	Unicolorous	Unicolorous	Unicolorous	Unicolorous	Unicolorous
Femoral-tibial junction	Black	Yellow	Yellow	Yellow	Black	Black	Black

Paratypes

TURKEY • 14 ♂♂, 13 ♀♀; same collection data as for holotype; LEMT • 2 ♂♂, 2 ♀♀; same collection data as for holotype; BCIT.

Description

Male

COLORATION. General coloration yellowish brown to orange (Fig. 2A). Head yellowish brown, clypeus narrowly black at apex, dark-brown dot adjacent to each eye in darker colored specimens. Antennal segments yellow, first segment with narrow ring basally and two black dots pre-apically from which two black bristles arise, second segment with very narrow and mostly faded black ring basally, rest of segments unicolorous yellow (Fig. 2F). Pronotum yellowish brown to orange, posterior corners slightly embrowned in darker colored specimens. Scutellum mostly dark brown, paler basally at center. Hemelytra yellowish brown to orange, with brown longitudinal stripe medially on corium that widens apically and more easily distinguished in alive specimens (Fig. 1B–D), cuneus largely dark brown except basal margin and extreme apex. Membrane with black spot below membranal cells that is connected to outer margin of membrane with broad and marginally diffuse transverse band. Posterior femora pale yellow with minute black dots pre-apically on dorsal surface and larger black dots on ventral surface, characteristic of this genus. Tibiae with large black dots at base of each tibial spine and at femoral-tibial junction. First two tarsal segments yellow, last segment dark brown. Body dark brown to black.

VESTITURE. Dorsum uniformly covered with dense, semi-erect, simple, pale-yellow setae. Head densely covered with pale-yellow setae, from semi-erect to erect. Antennal segments covered with very fine, adpressed pale-yellow setae, first antennal segment with two black bristles that arise from black dots. Pronotum and hemelytra covered with, dense, semi-erect, simple pale-yellow setae. Tibiae with long

black spines, two spines arise from each black dot. Abdomen covered densely with short adpressed pale yellow setae.

STRUCTURE. Small and ovoid, 2.6–2.9 mm in size, 3.0–3.3 × as long as the width of posterior margin of pronotum. Head, including eyes, 1.2–1.4 × as broad as the width of anterior margin of pronotum, interocular distance 1.4–1.8 × as long as eye width (Fig. 2C), buccala variable in shape, from a straight inferior margin to triangular projection anteriorly (Fig. 2D–E), labium reaching posterior coxae. Second antennal segment 1.0 × as long as head width across eyes, 0.7–0.8 × as long as width of posterior margin of pronotum, ratios of antennal segments 7: 22–25: 14–16: 9–10, length of antennae 0.5 × total length of body. Pronotum 2.1–2.3 × as long as wide at posterior margin, anterior margin 0.5–0.6 × as wide as posterior one, lateral and posterior margins straight, anterior margin with shallow depression medially. Hemelytra slightly enlarged towards middle, surpasses apex of abdomen only slightly. Right paramere lanceolate with single pointed apex (Fig. 3H), left paramere as in Fig. 3D–G, apical blades of vesica large, after gonopore tapering and separated from each (Fig. 3A–C).

Female

Closely resemble male in coloration and vestiture (Fig. 2B), but size slightly larger, 2.6–3.0 mm, 3.0–3.5 × as long as width of posterior margin of pronotum. Interocular distance 1.8–2.2 × as long as eye width, second antennal segment 0.9–1.0 × as long as head width across eyes and 0.6–0.7 × as long as width of posterior margin of pronotum, length of antennae 0.4–0.5 × as long as total length of body. Rest of morphometric characters as in male.



Fig. 1. *Plagiognathus ozgurkocaki* sp. nov. A. Colony on *Phlomis leucophracta* P.H.Davis □ Hub. □ □ or B. □. C. □. D. □. Photographs: □zg□r □o□ak.

Host plant association

All the specimens were collected from *Phlomis leucophracta* (Lamiaceae) (Fig. 1A).

Differential diagnosis

The genus *Plagiognathus* Fieber, 1858 is characterized by the sigmoid shaped and half-twisted body of vesica that has a more or less developed flange and terminates in two apical blades, lanceolate right paramere that has single apex and uniform dorsal vestiture, either black or pale (Schuh 2001). Additionally, all the Palearctic species have black dots on femora that form longitudinal lines (Wagner 1975). The new species is placed in this genus due to the shape of its vesica that closely resembles that of other species of *Plagiognathus*, the shape of right paramere, the black dots on the femora and uniform vestiture. Although pale yellow vestiture of dorsum in the new species reminds species of *Europiella* Reuter, 1909, it surely is not a member of this genus since species of *Europiella* invariably have apically bifid right paramere (Schuh *et al.* 1995). Among the 16 native species of *Plagiognathus* recorded from Western Palaearctic Region, only *P. marivanensis*, *P. bipunctatus albicans* (Reuter, 1901) and *P. reuterellus* Schuh, 2001 bear unicolorous pale yellow vestiture (Wagner 1975; Schuh 2001; Linnavuori 2010). The new species differs from these species by the combination of smaller size, presence of large black dots at the base of tibial spines, black dot at the femoral-tibial junction, brown pattern of endocorium, darkened cuneus and dark patterns of first and second antennal segments (Table 1). An identification key for these species is presented below.

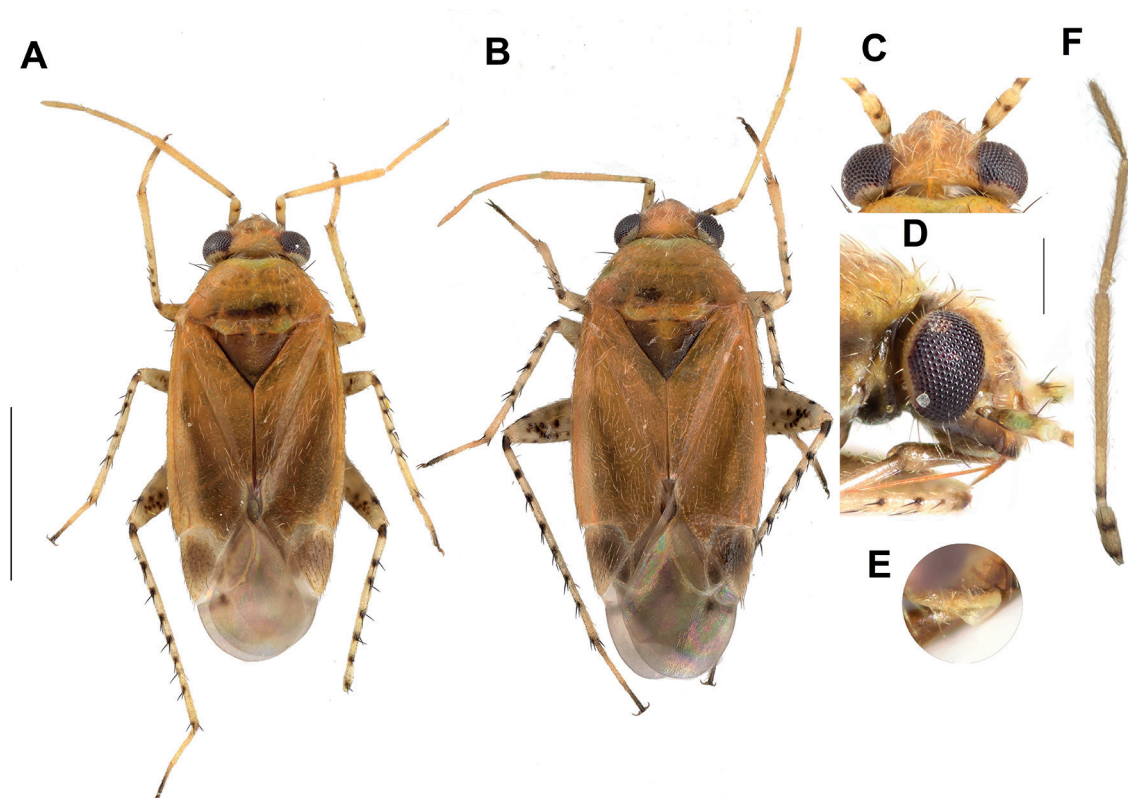


Fig. 2. *Plagiognathus ozgurkocaki* sp. nov. **A.** ♂, holotype (LEMT). **B.** ♀, paratype (LEMT). **C.** Head from dorsal view, ♂, paratype (LEMT). **D.** Head from lateral view, ♂, paratype (LEMT). **E.** Variability of buccal plate, ♂, paratype (LEMT). **F.** Antenna, ♂, paratype (LEMT). Scale bars: A–B = 1 mm; C–F = 0.25 mm.

Plagiognathus reuterellus, formerly *P. flavipes*, is characterized by unicolorous black dorsum and first two antennal segments, hence easily distinguish from the new species. This species is also strictly associated with *Lonicera* spp. (Wagner 1975).

The other species with unicolorous pale yellow vestiture, *P. marivanensis* and *P. bipunctatus albicans* have unicolorous whitish yellow dorsum and antennal segments (Fig. 4B–C) whereas *P. ozgurkocaki* sp. nov. is yellowish brown to orange with dark patterns on corium, cuneus and first two antennal segments (Fig. 4A). These two species are also remarkably larger, 3.0–4.0 mm, compared to *P. ozgurkocaki* sp. nov., 2.6–3.0 mm. Finally, *P. marivanensis* lacks a black spot below the membranal cells and that of *P. bipunctatus albicans* is punctual whereas that of *P. ozgurkocaki* sp. nov. is connected to outer margin of the membrane with a broad and marginally diffuse transverse band. The vesica of *P. marivanensis* is generally similar to that of the new species and only differ from it by small details, e.g., slightly smaller apical blades and the recess on the body of posterior blade around the secondary gonopore (Linnavuori 2010). In contrast, vesica of *P. bipunctatus albicans* differs from that of *P. ozgurkocaki* sp. nov. remarkably by much smaller and straight apical blades that do not separate from each (Schuh 2001).

Another species, *Plagiognathus zuvandiensis* Putshkov, 1978, known from Azerbaijan and Iran, also bears pale yellow setae admixed to the predominant black vestiture (Putshkov 1978; Linnavuori 2010). This species differs from the new species by remarkably larger size (3.3–4.1 mm), predominant black vestiture of dorsum, unicolorous hemelytra, lack of black spot at the base of hind tibia and long and slender vesica (Table 1) (Putshkov 1978).

The new species is remarkably small, among the Western Palearctic species, only *Plagiognathus fusciloris* Reuter, 1878 and *Plagiognathus olivaceus* Reuter, 1880 are known to be smaller than 3 mm (Wagner 1975). The new species mainly differs from both species by pale yellow vestiture, yellowish brown to orange coloration, brown pattern of endocorium, darkened cuneus and different coloration of first antennal segment (Table 1).

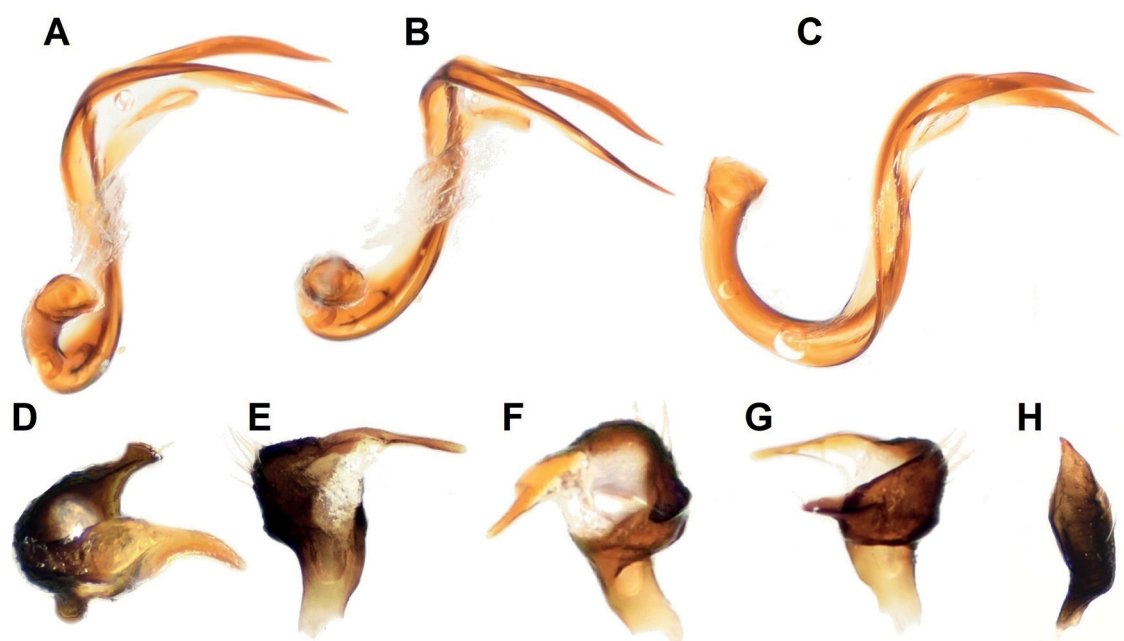


Fig. 3. *Plagiognathus ozgurkocaki* sp. nov., ♂, paratype (LEMT). A–C. Vesica from different perspectives. D–G. Left paramere from different perspectives. H. Right paramere. Scale bar = 0.1 mm.

Plagiognathus fulvipennis and *P. raphani* Wagner, 1963 are two species that show similarity with the new species due to yellowish brown to orange coloration of dorsum (Wagner 1963, 1975). Although both species can be easily distinguished from the new species by predominant black vestiture, there are other characteristic features that differ these species from the new species. *Plagiognathus fulvipennis* is much larger (3.5–4.7 mm), has unicolorous hemelytra, black first antennal segment with apical white ring, largely black second antennal segment and dark brown third and fourth segments, vesica with remarkably shorter posterior blade than anterior one (Wagner 1975; Schuh 2001). *Plagiognathus raphani* also has unicolorous hemelytra, black first antennal segment with apical white ring, vesica with small apical blades that are not separating from each other and is associated with *Raphanus* spp. (Wagner 1975; Schuh 2001).

Interestingly, the new species resembles *Plagiognathus delicatus* Uhler, 1887, a North American species, recently recorded from Germany (Rieger 2015), with regard to general coloration and patterns of dorsum, as well as pale yellow vestiture but this species has largely black first antennal segment, characteristically black calli, and is associated with *Gleditsia triacanthos* L. (Fabaceae) in North America (Schuh 2001) whereas the new species is associated with *Phlomis leucophracta* (Lamiaceae) (Fig. 1A). This plant species is endemic to Southern Anatolia and known only from several locations in Antalya, Isparta, Mersin and Karaman (Davis *et al.* 1982). This is the first record of a species of *Plagiognathus* associated with a species of *Phlomis*. Finally, the new species can be easily distinguished from all its congeners that are not explicitly mentioned above, by smaller size (below 3 mm) and unicolorous pale yellow vestiture.

***Plagiognathus bipunctatus albicans* (Reuter, 1901)**

Figs 4C, 5; Table 1

Psallus albicans Reuter, 1901: 186 [syn. by Kerzhner (1970) with *Plagiognathus bipunctatus*, resurrected as subspecies by Linnavuori (2010)].

Material examined

TURKEY • 4 ♂♂, 4 ♀♀; Karaman, Merkez, Elmaşehir; 28 Jun. 2017; Ö. Koçak leg.; BCIT • 9 ♂♂, 15 ♀♀; same collection data as preceding; 1 Jul. 2017; BCIT • 5 ♂♂, 2 ♀♀; same collection data as preceding; 2 Aug. 2017; BCIT • 2 ♂ 2 ♀♀; Karaman, Kazımkarabekir, Hacıbaba; 30 Jul. 2017; Ö. Koçak leg.; BCIT.

Remarks

Plagiognathus bipunctatus together with *P. tamaninii* Carapezza, 1998, *P. fusciloris* Reuter, 1878 and *P. albus* Reuter, 1894 form a group of similar species (Carapezza 1998). Among them, *P. bipunctatus* is characterized by the bigger ocular index, slightly bigger second antennal segment/width of head ratio in male and the straight process of the left paramere (Wagner, 1975). It has two subspecies, nominotypical subspecies and *P. b. albicans*. *Plagiognathus bipunctatus albicans* was first described as *Psallus albicans* from Turkmenistan (Reuter 1901). It is characterized by almost to completely pale yellow vestiture, pale yellow coloration of dorsum and absence of black spot at the base of each tibia. This taxon was synonymized with *P. bipunctatus* by Kerzhner (1970) without any comments. Later it was resurrected in the subspecies rank by Linnavuori (2010) based on pale specimens collected from different regions in Iran. The nominotypical subspecies differs from *P. b. albicans* by the black vestiture, whitish green coloration of body dorsum and the presence of a black spot at the base of at least the hind tibia (or on each tibia in var. *picticornis*) (Fig. 4D). We examined a long series of specimens collected from different localities at different times in Karaman. The specimens perfectly fit the description of *P. b. albicans* with whitish yellow coloration, partly to totally pale yellow vestiture and lack of black spots at the base

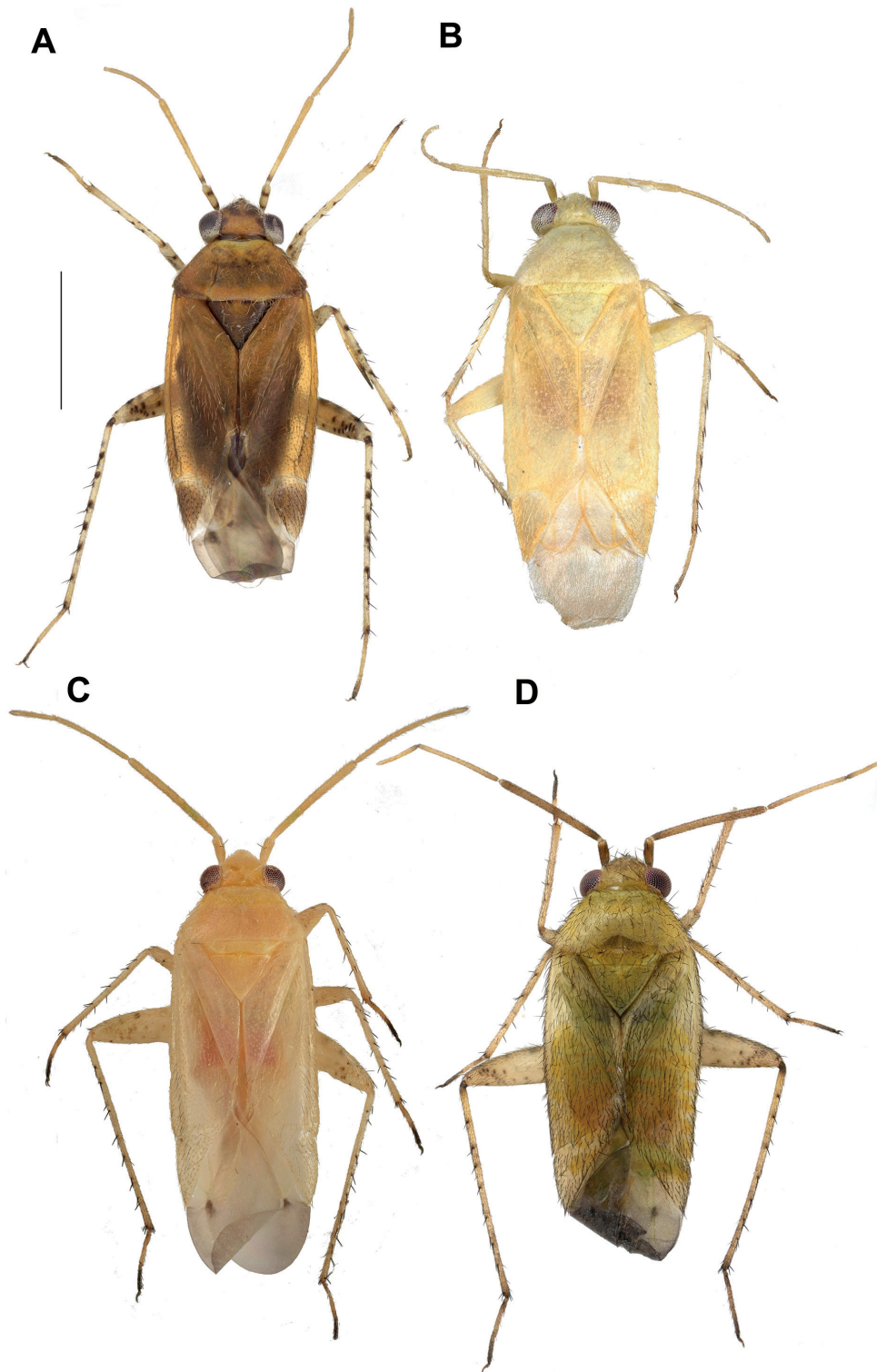


Fig. 4. *Plagiognathus* spp. **A.** *P. ozgurkocaki* sp. nov., ♂, paratype (LEMT). **B.** *P. marivanensis* Linnavuori, 2010, ♂ (BCIT), Karaman. **C.** *P. bipunctatus albicans* (Reuter, 1901), ♂ (BCIT), Karaman. **D.** *P. bipunctatus bipunctatus*, ♂ (BCIT), İzmir. Scale bar = 1 mm.

of tibial spines and the femoral-tibial junction. These records greatly enlarge the known distribution this subspecies to the West (Fig. 5). Although Linnavuori (2010) mentions that he has not observed any intermediate specimens among the ones he examined, some of the specimens from Karaman have predominantly black vestiture which very closely resemble the nominotypical subspecies and differ from it by the lack of black spot at femoral-tibial junction of hind tibiae and presence of scarce pale setae.

Plagiognathus marivanensis Linnavuori, 2010
Figs 4B, 5; Table 1

Plagiognathus marivanensis Linnavuori, 2010: 389–391, figs 10, 27b [type locality: West Azerbaijan, Sardasht, Iran].

Material examined

TURKEY • 1 ♂; Karaman, Bucakkışla; 20 May 2020; Ö. Koçak leg.; BCIT.

Remarks

This species was originally described from Iran and later discovered in Diyarbakır, Elazığ and Mersin in Turkey (Linnavuori 2010; Matocq *et al.* 2014; Carapezza & Kment 2018). It is characterized by whitish yellow coloration, pale yellow vestiture, immaculate tibiae and lack of black dot below membranal cells (Fig. 4B) (Linnavuori 2010). This species is recorded from Karaman for the first time in this paper.



Fig. 5. Distribution of *Plagiognathus* spp. Star: *P. ozgurkocaki* sp. nov.; circle: *P. marivanensis* Linnavuori, 2010; square: *P. bipunctatus albicans* (Reuter, 1901). Grey color indicates previous literature records, red color indicates new records presented in this paper.

Identification key of Western Palearctic* species of *Plagiognathus* with predominantly pale yellow vestiture**

1. Dorsum unicolorous dark brown to black, antennal segments completely black, sometimes third and fourth segments dark brown. Vesica: cf. Schuh (2001: fig. 39). Body length: 3.3–3.6 mm (♂♂), 3.2–3.5 mm (♀♀). West Mediterranean, Balkan peninsula, Turkey *P. reuterellus* Schuh, 2001 (= *P. flavipes* Reuter, 1875, preoccupied)
 - Dorsum whitish yellow to orange colored, antennal segments either unicolorous yellow or yellow with dark rings in first and second segments 2
2. Corium with a faint black stripe along outer margin of endocorium, cuneus largely black, first antennal segment yellow with basal ring and pre-apical dots, second antennal segment yellow with very narrow basal ring (Fig. 2F), vesica as in Fig. 3A–C. Body length: 2.6–2.9 mm (♂♂), 2.6–3.0 mm (♀♀). Endemic to Turkey *P. ozgurkocaki* sp. nov.
 - Hemelytra and antennae unicolorous, body length 3.0–4.2 mm 3
3. Membrane without a black spot, interocular distance 1.1–1.2 × as long as the eye width (Fig. 4B). Vesica: cf. Linnavuori (2010: figs 10g–h). Body length: 3.8–4.0 mm (♂♂), 3.5–3.8 mm (♀♀). Iran, Turkey *P. marivanensis* Linnavuori, 2010
 - Membrane with a black spot, interocular distance 1.5–1.7 × as long as the eye width (Fig. 4C). Vesica cf. Schuh (2001: fig. 39). Body length: 3.1–3.4 mm (♂♂), 3.0–3.6 mm (♀♀). Iran, Kazakhstan, Turkey *P. bipunctatus albicans* (Reuter, 1901)

*Western Palearctic Region includes Europe, Northern Africa and South-West Asia, as defined by Vigna Taglianti *et al.* (1999).

**Some specimens of *Plagiognathus bipunctatus albicans* can have predominantly black vestiture.

Discussion

Species of *Plagiognathus* have similar male genitalia and many species show remarkable color and morphological differences despite having very similar male genital structures (Schuh 2001). Accordingly, the new species described above has very characteristic morphological features that allow it to be easily distinguish from all other species of its congeners, but the shape of its vesica is similar to that of other species like *P. marivanensis* and *P. arbustorum*. The association of this new species with an endemic plant species brings up the question whether it is also an endemic species that is strictly bound to its host plant, as some species of this genus has been shown to be host specific, both in North America (Schuh 2001) and the Western Palearctic Region (Wagner 1975). Contrastingly, there are also species of *Plagiognathus* with restricted distribution but not host specificity, e.g., *Plagiognathus olivaceus*, known only from France and Spain, and associated with *Lavandula stoechas* L. and *Thymus vulgaris* L. (Wagner 1975; Schuh 2001). In any case, the discovery of this new species and others described from Karaman and its neighboring provinces in the recent years (Carapezza & Kment 2018; Çerçi *et al.* 2019, 2021; Pagola-Carte 2019), highlights the fact that further field work in this region is necessary to truly illustrate its Heteroptera diversity.

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