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New findings of Deltocephalinae (Hemiptera, Cicadellidae) from Pakistan

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ABSTRACT. The genus *Cicadula* Zetterstedt is reported for the first time from Pakistan with a newly recorded *Cicadula simlaensis* Viraktamath & Yeshwanth. In addition, *Platymetopius fidelis* (Distant) is also rediscovered from Pakistan and studied here. A brief diagnosis along with the digital photographs of the habitus and male genitalia of both species are provided. General distribution of these species in both Palaearctic and Oriental regions is also briefly discussed.

Key words: Athysanini, Auchenorrhyncha, Cicadulini, morphology, taxonomy

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INTRODUCTION

Leafhoppers (Hemiptera, Auchenorrhyncha, Cicadellidae) are small, very active jumping insects that usually feed on sap of various plants and some species are considered pests in agriculture (Day & Fletcher, 1994) while many of them act as vectors of phytopathogenic viruses and phytoplasmas (Nielson,

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1979; Stiller, 2009). They are distributed worldwide and dominant in tropical and subtropical ecosystems (Dietrich, 2005). Leafhoppers can be easily recognized by rows of setae on hind tibiae, and their pronotum is not prolonged back over the abdomen.

Deltocephalinae is a diverse leafhopper subfamily group, currently including 39 tribes and more than 923 valid genera worldwide (Zahniser & Dietrich, 2013). The earliest Deltocephalinae species documented from Pakistan were by Singh-Pruthi (1930, 1936), who reported numerous species from Indian zones now a part of Khyber Pakhtunkhwa and Punjab provinces in Pakistan, e.g., Changla Gali, Lyallpur (now called Faisalabad), and Murree hills. Later, Khatri & Webb (2010) recorded 31 genera and 57 species of the subfamily and provided the first comprehensive checklist on Deltocephalinae of Pakistan along with digital photos of various species for the country. Consequently, Khatri & Rustamani (2011) further studied the country's fauna and provided key to known tribes and genera in Pakistan. Recently, Naveed et al. (2021) provided an updated key to known tribes, genera, and species of Deltocephalinae (Hemiptera, Cicadellidae) of Pakistan along with the updated checklists to the genera and species from Pakistan. In the present study, we record the genus *Cicadula* Zetterstedt and two species of leafhoppers from Pakistan.

MATERIAL AND METHODS

Adult specimens were collected from northern Pakistan, including Khyber Pakhtunkhwa, Punjab provinces, and Islamabad Capital during 2018–2019. The freshly collected samples were initially preserved in 90% ethanol for future studies before being pinned, labeled, and preserved in the university department. External body morphology was carefully examined for identification and redescription. The last abdominal segment was removed from the body and then treated with 10% NaOH solution on a hot plate for maceration (elimination of soft tissues and muscles) and carefully rinsed with water. The genitalia were then placed on a glass slide with a glycerol drop and studied under microscope. A digital camera Nikon DS-Ri2 fixed on a Nikon SMZ 1500 stereoscopic microscope, and Nikon Eclipse 50i POL polarizing microscope were used to take the morphological and genital photographs. Digital photographs were modified to balance color and contrast and to remove the background using Adobe Photoshop CS.

Morphological terminology follows Dietrich (2005). Terminology for male genital characters follows Oman (1949) and Knight (1965). The specimens studied are deposited in the School of Plant Protection, Anhui Agricultural University, Hefei, Anhui, China.

RESULTS

Taxonomic hierarchy

Class Insecta Linnaeus, 1758

Order Hemiptera Linnaeus, 1758

Suborder Auchenorrhyncha Duméril, 1806

Family Cicadellidae Latreille, 1825

Subfamily Deltocephalinae Fieber, 1869

Tribe Athysanini Van Duzee, 1892

Genus *Platymetopius* Burmeister, 1838

Platymetopius Burmeister, 1838:16. Type species: *Cicada vittatus* Fabricius, 1775.

Mahalana Distant, 1918:64. Type species: *Mahalana fidelis* Distant, 1918.

Eremetopius Lindberg, 1927:29. Type species: *Eremetopius albus* Lindberg, 1927.

Diagnosis. This genus can be easily distinguished from allied genera by the more or less angularly produced head, and the forewing with strong venation. Vertex depressed, with angular transition between

face and vertex. Ocelli present on the anterior margin of head near compound eyes. Clypellus expanding towards apex. Male pygofer with a ventrocaudal process. Subgenital plate obliquely long, approximately triangular, and the outer margin with long setae. Connective stem long. Forewings longer than body at rest and with distinctive, elegant markings, with three ante-apical and five apical areoles of which the outer is broadly triangular. In more typical species, forewings are more or less closely ornamented with fine brown or fuscous pigment lines and inscribed with a few oval or rounded whitish spots placed near the ends of the areoles.

Distribution. Afrotropical, Palearctic and Oriental regions (Zahniser, 2007).

Platymetopius fidelis (Distant, 1918) (Fig. 1A-H)

Mahalana fidelis Distant, 1918:63. Type locality: India.

Platymetopius fidelis (Distant, 1918): Webb & Godoy, 1993:424; Viraktamath & Yeshwanth, 2017:48.

Material examined. Pakistan: Khyber Pakhtunkhwa Province, 1♂, Paras, 34°39'6.0408"N, 73°26'50.9028"E, 12-viii-2019, Sweeping hand net, coll. Bismillah Shah.

Measurements. Body length male (this study): 4.7 mm; Viraktamath & Yeshwanth (2017): 6.3 mm.

Diagnosis. Body color yellowish-brown, mottled with dark brown patches and whitish or smoky spots on pronotum and forewings (Figs 1A-B). Frontoclypeus with faded white transverse streaks (Fig. 1D). Pronotum almost twice longer than vertex median length (Figs 1A, 1C). Gena usually with a small, dark dot near the lorum (Fig. 1D). Forewings longer than abdomen, and as long as the hind wings (Figs 1A-B). Subgenital plate longer than pygofer (Fig. 1E). Aedeagus broad at base in dorsal view, shaft cylindrical with apex truncate; a pair of lateral appendages arising near the basal portion of shaft; appendages longer than shaft, uniformly curved dorsally (Figs 1G-H). For detailed description, see Viraktamath & Yeshwanth (2017).

Distribution. Pakistan, India (Distant, 1918; Viraktamath & Yeshwanth, 2017).

Tribe Cicadulini Van Duzee, 1892

Genus *Cicadula* Zetterstedt, 1840

Cicadula Zetterstedt, 1840:296. Type species: *Cicada quadrinotata* Fabricius, 1794. Designated by Woodworth, 1888:76.

Diagnosis. Body elongate, relatively slender. Head broader than pronotum. Clypellus wider at apex. Antennae long. Forewings narrow, long. Fore tibia with five setae, one on anterioventral and four on dorsal row. Male subgenital plate short, rounded apically, macrosetae one row, more or less abruptly turning off mesad. Male pygofer deeply excised dorsally, anal tube long and well sclerotized dorsally (Ossiannisslon, 1983, as cited in Viraktamath & Yeshwanth, 2017).

Distribution. Nearctic, Neotropical, Palearctic, and Oriental regions (Dmitriev, 2003).

Cicadula simlaensis Viraktamath & Yeshwanth, 2017 (Figs 2A-I)

Cicadula simlaensis Viraktamath & Yeshwanth, 2017:51. Type locality: India, Shimla hills.

Material examined. Pakistan: Khyber Pakhtunkhwa Province, 2♂♂, 7♀♀, Ayubia, 34°1'48.5544"N, 73°24'24.4332"E, Sweeping hand net, 28-vii-2019; Punjab Province, 1♂, Murree, 33°54'23.508"N, 73°23'37.284"E, Sweeping hand net 23-vii-2018; 8♂♂, 5♀♀, Arokas, 33°51'11.8044"N, 73°19'2.0784"E, Sweeping hand net, 27-vii-2019; 17♂♂, 6♀♀, Sandhian, 33°55'53.9976"N, 73°23'35.1744"E, Sweeping hand net, 28-vii-2019; 1♂, 3♀♀, Barrian, 33°58'25.7592"N, 73°23'35.3364"E, Sweeping hand net, 28-vii-2019; 4♂♂, 1♀, Ghora Gali, 33°52'56.5392"N, 73°21'41.6772"E, Sweeping hand net, 31-vii-2019; 4♂♂, 9♀♀, Kuldana, 33°55'15.8232"N, 73°23'58.0812"E, Sweeping hand net, 1-viii-2019; 2♂♂, Sunny Bank, 33°55'1.1244"N, 73°23'39.8256"E, Sweeping hand net, 15-viii-2019; 1♂, 3♀♀, Lower Topa, 33°53'51.198"N, 73°25'53.8932"E, Sweeping hand net, 16-viii-2019 (all collected by Bismillah Shah).

Measurements. Body length: male: 3.5–3.9 mm; female: 4.0–4.4 mm.

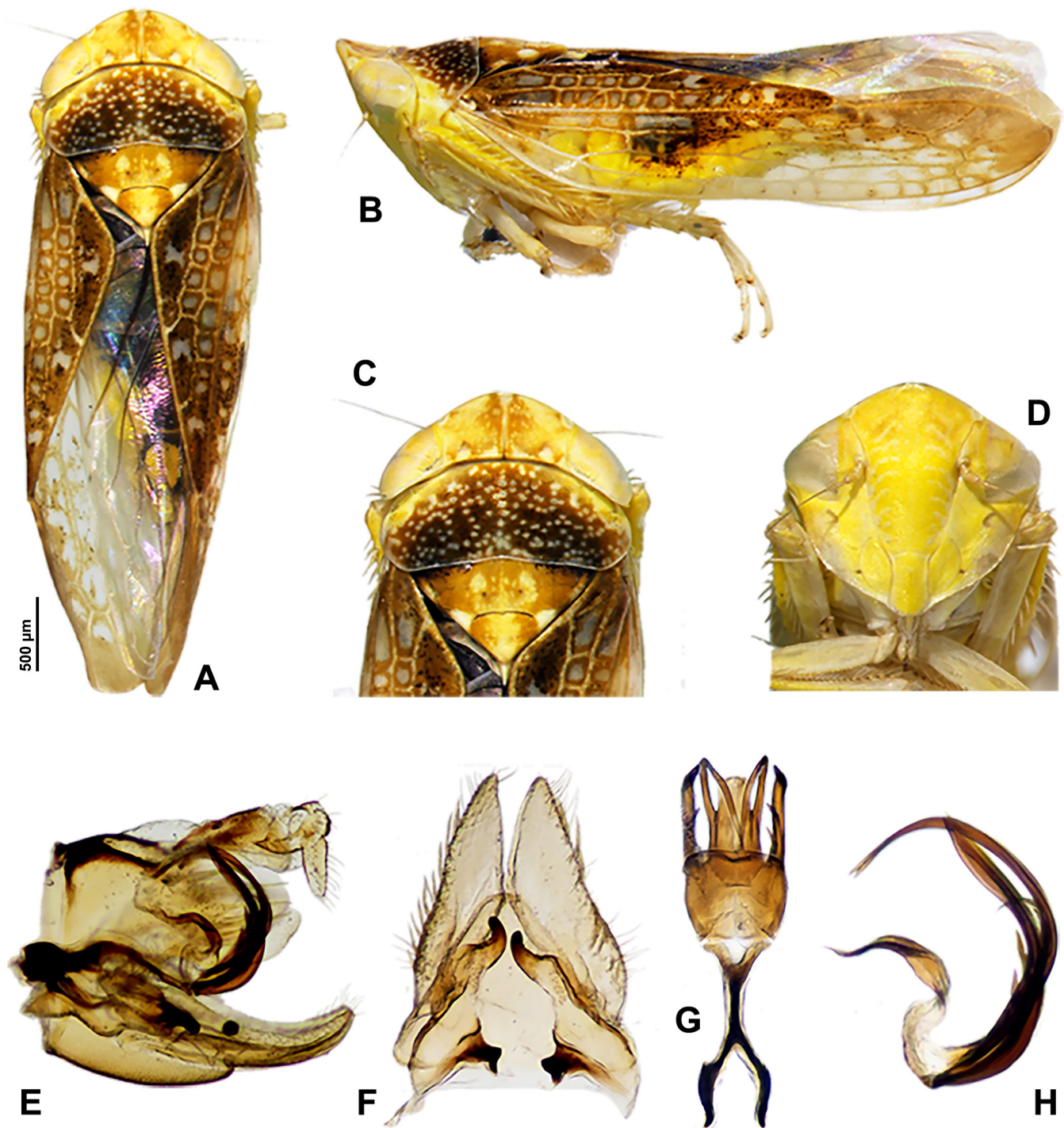


Figure 1. *Platymetopius fidelis* (Distant, 1918). **A.** Habitus, dorsal view; **B.** Habitus, lateral view; **C.** Head and thorax, dorsal view; **D.** Face; **E.** Male pygofer, lateral view; **F.** Subgenital plates, valve and styles, dorsal view; **G.** Connective and aedeagus, dorsal view; **H.** Aedeagus, lateral view.

Diagnosis. Body color yellowish green (Figs 2A–B). Crown with two pairs of black rounded spots, one in the middle of crown near to eyes, another on anterior margin (Figs 2A, 2C). Ocelli red (Figs 2A–C). Forewings transparent, with prominent yellow venation (Figs 2A–B). Pygofer side projected posteriorly, with several macrosetae posterodorsally (Fig. 2E). Subgenital plates apart from each other (Fig. 2F). Aedeagus extending dorsally beyond pygofer in lateral view (Fig. 2E). Aedeagal shaft uniformly slender dorsally (Fig. 2H), sickle-shaped laterally, apex with a slight expansion in lateral view (Fig. 2I).

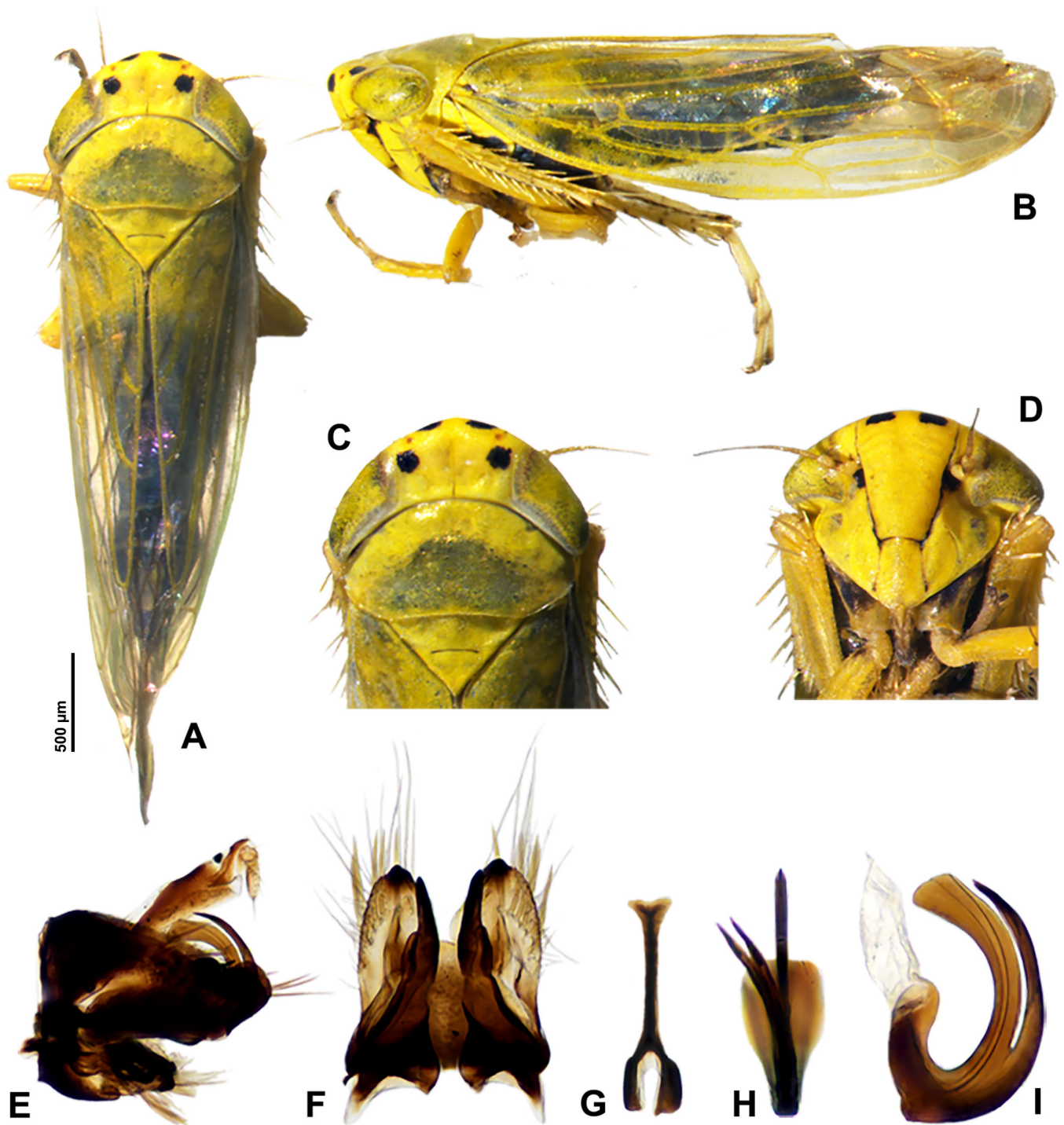


Figure 2. *Cicadula simlaensis* Viraktamath & Yeshwanth, 2017. **A.** Habitus, dorsal view; **B.** Habitus, lateral view; **C.** Head and thorax, dorsal view; **D.** Face; **E.** Male pygofer, lateral view; **F.** Subgenital plates, valve and styles, dorsal view; **G.** Connective, dorsal view; **H.** Aedeagus, ventral view; **I.** Aedeagus, lateral view.

Aedeagus ventral process bilobed apically (Fig. 2H), diverged from shaft at almost 1/3 distance from the base, uniformly curved dorsally (Fig. 2I). For detailed description, see Viraktamath & Yeshwanth (2017).

Distribution. Pakistan (new record), India (Viraktamath & Yeshwanth, 2017).

DISCUSSION

The genus *Platymetopius* currently includes more than 75 species globally (Guerrouche et al., 2021) under two subgenera: *Platymetopius* and *Quernus*. Mahmood (1979) recorded the genus *Platymetopius* for the first time from Pakistan with an undetermined species, *Platymetopius* sp. However, the exact locality of this species is not provided in Mahmood (1979) under the specific code number DW 50A in material examined table. Following his work, Khatri & Webb (2010), Khatri & Rustamani (2011), and Naveed et al. (2021) listed this species from Pakistan. Based on the line drawings of male genitalia provided by Mahmood (1979), Viraktamath & Yeshwanth (2017) confirmed the presence of *P. fidelis* in Pakistan. However, the locality information of this species is not provided in any published literatures neither from Pakistan nor from India. Here we reported *P. fidelis* from the northern parts of Pakistan, and we deemed this species may also be found in the southern parts of the country, Sindh province, as most of Mahmood's work is from southern part of Pakistan.

The genus *Cicadula* currently holds around 40 valid species worldwide (Dmitriev, 2003). Among these, only two species, *Cicadula simlaensis* Viraktamath & Yeshwanth, and *Cicadula compressa* Ramachandra Rao are known to occur in India (Viraktamath & Yeshwanth, 2017). The present study documented the genus *Cicadula* for the first time in Pakistan, along with a newly recorded species, *Cicadula simlaensis* from the northern areas. *Cicadula simlaensis* resembles *Cicadula (Henriana) frontalis* Herrich-Schäffer but can be distinguished in the aedeagal shaft with a single subapically bifid basal process and in having a spine on the dorsal margin of the pygofer. As Pakistan is a country with vast biodiversity, there is a chance to get more species of Deltocephalinae. So, further intensive, and extensive surveys are needed especially on those areas such as north-west and western Pakistan which are comparatively less explored.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: B. Shah: field work, original draft preparation, review and editing; M.A. Hassan: software, review and editing; H. Naveed: identification; M. Shakeel: review and editing; M.T. Khan: data curation; Y.N. Duan: Funding acquisition and overall supervision. All authors read and approved the final version of the manuscript

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the Insect collection of the School of Plant Protection, Anhui Agricultural University, Hefei, Anhui, China, and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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یافته‌های جدید از زنجرک‌های زیر خانواده (Hemiptera, Cicadellidae) Deltocephalinae از پاکستان

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چکیده: زنجرک جنس *Cicadula* Zetterstedt براساس گونه *Cicadula simlaensis* Viraktamath & Yeshwanth برای اولین بار از کشور پاکستان گزارش شد. علاوه بر این، پراکنش زنجرک *Platymetopius fidelis* (Distant) در پاکستان مجدداً ثبت و بررسی شد. خصوصیات افتراقی هر گونه به همراه تصاویر کلی از حشره نر و اندام جنسی هر دو گونه ارائه شد. پراکنش عمومی این گونه‌ها در دو منطقه پالئارکتیک و اورینتال به طور مختصر بحث شد.

واژگان کلیدی: *Cicadulini*, *Auchenorrhyncha*, *Athysanini*, ریخت‌شناسی، تاکسونومی