



## Research Article

# Genus *Exitianus* Ball, 1929 (Hemiptera: Cicadellidae: Deltocephalinae). A Taxonomic Revision from Pakistan

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**Abstract** | In the current study, the leafhopper genus *Exitianus* Ball is reviewed based on around 200 specimens sampled from various regions of Pakistan during 2019–2021. The study revealed the presence of two species, *Exitianus nanus* (Distant) and *Exitianus indicus* (Distant) in the region. Their morphological descriptions, an identification key, and photographs are given. Specimens of all examined materials are deposited at the department of Entomology, The University of Agriculture, Peshawar, KP, Pakistan.

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**Keywords** | Auchenorrhyncha, *Exitianus indicus*, *Exitianus nanus*, Pakistan, Taxonomy



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## Introduction

Leafhoppers are small wedge-shaped insects that ranges from 2–30 mm in length. Species of leafhoppers may be dorso-ventrally flattened, globular or elongated in appearance. They are found everywhere in subtropical and tropical ecosystems (Dietrich, 2005). Leafhoppers have piercing-sucking type of mouthparts hence suck plant sap from trees, grasses and shrubs, also recognized as plant sap feeders (Dietrich, 2004; Wayadande and Nault, 1996). Some leafhopper are pests while many of them transmit plant diseases (Nielson, 1979), viruses and phytoplasma. Leafhoppers are generally sampled by sweeping method more commonly than other insect group (Ross *et al.*, 1982).

In taxonomic classification, leafhoppers were considered before in order Homoptera of class Hexapoda, but due to more finding and modern researches by taxonomists they are now grouped together in order Hemiptera, followed by infraorder Cicadomorpha, superfamily Membracidae and family Cicadellidae respectively. Leafhoppers can be easily recognized from hind tibiae with the rows of spines. Also, the pronotum is not prolonged back on abdomen. Location of the lateral ocelli is also an important distinctive feature in leafhopper subfamilies. Wing venations, arrangement of setae on legs, and male and female genitalia are few additional morphological character for variation in leafhoppers species.

*Exitianus* is a member of tribe Chiasmini in subfamily Deltocephalinae. It holds 43 species worldwide with 6 species exist in Asia. Leafhoppers from this genus are very prominent by the presence of a transverse dark band on crown. It varies from the related species in male pygofer with a few apical, stout setae and the female with long ovipositor. Ross (1968) studied the genus *Exitianus* earlier from the old world, whereas recently, this genus is revised by Zahniser (2008), Khatri and Webb (2010) plus Duan and Zhang (2013) respectively.

## Materials and Methods

In present research, the fresh specimens from genus *Exitianus* were sampled from different locations of KP and Punjab provinces of Pakistan during 2019–2021 and were preserved in 90% ethanol for further studies. External characteristics such as shape, size, coloration and patterns of head, thorax and abdomen were thoroughly studied. For male genitalial preparation, the entire abdomen was removed from the specimen by applying pressure in between the thorax and abdomen with a pointed needle and then treated with 10% NaOH solution for maceration (removal of soft tissues and muscles) on a hot plate. Later, the genitalia were rinsed in water, placed in glycerol, and then observed under microscope. Digital photographs were captured using a Nikon DS-Fi2 camera attached on Nikon SMZ 745T stereoscopic microscope and Nikon Eclipse 50i polarizing microscope. Photographs were modified to remove background and balance color and contrast using Adobe Photoshop CS.

Morphological terminology follows Dietrich (2005). The material examined is deposited as voucher specimens at the department of Entomology, The University of Agriculture, Peshawar, KP-Pakistan.

## Results and Discussion

*Genus Exitianus* Ball (1929)

*Exitianus* Ball (1929): 5 (Type species: *Jassus obscurinervis* Stål (1859).

*Exitianus* Oman *et al.* (1990): 213.

*Exitianus* Fang *et al.* (1993).

*Exitianus* Emeljanov (1999): 547.

*Exitianus* Dmitriev (2003): 677.

*Exitianus* Zahniser and Dietrich (2013): 56.

**Diagnosis:** Size medium, color yellowish-brown with blackish or brown patterns. Head usually broader than pronotum. Ocellus large, present dorsally. Pronotum plus mesonotum with various markings. Wings elongate with usual leafhopper wing venation, with/without brown pigmentation on the anal veins. Pygofer (male) having two to six blackish spines along apical margins of pygofer. Male subgenital plate separate. Connective Y-shaped, with wide stem. Aedeagus thick, dorsal view wide at basal part and convergent at very apical end acute round at apex; base with articulation between the shaft, shaft comparatively simple in structure with gonopore apical. Female ovipositor exceeding a significant distance outside abdominal tergites.

**Distribution:** Worldwide.

**Remarks:** *Exitianus* holds 43 species worldwide with 6 species exist in Asia. The *Exitianus* species can be distinguished generally by the crown having a transverse dark band, males pygofer with some strong setae apically and female ovipositor surpassing clearly the last segment dorsally. These characteristics are only common with the apparently sister genus *Nephotettix* Matsumura, however they are different in crown abruptly ridged where it meets face, plus in having an opaque green color with diverse black markings.

*Key to the species of genus Exitianus Ball from Pakistan*

1. Crown having transverse brownish band usually complete; pygofer with 2–3 apical black or brownish macrose..... *E. indicus*
2. Crown having transverse brownish band usually interrupted medially; pygofer with 2–6 apical black or brownish macrosetae.... *E. nanus*

*Exitianus indicus* (Distant)

(Figure 1)

*Athysanus indicus* Distant (1908): 344.

*Phrynomorphus indicus* Distant (1918): 51.

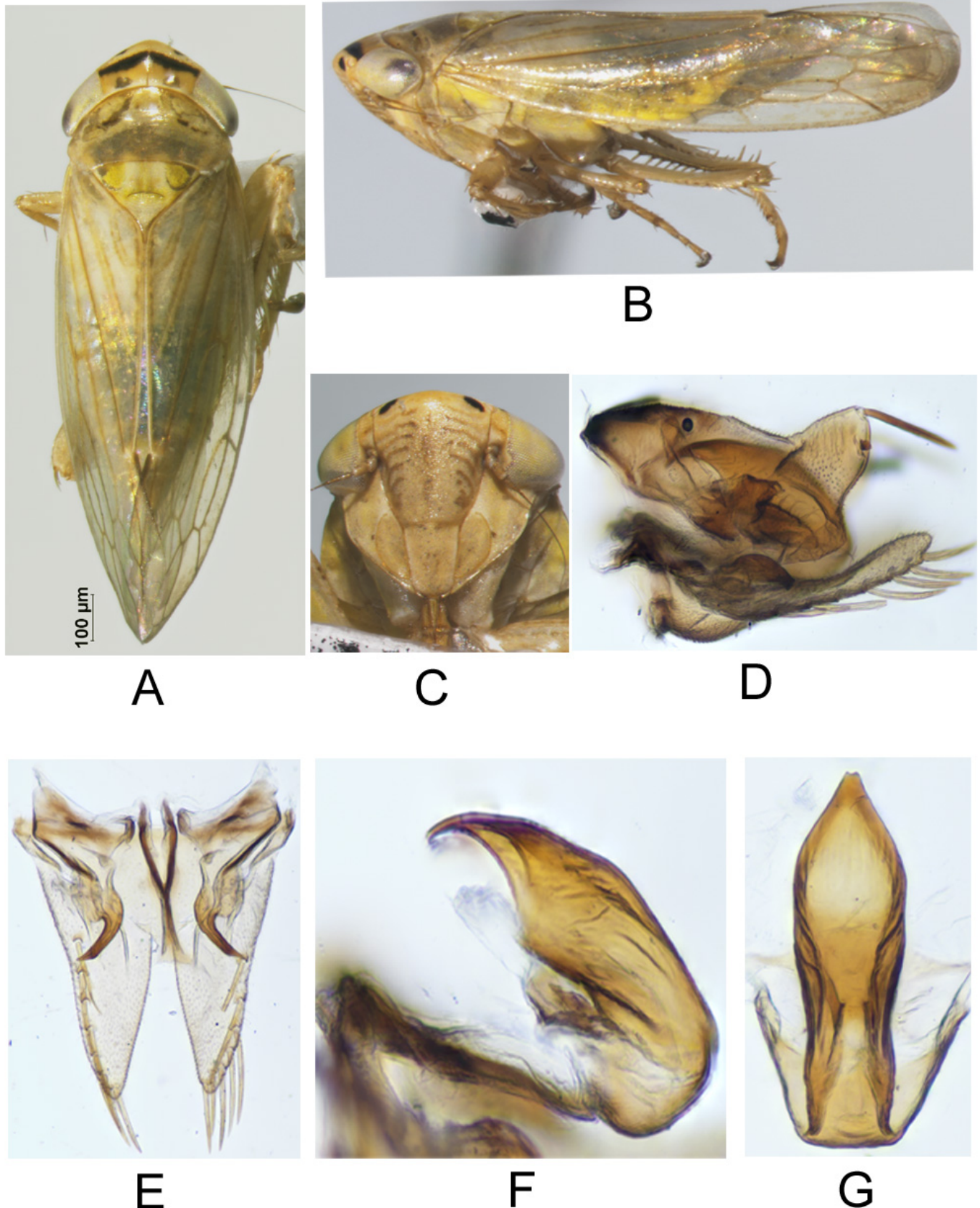
*Euscelis indicus* Lindberg and Zachvatkin (1936): 15.

*Exitianus indicus* Oman (1938): 383.

*Exitianus major* Ahmed and Qadeer (1988) in Ahmed *et al.* (1988): 10.

*Exitianus indicus* in Khatri *et al.* (2014): 3.

**Measurement:** Male: 4.1–4.4mm; female: 4.2–5.1mm (this study). Forewing length: 3.7mm, crown middle length: 0.34mm, crown width crosswise eyes: 1.42mm, interocular width anteriorly: 0.89mm, eyes

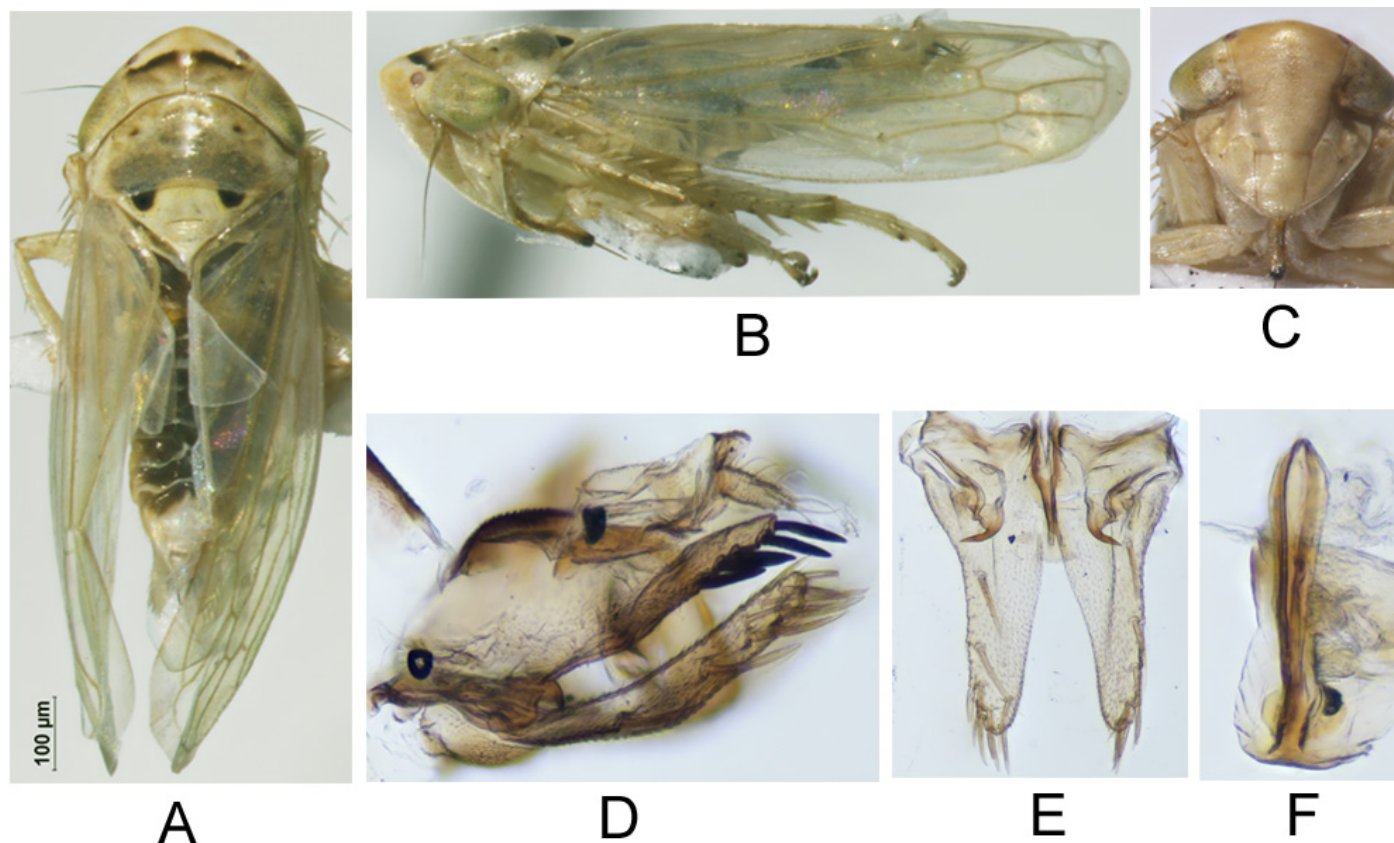


**Figure 1:** *Exitianus indicus* (Distant). A: habitus, dorsal view; B: habitus, lateral view; C: face; D: male pygofer, lateral view; E: subgenital plate, valve, styles and connective, dorsal view; F: aedeagus, lateral view; G: aedeagus, dorsal view.

length in cross: 0.56mm, pronotum width: 1.32mm, pronotum length: 0.6mm, mesonotum length: 0.25mm, scutellum length: 0.38mm (after [Khatri et al., 2014](#)).

**Description:** Yellowish brown with different transverse arcuate brownish band on crown ([Figure 1A](#)); frontoclypeus with pale brownish lateral arcs ([Figure 1C](#)). Scutellum with pale brownish basal triangles





**Figure 2:** *Exitianus nanus* (Distant). A: habitus, dorsal view; B: habitus, lateral view; C: face; D: male pygofer, lateral view; E: subgenital plate, valve, styles and connective, dorsal view; F: aedeagus, dorsal view.

(Figure 1A). Pygofer with 2–3 apical black or brown macrosetae (Figure 1D). Style preapical lobe with narrowly triangular shape, style apophysis with abrupt tapering apically (Figure 1E). Aedeagus with shaft strongly compressed at lateral aspect, gonopore large with edge form a concave margin in lateral aspect (Figure 1F); with pair of small processes dorsobasally.

**Material examined:** Pakistan: Khyber Pakhtunkhwa: 14♂♂, 9♀♀, Pirsabak, 34°0'37.1196"N, 72°3'3.6648" E, Sweeping hand net, 12.VII.2018; 8♂♂, 6♀♀, Kund Park, 33°55'50.0304" N, 72°14'5.0064" E, Sweeping hand net, 30.VII.2018; 4♂♂, 3♀♀, Khairabad, 33°54'15.1596" N, 72°13'37.8264" E, Sweeping hand net, 21.VII.2019; 9♂♂, 10♀♀, Nowshera, 34°0'53.8056" N, 71°58'59.3184" E, Sweeping hand net, 13.VI.2021; Punjab: 9♂♂, 1♀, Murree, 33°54'23.508" N, 73°23'37.284" E, Sweeping hand net, 23.VII.2018; 13♂♂, 11♀♀, Islamabad, 33°45'50.5884" N, 73°13'31.7712" E, Sweeping hand net, 23.VII.2018; 7♂♂, 8♀♀, Haji Shah, 33°49'32.9304"N, 72°20'31.6932"E, Sweeping hand net, 16.VII.2021.

**Distribution:** Australia, China, India, Nepal, Pakistan, Philippines, Taiwan.

**Remarks:** *E. indicus* (Distant) resembles *E. nanus* in external look but *E. indicus* can be distinguished by pygofer with two macrosetae, and by aedeagus shape.

*Exitianus nanus* (Distant)

(Figure 2)

*Athysanus nanus* Distant (1908): 345.

*Athysanus fasciolatus* Melichar (1911): 107.

*Athysanus simillimus* Matsumura, (1914): 185.

*Athysanus vulnerans* Bergevin (1925): 42.

*Athysanus digressus* Van Duzee (1933): 32.

*Exitianus karachiensis* Ahmed (1986): 59.

*Exitianus peshawarensis* Ahmed and Rao (1986): 76.

*Exitianus minor* Ahmed and Qadeer (1988) in Ahmed *et al.* (1988): 12.

*Exitianus fulvinervis* Li and He (1993): 27.

*Exitianus nanus* in Khatri *et al.* (2014): 4.

**Measurement:** Male: 3.1–4.2mm; female: 3.8–5.1mm (this study). Forewing length: 3.40mm, crown middle length: 0.25mm, crown width crosswise eyes: 1.17mm, interocular width anteriorly: 0.72mm, eyes length in cross: 0.48mm, pronotum width: 1.11mm, pronotum length: 0.47mm, mesonotum length: 0.16mm, scutellum length: 0.25mm (Khatri *et al.*, 2014).

**Description:** Yellowish brown coloration with different brownish marks on crown comprising acnes on the anterior margin and a posterior arcuate band having a cut at median (Figure 2A); frontoclypeus with pale brownish arcs at lateral (Figure 2C). Pronotum typically with some dark infuscation (Figure 2A). Scutellum with dark brownish triangles basally. Crown width almost 3 times its length. Pygofer generally with 2–6 black or brown macrosetae at apex (Figure 2D). Style pre-apical lobe widely triangular, apophysis uniformly pointing towards apex (Figure 2E). Aedeagal shaft somewhat compressed at lateral having small subapical gonoduct dorsally; without processes (Figure 2F).

**Material examined:** Pakistan: Khyber Pakhtunkhwa: 7♂♂, 9♀♀, Pirsabak, 34°0'37.1196"N, 72°3'3.6648"E, Sweeping hand net, 12.VII.2018; 3♂♂, 4♀♀, Kund Park, 33°55'50.0304"N, 72°14'5.0064"E, Sweeping hand net, 30.VII.2018, 2♂♂, 5♀♀, Khairabad, 33°54'15.1596"N, 72°13'37.8264"E, Sweeping hand net, 21.VII.2019; 7♂♂, 2♀♀, Nowshera, 34°0'53.8056"N, 71°58'59.3184"E, Sweeping hand net, 13.VII.2021; Punjab: 11♂♂, 3♀♀, Murree, 33°54'23.508"N, 73°23'37.284"E, Sweeping hand net, 23.VII.2018; 6♂♂, 7♀♀, Islamabad, 33°45'50.5884"N, 73°13'31.7712"E, Sweeping hand net, 23.VII.2018; 13♂♂, 3♀♀, Haji Shah, 33°49'32.9304"N, 72°20'31.6932"E, Sweeping hand net, 16.VII.2021

**Distribution:** Algeria, Australia, Bangladesh, Chile, China, Ecuador, Ethiopia, India, Iraq, Italy, Japan, Jordan, Kenya, Libya, New Zealand, Pakistan, Saudi Arabia, Seychelles, Taiwan, Tanzania, Uganda, Yemen.

**Remarks:** Externally, *E. nanus* closely resembles *E. indicus*. Connective and styles are also alike, but can readily be distinguished through pygofer with four macrosetae. *E. nanus* with aedeagus less wide as compared to *E. indicus* laterally, and the aedeagus with median process absent.

## Conclusions and Recommendations

It is concluded from the present study that only two species of the genus *Exitianus* Ball, *E. indicus* and *E. nanus* are present and has been identified so far from Pakistan. Further collection and identification of the leafhopper species is recommended to explore the diverse fauna of this insect. Moreover, the morpho-

logical descriptions and well-illustrated photos will create easiness in identification and will assist in pest management approaches.

## Novelty Statement

This study reflects the fauna of genus *Exitianus* from Pakistan. The morphological descriptions, genitalia dissection and well-illustrated photographs presented in this paper create an ease in the identification of the genus till species level.

## Author's Contribution

**Waqar Khan:** Performed the research study and wrote the paper.

**Muhammad Atif Khan:** Performed surveys and specimen collections.

**Waseem Abbas:** Assisted in field experiment.

**Muhammad Shakeel:** Provided technical assistance.

**Hammad Uddin:** Assisted in field experiment.

**Bismillah Shah:** Identified the species and prepared the final draft of the paper.

**Waqar Khan, Muhammad Atif Khan, Waseem Abbas and Bismillah Shah:** Collected data for Material examined.

## Conflict of Interest

The authors declare no conflict of interest regarding the present paper.

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