

Study on the leafhopper genus *Goniagnathus* Fieber (Hemiptera: Cicadellidae: Deltocephalinae) from Pakistan with a newly recorded species

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Abstract: *Goniagnathus (Tropicognathus) punctifer* (Walker) is recorded from Pakistan for the first time. A worldwide checklist of the species in the genus *Goniagnathus* is provided and a key to distinguish the known subgenera and species from Pakistan is also provided.

Key words: Auchenorrhyncha; Cicadelloidea; taxonomy; key

巴基斯坦刻纹叶蝉属分类并记一新记录种（半翅目：叶蝉科：角顶叶蝉亚科）

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摘要: 记述采自巴基斯坦的刻纹叶蝉属 1 新记录种: *Goniagnathus (Tropicognathus) punctifer* (Walker), 提供了该属的世界名录, 以及巴基斯坦该属分亚属和分种检索表。

关键词: 头喙亚目; 叶蝉总科; 分类; 检索表

Introduction

The leafhopper genus *Goniagnathus* Fieber belongs to the subfamily Deltocephalinae and is the member of the Goniagnathini (Naveed & Zhang 2018). These leafhoppers are found in the grassland ecosystem (Meshram & Ramamurthy 2012) in the Oriental, Afrotropical and Palaearctic Regions as well as being reported from the Australian region (Fletcher & Zahniser 2008; Viraktamath & Gnanewaran 2009). Members of this genus are brownish, squat and robust. They can easily be recognized by their short and broad heads, plus the fused valve and subgenital plates, style with a membranous fracture at mid-length, and a fused connective and aedeagus (Duan & Zhang 2012; Fletcher & Zahniser 2008; Meshram & Ramamurthy 2012; Viraktamath & Gnanewaran 2009).

Emeljanov (1999) divided the Palaearctic species of the genus into five subgenera and provided the key for their separation. Viraktamath & Gnanewaran (2009) added another subgenus (*Tropicognathus*) from India. Other regional studies of this genus include those of Linnavuori (1978) from Africa, Dash & Viraktamath (2001) from the Indian subcontinent, Fletcher & Zahniser (2008) from Australia, Duan *et al.* (2009) from China, Khatri & Webb

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(2010) from Pakistan, Zahniser & Dietrich (2013) from Madagascar and Naveed & Zhang (2018) also from Pakistan.

Examination of material collected from Pakistan revealed the presence of *Goniagnathus (Tropicognathus) punctifer* (Walker) as a new record for Pakistan, which brings the known species of this genus in Pakistan to four. Photos of habitus and male genitalia are given and figures for all the known species of this genus from Pakistan are provided.

Key to subgenera and species of genus *Goniagnathus* (males) from Pakistan

1. Male pygofer with dorsal appendage absent (Fig. 2C); aedeagus with pair of ventral processes exceeding aedeagal shaft (Figs. 2G, H) *G. (Epistagma) guttulinervis*
- Male pygofer with dorsal appendage present (Figs. 4A, 5A, 7A, B, 8A) *G. (Tropicognathus)* 2
2. Aedeagus with one pair of long processes present at mid-length (Fig. 5D), subgenital plates fused with truncate margin caudally (Fig. 5B) *G. (Tropicognathus) nepalicus*
- Aedeagus with two pairs of processes (Figs. 4G, 7F, 8D, E) 3
3. Aedeagal shaft with a pair of apical and a pair of median asymmetrical processes (Figs. 7E, F, 8D, E) *G. (Tropicognathus) punctifer*
- Aedeagal shaft with two pairs of processes present near apex, having lateral processes longer and stouter than the dorsal processes (Fig. 4G–H) *G. (Tropicognathus) quadripinnatus*

Checklist of the species of *Goniagnathus* worldwide

Goniagnathus (Episarca) sanguisparsus Haupt, 1917: 248

Distribution: Kyrgyzstan (Issyk-Kul' obl., north, W. Tian Shan); Turkmenia (Mary region); Uzbekistan (Fergana Valley); Russia (European part); Kazakhstan; Tadjikistan; Turkmenistan.

Goniagnathus (Epistagma) guttulinervis Kirschbaum, 1868: 116

Distribution: Balearic Isls.; China (Sinkiang); Ethiopian Region; Italy (Sardinia, Sicily); Russia (European, S. European part); Turkmenia (Mary region); Afghanistan; Algeria; Armenia; Canary Islands; Egypt; Ethiopia; France; Hungary; Iran; Iraq; Israel; Jordan; Kazakhstan; Kyrgyzstan; Morocco; Netherlands; Pakistan; Portugal; Spain; Tadjikistan; Turkey; Tanzania; Tunisia; Turkmenistan; Ukraine; Uzbekistan.

Goniagnathus (Epitephra) rugulosus Haupt, 1917: 248

Distribution: China (Manchuria); Kyrgyzstan (Issyk-Kul' obl., north, Tian Shan); Russia (Gorno-Altayskaya AO, Primorskiy Krai, European, S. European part); Uzbekistan (Fergana Valley); Altai Mts.; Japan; Kazakhstan Korea; Mongolia; Turkmenistan; Ukraine.

Goniagnathus (Goniagnathus) brevis Herrish-Schäffer, 1835: 71

Distribution: Germany (east, west); Italy (Pantelleria Isl., Sicily); Kyrgyzstan (Issyk-Kul' obl., north, W. Tian Shan); Russia (European, S European part); Turkey (Anatolia, European part); Uzbekistan (Fergana Valley); Albania; Algeria; Armenia; Austria; Azerbaijan; Belgium; Bohemia; Bulgaria; Croatia; Cyprus; Czechoslovakia; Denmark; France; Georgia; Hungary; Iran Israel; Kazakhstan; Moldova; Moravia; Morocco; Netherlands; Norway; Poland; Portugal; Romania; Serbia; Slovakia; Spain; Sweden; Switzerland; Syria; Tadjikistan; Tajikistan; Tunisia; Turkmenistan; Ukraine; Yugoslavia.

Goniagnathus (Goniozygotes) bolivari Melichar, 1907: 1035

Distribution: Bulgaria; Israel; Portugal; Spain; Turkey (Anatolia).

- Goniagnathus (Tropicognathus) anufrievi* Viraktamath & Gnaneswaran, 2009: 54
Distribution: India.
- Goniagnathus (Tropicognathus) appellans* Baker, 1924: 367
Distribution: India.
- Goniagnathus (Tropicognathus) concavus* Dash & Viraktamath, 2001: 66
Distribution: India.
- Goniagnathus (Tropicognathus) cornutus* Duan 2009 in Duan *et al.*, 2009: 54
Distribution: China.
- Goniagnathus (Tropicognathus) formosanus* Matsumura, 1913: 69
Distribution: Japan; China (Taiwan).
- Goniagnathus (Tropicognathus) fumosus* Distant, 1918: 43
Distribution: India.
- Goniagnathus (Tropicognathus) keralaensis* Meshram, 2012 in Meshram & Ramamurthy, 2012: 248
Distribution: India.
- Goniagnathus (Tropicognathus) nepalicus* Viraktamath & Gnaneswaran, 2009: 57
Distribution: Nepal; Pakistan.
- Goniagnathus (Tropicognathus) nervosus* Melichar, 1903: 180
Distribution: India.
- Goniagnathus (Tropicognathus) punctifer* Walker, 1858: 104
Distribution: India; Madagascar; Maldives; Myanmar; Pakistan; Sri Lanka.
- Goniagnathus (Tropicognathus) quadripinnatus* Dash & Viraktamath, 2001: 74
Distribution: India; Pakistan.
- Goniagnathus (Tropicognathus) symphysis* Dash & Viraktamath, 2001: 76
Distribution: India.
- Goniagnathus (Tropicognathus) syncerus* Dash & Viraktamath, 2001: 76
Distribution: India.
- Goniagnathus (Tropicognathus) taiwanus* Matsumura, 1912: 295
Distribution: China (Taiwan).
- Goniagnathus (Tropicognathus) viraktamathi* Duan & Zhang, 2012: 39
Distribution: China.
- Goniagnathus (Tropicognathus) zeylanicus* Viraktamath & Gnaneswaran, 2009: 57
Distribution: Sri Lanka.
- Goniagnathus agenor* Linnavuori, 1978: 491
Distribution: Chad; Zaire.
- Goniagnathus albomaculatus* Webb, 1980: 860
Distribution: Seychelles.
- Goniagnathus albomarginatus* Linnavuori, 1978: 496
Distribution: Burundi; Djibouti; Eritrea; Ethiopia; Kenya; Rwanda; Somalia; Sudan; Tanzania; Uganda; Zaire.
- Goniagnathus algiricus* Bergevin, 1920: 77
Distribution: Algeria.
- Goniagnathus alkhubricus* Dlabola, 1980: 88
Distribution: Saudi Arabia.

- Goniagnathus appendiculatus* Linnavuori, 1978: 493
Distribution: Sudan.
- Goniagnathus bishapuricus* Dlabola, 1994: 90
Distribution: Iran.
- Goniagnathus brachypterus* Linnavuori, 1978: 491
Distribution: Zaire.
- Goniagnathus caspianus* Dlabola, 1961: 330
Distribution: Russia (Dagestan, European, S European part).
- Goniagnathus centralis* Evans, 1966: 242
Distribution: Australia.
- Goniagnathus crocodontis* Fletcher, 2008 in Fletcher & Zahniser, 2008: 50
Distribution: Australia.
- Goniagnathus detectus* Bergevin, 1914: 242
Distribution: Morocco.
- Goniagnathus dursoicus* Dlabola, 1994: 93
Distribution: Iran.
- Goniagnathus emeljanovi* Zahniser & Dietrich, 2013: 182
Distribution: Madagascar.
- Goniagnathus hanifanus* Dlabola, 1979: 130
Distribution: Iran; Saudi Arabia (north).
- Goniagnathus hyalinus* Bergevin, 1924: 99
Distribution: Egypt.
- Goniagnathus kusnezovi* Dubovsky, 1966: 146
Distribution: Kyrgyzstan; Tajikistan; Uzbekistan.
- Goniagnathus lukjanovitshi* Kusnezov, 1929:184
Distribution. Mongolia; Russia (Central Siberia, European part).
- Goniagnathus minor* Kusnezov, 1928: 51
Distribution: Ukraine.
- Goniagnathus minutus* Dubovsky, 1966: 145
Distribution: Kyrgyzstan (W. Tian Shan); Turkmenia (Mary region); Tajikistan; Uzbekistan.
- Goniagnathus obesus* Jacobi, 1910: 133
Distribution : Tanzania.
- Goniagnathus obfuscatas* Linnavuori, 1978: 495
Distribution: Senegal; Yemen.
- Goniagnathus osmelaki* Fletcher, 2008 in Fletcher & Zahniser, 2008: 45
Distribution: Australia.
- Goniagnathus Othello* Distant, 1913: 468
Distribution: Algeria.
- Goniagnathus parvipictus* Linnavuori, 1978: 496
Distribution: Sudan.
- Goniagnathus pectinatus* Fletcher, 2008 in Fletcher & Zahniser, 2008: 5
Distribution: Australia.
- Goniagnathus severus* Stål, 1855: 99

Distribution: South Africa.

Goniagnathus turkestanicus Kusnezov, 1929: 322

Distribution: Kyrgyzstan (Tian Shan); Russia (S European part); Turkmenia (Mary region); Kazakhstan; Tadjhikistan; Turkmenistan; Uzbekistan.

Goniagnathus uniformis Distant, 1908: 312

Distribution: India.

Goniagnathus venenensis Fletcher, 2008 in Fletcher & Zahniser, 2008: 50

Distribution: Australia.



Figure 1. A, B. *Goniagnathus* (*Epistagma*) *guttulinervis* Kirschbaum; C, D. *Goniagnathus* (*Tropicognathus*) *quadripinnatus* Dash and Viraktamath; E, F. *Goniagnathus* (*Tropicognathus*) *nepalicus* Viraktamath and Gnaneswaran. A, C, E. Habitus, dorsal views; B, D, F. Face (F after Naveed and Zhang, 2018).

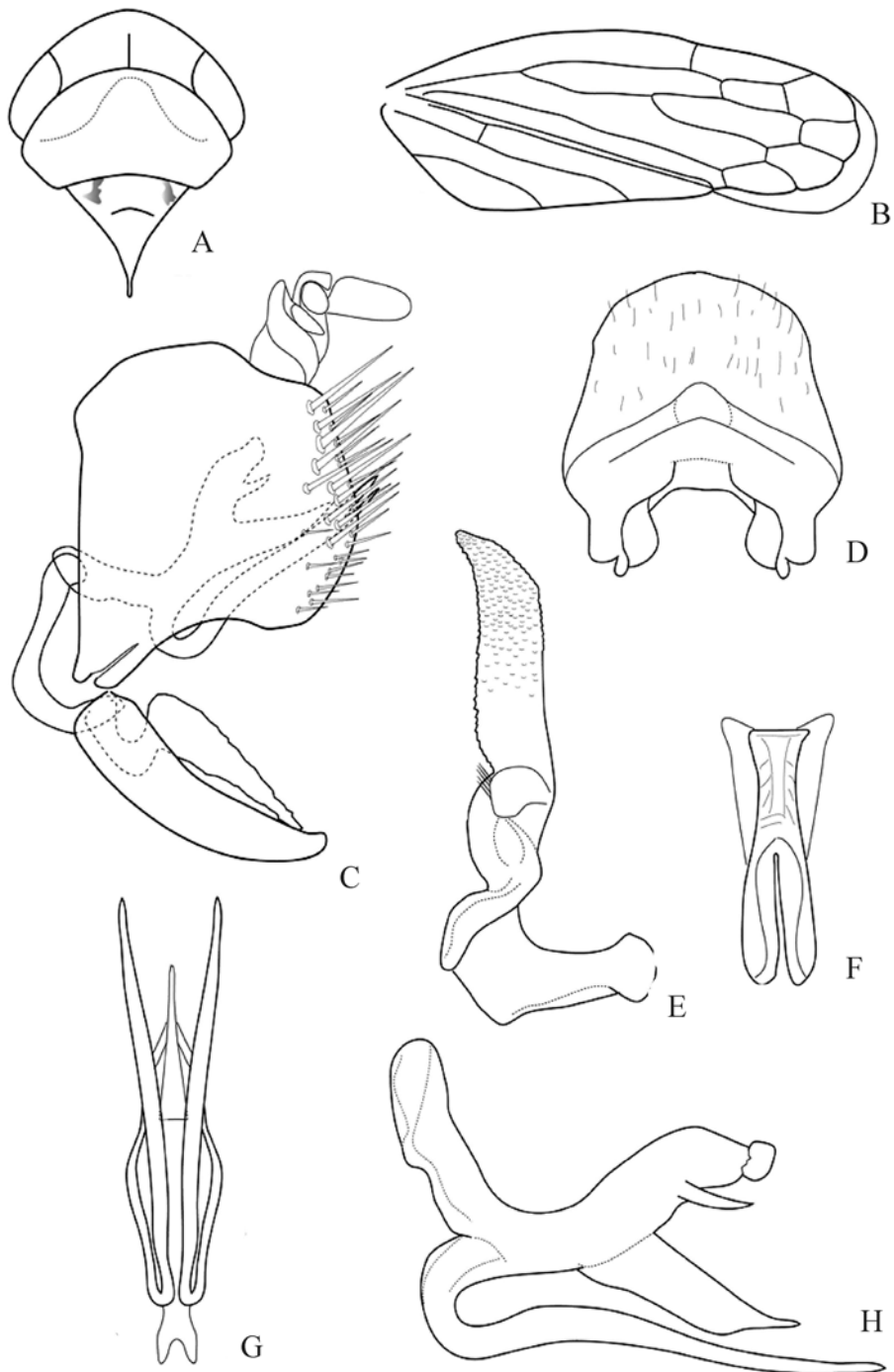


Figure 2. *Goniagnathus (Epistagma) gutulinervis* Kirschbaum (after Khatri & Webb, 2010). A. Head and thorax, dorsal view; B. Forewing; C. Male pygofer, lateral view; D. Fused valve and subgenital plates; E. Style; F. Connective; G. Aedeagus, ventral view; H. Aedeagus, lateral view.

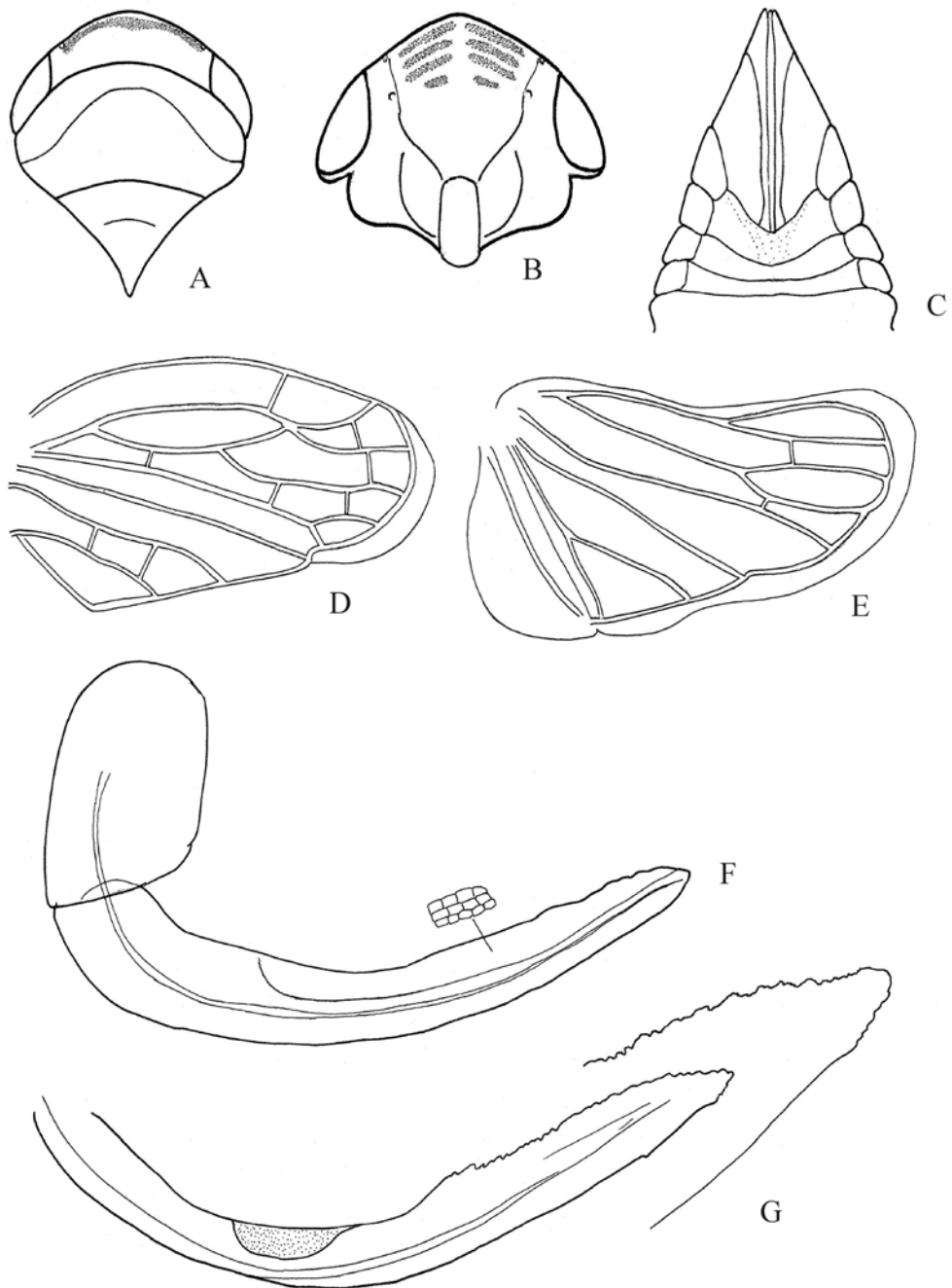


Figure 3. *Goniagnathus (Tropicognathus) quadripinnatus* Dash & Viraktamath (after Khatri & Webb, 2010).
A. Head and thorax, dorsal view; B. Face; C. Apex of female abdomen, ventral view; D. Forewing; E. Hindwing;
F. First valvulae; G. Second valvulae.

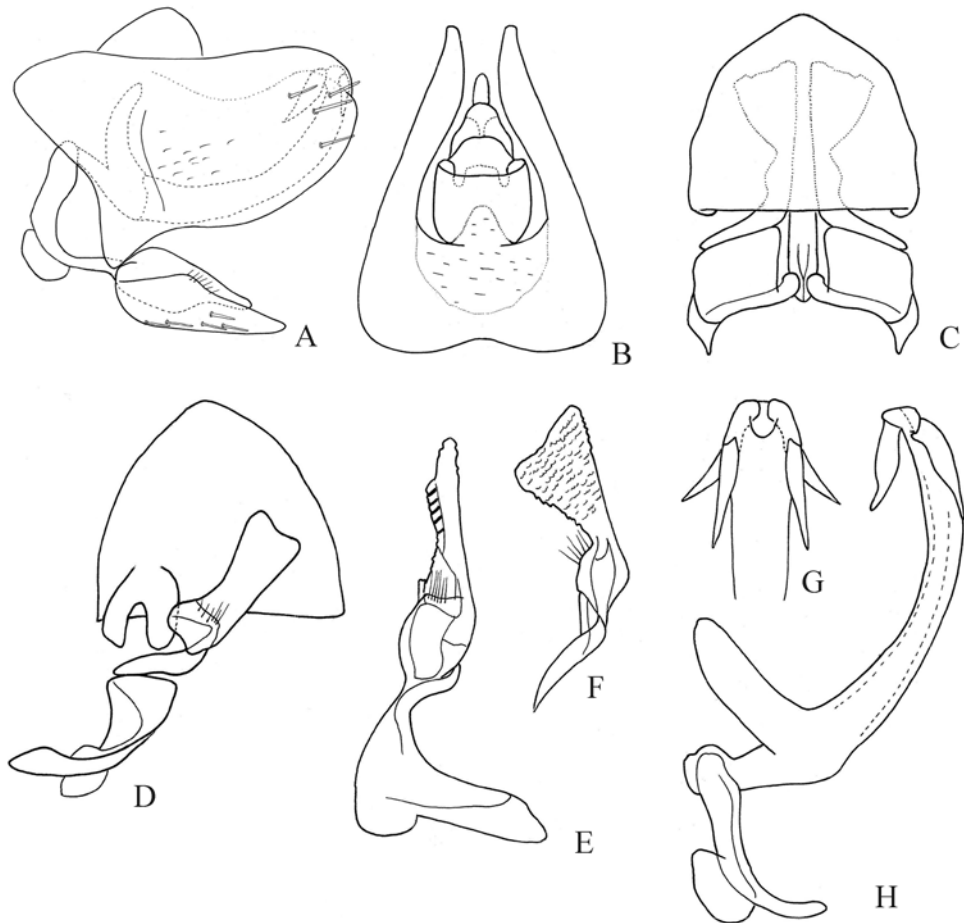


Figure 4. *Goniagnathus (Tropicognathus) quadripinnatus* Dash & Viraktamath (after Khatri & Webb, 2010). A. Male pygofer, lateral view; B. Male pygofer, dorsal view; C. Fused valve and subgenital plates, styles and connective, ventral view; D. Fused valve and subgenital plate, and style, dorsal view; E. Style and connective; F. Apex of style; G. Apex of aedeagus; H. Base of style, connective and aedeagus, lateral view.

***Goniagnathus (Tropicognathus) punctifer* (Walker) (Figs. 6–8), new record to Pakistan**

Bythoscopus punctifer Walker, F., 1858: 104.

Goniagnathus elongatus Lethierry, 1892: 209.

Goniagnathus spurcatus Melichar, 1903: 181.

Goniagnathus punctifer, Distant, 1908: 311; Zhang, 1990: 91; Dash & Viraktamath, 2001: 71.

Goniagnathus (Tropicognathus) punctifer, Duan *et al.*, 2009: 53.

Measurement. Male 5.1–6.4 mm.

Coloration and morphology. Ochraceous. Dorsal surface like vertex, pronotum and scutellum with reddish-brown irregular markings. Crown anterior margin yellow with faint brownish spots. Eyes greyish with margins plus vertical stripes reddish-brown and two blackish horizontal stripes. Face with interrupted black fascia. Forewing ochraceous.

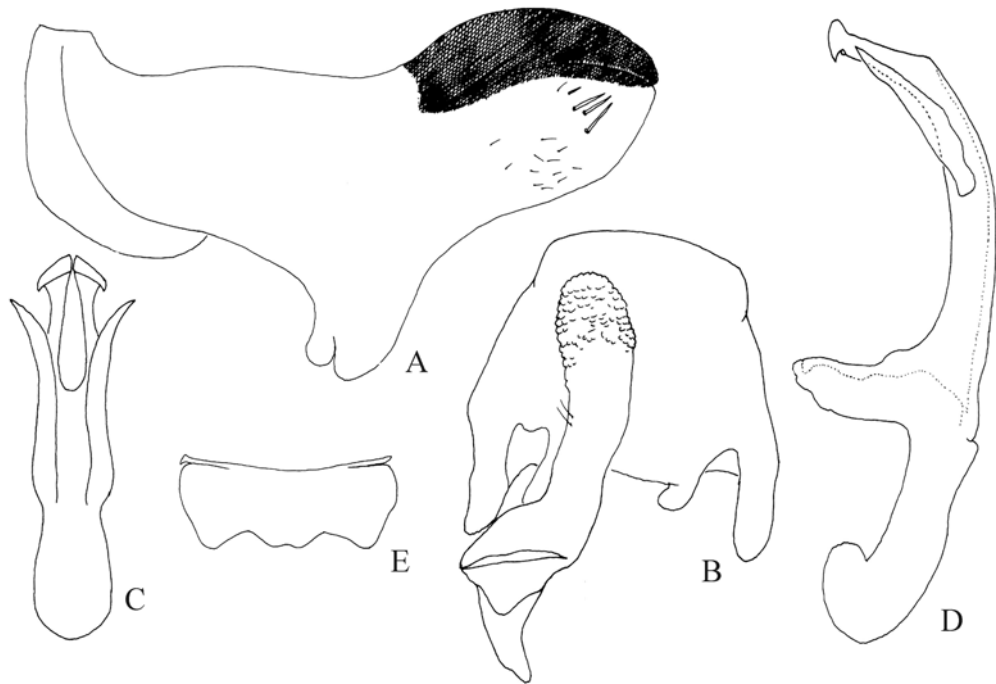


Figure 5. *Goniagnathus (Tropicognathus) nepalicus* Viraktamath & Gnaneswaran (after Viraktamath & Gnaneswaran, 2009). A. Male pygofer lobe, lateral view; B. Fused valve and subgenital plates, and style, dorsal view; C. Aedeagus, caudal view; D. Aedeagus, lateral view; E. Female 7th sternite.

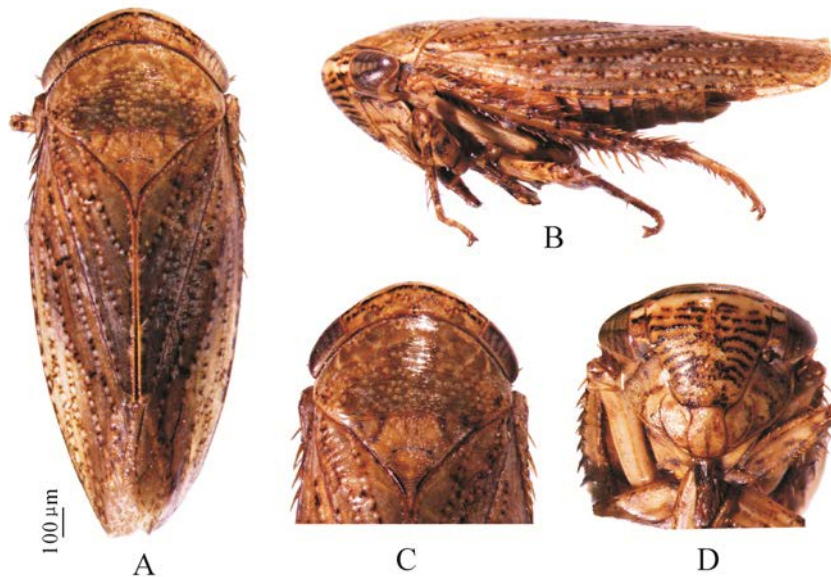


Figure 6. *Goniagnathus (Tropicognathus) punctifer* Walker. A. Habitus, dorsal view; B. Habitus, lateral view; C. Head and thorax, dorsal view; D. Face.

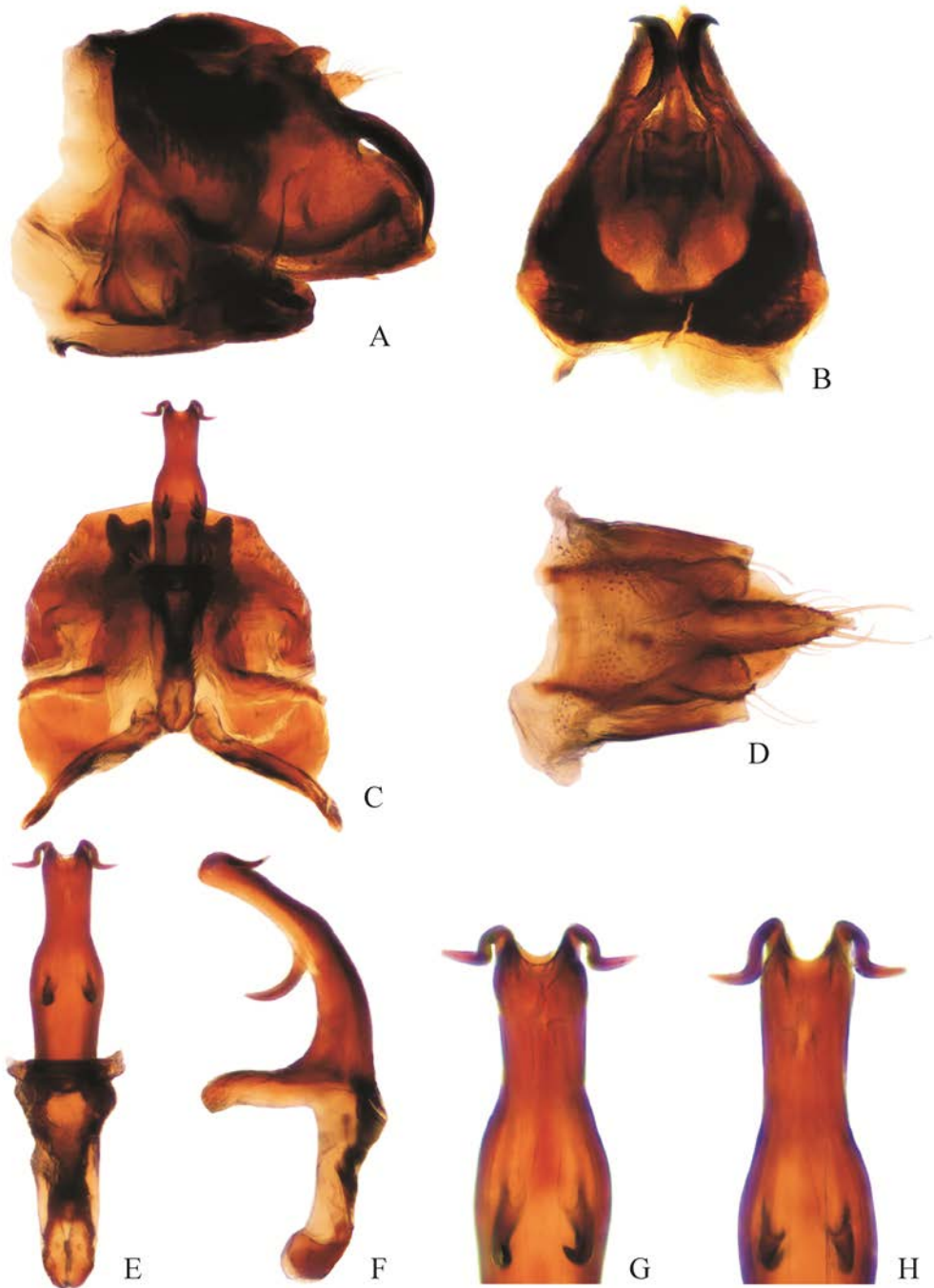


Figure 7. *Goniagnathus (Tropicognathus) punctifer* Walker. A. Male pygofer, lateral view; B. Male pygofer, dorsal view; C. Fused valve plus subgenital plates, style, connective and aedeagus, dorsal view; D. Anal tube, dorsal view; E. Connective and aedeagus, ventral view; F. Connective and aedeagus, lateral view; G. Apex of the aedeagal shaft, dorsal view; H. Apex of the aedeagal shaft, ventral view.

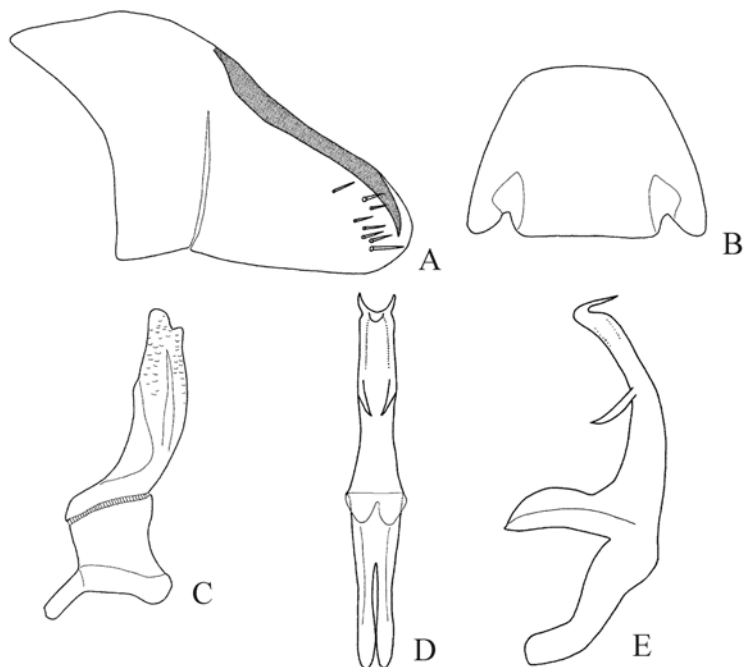


Figure 8. *Goniagnathus (Tropicognathus) punctifer* Walker (after Duan *et al.*, 2009). A. Male pygofer, lateral view; B. Fused valve and subgenital plates, ventral view; C. Style, dorsal view; D. Aedeagus, dorsal view; E. Aedeagus, lateral view.

Crown $5 \times$ broader than median length. Forewing with anteapical cell closed basally.

Genitalia. Pygofer narrowed caudally, with few setae near obtusely rounded caudal lobe. Dorso-caudal appendage black, slender-like, not reaching the caudo-ventral angle. Subgenital plates fused. Valve $2 \times$ broader than median length, caudally narrowed with truncate apex. Style with apophysis bilobed, outer lobe slightly longer than inner lobe. Aedeagal shaft slightly curved with apical pair of processes directed laterally, a median pair of slight asymmetrical curved processes on cephalic margin near mid-length. Gonopore apical. Apodeme prominent. Female 7th sternite $3 \times$ as broad as long with hind margins produced broadly, having a median notch.

Specimen examined. 1♂, **Pakistan**, Islamabad, $33^{\circ}45'50.558''\text{N}$, $73^{\circ}13'31.771''\text{E}$, Sweeping hand net, 23-VII-2018, coll. Bismillah SHAH.

Remarks. This species is similar to *Goniagnathus (T.) nepalicus* in the external coloration but differs from the latter in pygofer, style apophysis bilobed, and aedeagus shape. This species also resembles *Goniagnathus (T.) cornatus*, but can be distinguished by pygofer process not reaching the caudo-ventral angle and aedeagal shaft slightly curved with an apical pair of processes directed laterally.

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