

## **A New Species of *Goniozus* Förster (Hymenoptera: Chrysoidea: Bethyloidea) from India, Parasitizing *Helicoverpa armigera* (Hübner)**

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### **ABSTRACT**

*Goniozus armigeræ* Santhosh and Narendran sp. n. is described and illustrated based on specimens reared from *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) from Himachal Pradesh, India. The new species is compared with other related Oriental species of *Goniozus* Förster. A key to the Oriental species of *Goniozus* with elongate head and no areolet is also provided.

*Key words:* Chrysoidea, Bethyloidea, Himachal Pradesh, taxonomy, key, Oriental region, *Helicoverpa armigera*, Noctuidae.

### **INTRODUCTION**

*Goniozus* Förster 1856, is a cosmopolitan genus of Bethyloidea with the potential of being a biological control agent against various lepidopteran pests (Gordh & Witethom, 1994). Gordh and Móczár (1990) listed 140 nominal species of this genus worldwide and all of them are presumed to be primary external parasitoids of Lepidoptera larvae. *Goniozus* is the most speciose genus of the subfamily Bethyloidea, represented by 50 described species from the Oriental region, of which only 36 species are known from the Indian subcontinent.

In this paper, a new species is described with a key to the 15 species of the genus *Goniozus* with elongate head and no areolet in the forewing, known from Oriental region. This is the first record of a described bethyloid species reared from *Helicoverpa armigera*. Vadivelu *et al.* (1975), Divakar & Pawar, (1982), Divakar *et al.* (1983) reported two undescribed species of *Goniozus* as larval parasitoids of *Helicoverpa armigera* (Hübner) from south India. However, the voucher specimens of these reports are lost and have not been available for study. All the specimens studied were obtained

on loan from the National Insect Collections (NPC), Indian Agricultural Research Institute (IARI), New Delhi, India, and subsequently all the types were deposited there.

## MATERIAL AND METHODS

Measurements and structural terms used here follow Evans (1964), and Terayama (2006). The terms used for integument sculptures are as per Harris (1979) viz: AOL, antero-posterior ocellar line; EV, post orbital distance measured as distance from top of eye to posterior margin of vertex, measured in lateral view; of eye to posterior margin of vertex, measured in lateral view; F1, F2 and F11, funicular segments 1, 2 and 11 respectively; LFW, maximum length of forewing; HE, maximum length of eye in lateral view; LH, maximum length of head from clypeal margin to vertex in full-face view; LM, maximum length of mesosoma excluding pronotal collar in lateral view; LP, length of propodeum measured along midline including posterior declivity in dorsal view; LPD, length of dorsal propodeum disc excluding declivity in dorsal view; M, median vein; OOL, ocello-ocular line; POL, posterior-ocellar line; Rs, radial sector; TL, total length of outstretched specimen from mandibular apex to metasomal apex excluding ovipositor; WF, minimum distance between the eyes in full-face view; WH, maximum width of head including eyes in full-face view; WOT, width of ocellar triangle; WPD, maximum width of the propodeal disc posterior to level of spiracles; SI, fore femur sphericity index.

Fore femur Sphericity Index is calculated using the formula  $SI = (\text{Fore femur Length} \times \text{Fore femur Width}) / (\text{Fore femur Height})^2$  to indicate the overall three-dimensional shape of the fore femur (Aguiar, 2001), where the value 1 indicates a perfect sphere and the increasingly greater values indicate an elongated flattened or compressed fore femur.

The new species is compared with the fourteen described species known from the Oriental region with elongate head (WH equal to or less than  $0.91 \times LH$ ) and a short stub (Rs+M vein) arising from the basal vein, but not forming an areolet.

## RESULTS

***Goniozus armigeræ* Santhosh and Narendran sp. n.** (Figs. 1-4).

*Diagnosis:* Eye setose, mandible and antenna brownish yellow, anterior median propodeal carina connected to posterior transverse carina by smooth line, head elongate, WH  $0.84-0.89 \times LH$ , areolet in forewing absent, clypeal margin obtuse, and scape less than twice pedicel length.

**Description:** Female (Holotype) TL = 2.79mm; LFW = 2.06mm; LH = 0.70mm; WH = 0.63mm; WF = 0.38mm; LM = 0.84mm; LP = 0.38mm; WPD = 0.49mm; LPD = 0.29mm.

**Colour:** Body black; leg with coxa, fore femur, and hind femur testaceous, hind femur lighter than fore femur and coxa, other segments yellow; antenna uniformly yellow except single brownish apical segment; mandible brownish yellow, basal, dorsal and ventral margins brownish, teeth red; wings hyaline, stigma and prostigma testaceous, costa and subcosta light brown, other veins unpigmented.

**Head** (Fig.1): Longer than wide; somewhat flattened 1.5x as long as wide (Fig.2); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; pubescence suberect, short and sparse, longest (0.13 mm) hairs on vertex margin; vertex margin straight, ecarinate; antennal scrobe weakly carinate; mandible moderately stout with four teeth; median lobe of clypeus with obtusely angulate terminal margin; clypeal carina strong, arcuate in profile, extending onto front up to level of posterior margin of scrobe; anterior margin of frontal lobe notched in middle; length of clypeal carina 0.68-0.78x HE; WH 0.84-0.89x LH; WF equal to HE; EV 0.41-0.44x HE; ocular setae minute, sparse, as long as single facet; frontal angle of ocellar triangle obtuse, posterior pair separated from crest of vertex by less than their own diameters; OOL 0.84-0.95x WOT; POL 2.0x AOL; antenna (Fig. 3) as long as head; first 4 antennal segments in ratio of length (width) - 8(5.5): 4.2(3.5): 4(3.3): 4 (3.5); third segment 1.14-1.29x as long as wide.

**Mesosoma** (Fig.1): Short; pronotal disc dull and coriaceous, 0.45x as long as wide, vestiture longer than that of head; mesoscutum rather smooth and shining, only weakly microreticulate with sparse punctures; propodeal disc 0.63x as long as maximum width posterior to spiracles in dorsal view; ratio of maximum width anterior to spiracles to minimum width at posterior margin of dorsal propodeal disc 1.33; complete transverse carina on posterior margin; median basal triangle of propodeal disc smooth and polished, extending beyond mid-level of propodeal disc, connected to posterior transverse carina as a smooth line in microreticulate surface, not elevated as a ridge; other parts of disc and posterior declivity microreticulate; fore femur (Fig.4) length 1.78-1.85x its width. SI = 4.72; mid tibia with a terminal spine slightly longer than half length of basitarsus; forewing (Fig.1) without areolet; median and submedian cells sparsely hairy; Rs+M slightly curved at apex. M:Rs:Rs+M = 9:5:7.

**Metasoma** (Fig.1): Smooth and polished, as long as mesosoma.

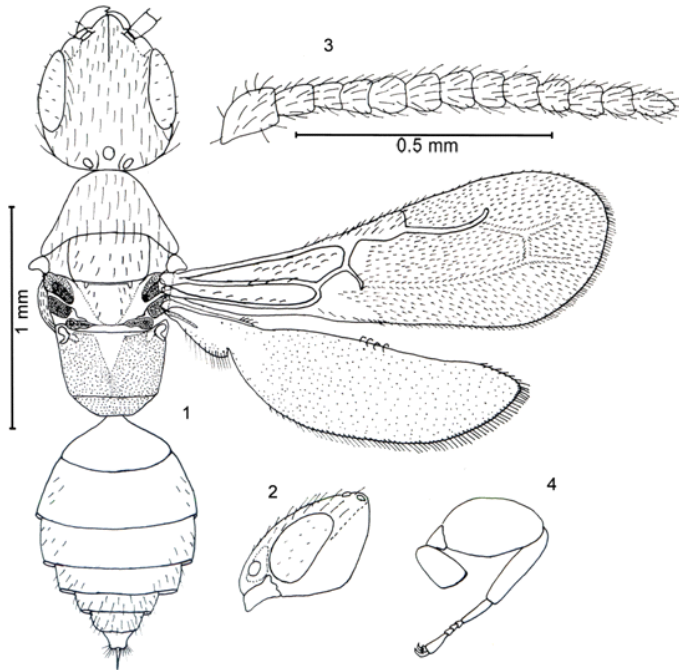
**Male:** Unknown.

*Host:* ex. larvae of *Helicoverpa armigera* (Lepidoptera: Noctuidae).

*Etymology:* Specific epithet is after *armigera*, the host specific epithet,.

*Distribution:* India, Himachal Pradesh.

*Material Examined:* Holotype. Female, India, Himachal Pradesh, Solan, 30°53'N 77°06'E, 1742 m, 06.02.1995; J. N. Thakur (NPC, Cabinet No. 0116 Tag. No. 4181-85/95). Paratype - 4 females, same data as Holotype (NPC, Cabinet No. 0116 Tag. No. 4181-85/95). All types are deposited at the National Insect Collections (NPC), Indian Agricultural Research Institute (IARI), New Delhi, India.



Figures 1-4. *Goniozus armigerae* Santhosh and Narendran sp. n.; Female. 1. body in dorsal view; 2. head in lateral view; 3. antenna; 4. foreleg.

*Remarks:* *Goniozus armigerae* sp. n. is similar to *G. chatterjii* Kurian, 1955, but in *G. armigerae* sp. n. the mandible is brownish yellow in colour, EV 0.41-0.44x HE, and the propodeal triangle is connected to the transverse carina by a smooth line, whereas in *G. chatterjii* mandible is reddish brown in colour, EV 0.25x HE, and the anteromedial propodeal smooth triangle is connected to the posterior transverse carina by a raised median carina. This species is also similar to *G. japonicus* Ashmead 1904, but in *G. armigerae* sp. n. the clypeal margin is obtusely angulated, the posterior transverse carina is complete, eye setose, and the anteromedial smooth propodeal

triangle is connected to the transverse carina by a median smooth line, whereas in *G. japonicus* the clypeal margin is acutely angulated, the posterior transverse carina of propodeum is evanescent in the middle, the eye bare, and the anteromedial smooth propodeal triangle is connected to the posterior margin by a smooth blotch.

**Key to species of the genus *Goniozus* with elongate head and no areolet from Oriental region (Female).**

- 1. Clypeal carina absent..... *G. fulgidus* Krombein
- Clypeal carina present..... 2
- 2 (1). Length of Rs+M vein equal to or more than M; anterior medial propodeal triangle well developed; head smooth and shiny..... *G. philippinensis* Ashmead
- Length of Rs+M vein shorter than M; other characters not in above combination, partly or completely different..... 3
- 3 (2). Parapsidal furrows absent; clypeal margin obtuse; clypeal carina weak; head in dorsal view coriaceous; scape as long as the Pedicel + F1; Pedicel, F1, and F11 longer than wide, other segments wider than long; propodeal disc shorter than scutellum and mesonotum combined..... *G. borneanus* Cameron
- Parapsidal furrows present; other characters not in above combination, partly or completely different..... 4
- 4 (3). Pedicel shorter than F1..... 5
- Pedicel as long as or longer than F1 ..... 8
- 5 (4). Clypeal margin acute; mandible yellow..... *G. keralensis* Gordh
- Clypeal margin obtuse; mandible reddish brown or black..... 6
- 6 (5). Anteromedial propodeal triangle elevated and well developed, connected to posterior margin by a weak short carina..... *G. hanoiensis* Gordh
- Anteromedial propodeal triangle weak or absent; no median short carina on propodeal disc..... 7
- 7 (6). Clypeal carina weak; mandible black; posterior propodeal transverse carina evanescent in middle..... *G. thailandensis* Gordh & Witethom
- Clypeal carina strong and acute; mandible reddish brown; posterior propodeal transverse carina complete..... *G. pakmanus* Gordh
- 8 (4). Length of scape less than 2x pedicel..... 9
- Length of scape equal to or more than 2x pedicel ..... 12

- 9 (8). Mandible reddish brown..... 10  
 - Mandible yellow or yellowish brown..... 11
- 10 (9). Head shiny, very weakly coriaceous; body light brown; EV 0.43x HE..... *G. rutherfordi* Krombein  
 - Head coriaceous; body black or dark reddish brown; EV 0.25x HE.....  
 ..... *G. chatterjii* Kurian
- 11 (9). Clypeal margin obtuse; eye setose; posterior propodeal carina complete  
 ..... *G. armigerae* sp. n  
 - Clypeal margin acute; eye bare; posterior propodeal carina evanescent in  
 middle..... *G. japonicus* Ashmead
- 12 (8). Anteromedial propodeal triangle absent..... *G. marianensis* Terayama  
 - Anteromedial propodeal triangle well developed..... 13
- 13 (12). Mandible reddish brown; OOL nearly twice as long as WOT; pedicel longer  
 than F1..... *G. sinicus* Xiao & Wu  
 - Mandible yellow or yellowish brown; OOL subequal to WOT; pedicel as long as  
 F1..... 14
- 14 (13). Clypeal margin obtuse; eye asetose; propodeal disc 0.63x as long as wide,  
 without posterior transverse carina; median and submedian cells with numerous short  
 hairs..... *G. lamprosemae* Xu, He & Terayama  
 - Clypeal margin acute; eye with minute erect setae; propodeal disc 0.54x as long as  
 wide, with complete posterior transverse carina; median and submedian cells without  
 hairs..... *G. baishanzuensis* Xu, He & Terayama

## DISCUSSION

The bethylid fauna of the Indian subcontinent is interesting, but the current nomenclatural and taxonomic conditions must be improved before reaching a conclusion on either endemism or relationships with other geographic regions (Gordh, 1986). Among the 50 species of *Goniozus* known from the Oriental region, 34 species are without an areolet in the forewing.

Since *Goniozus ahmeadi* Kurian, 1955 is based on a male specimen and is only known from the type, it is not included in table 1. Though the configuration and concomitant ratios of the head differ between the sexes, the propodeal sculpture remains consistent. *G. ahmeadi* with the long anterior median propodeal triangle reaching the

posterior margin and the absence of a transverse propodeal carina is different from all other related species.

*Goniozus* species that emerged from *Helicoverpa* (= *Heliothis*) *armigera* have previously been recorded from the regions of Coimbatore, Tamil Nadu (Vadivelu *et al.* 1975), and from the maize fields of Bangalore, Karnataka (Divakar & Pawar, 1982, Divakar *et al.* 1983), but none of them were described. These undescribed species may be conspecific with *G. armigerae* sp. n., but voucher specimens of the previous records were not available for verification.

Table 1. Coding of the diagnostic characters of *Goniozus* species with elongate head and no areolet (based on females).

Taxa	1	2	3	4	5	6	7	8	9	10	11	12
<i>G. chatterjii</i> Kurian, 1955	0	1	0	2	1	1	0	1	0	0	0	0
<i>G. armigerae</i> Santhosh & Narendran sp. n.	0	1	0	0	0	1	1	1	0	0	1	0
<i>G. japonicus</i> Ashmead, 1904b	0	0	0	1	0	1	0	1	0	1	2	0
<i>G. borneanus</i> Cameron, 1910	1	1	0	0	?	?	?	1	0	?	2	0
<i>G. baishanzuensis</i> Xu, He & Terayama, 2002	1	0	0	2	1	0	1	1	0	0	2	0
<i>G. keralensis</i> Gordh, 1986	0	0	0	1	0	0	0	?	0	1	0	0
<i>G. lamprosemae</i> Xu, He & Terayama, 2002	1	1	0	2	1	0	1	1	0	2	2	0
<i>G. marianensis</i> Terayama, 1994	0	1	0	0	?	0	0	1	1	0	2	0
<i>G. sinicus</i> Xiao & Wu, 1987	0	1	0	0	1	0	?	1	0	?	?	0
<i>G. hanoiensis</i> Gordh, 1993	0	1	0	1	1	0	0	1	0	?	0	0
<i>G. fulgidus</i> Krombein, 1996	2	1	1	2	1	1	1	?	?	0	?	0
<i>G. rutherfordi</i> Krombein, 1996	0	?	1	2	1	1	0	?	0	0	3	1
<i>G. pakmanus</i> Gordh, 1984	0	1	1	0	2	0	?	0	1	0	3	0
<i>G. philippinensis</i> Ashmead, 1904a	1	?	1	1	?	?	?	0	0	1	1	0
<i>G. thailandensis</i> Gordh & Witethom, 1994	1	1	1	1	2	0	1	1	2	1	3	0

Characters and their status used in the comparison of *Goniozus* species with elongate head and no areolet (based on females).

1. Clypeal carina. strong and extends caudad between scrobes (0); weak and restricted to clypeus (1); absent (2).

2. Clypeal margin. acute (0); obtuse (1); unknown (?)

3. Head. strongly coriaceous (0); shiny, weakly coriaceous (1).

4. Antenna. uniformly yellow to yellowish brown (0); yellow with apical segments fuscous (1); reddish brown (2).
5. Mandibles. yellow or brownish yellow (0); reddish brown (1); black (2); unknown (?).
6. Scape. as long as or longer than 2x pedicel (0); shorter than 2x pedicel (1); unknown (?).
7. Eyes. bare (0); setose (1); unknown (?).
8. Length of Rs+M vein. as long as or longer than M (0); shorter than M (1); unknown (?).
9. Anterior medial smooth propodeal triangle. well developed (0); weak (1); absent (2); unknown (?).
10. Posterior propodeal carina. complete (0); evanescent in middle (1); absent (2); unknown (?).
11. Connection between propodeal smooth triangle to posterior margin. by median carina (0); by smooth line (1); by smooth blotch (2); absent (3); unknown (?).
12. Body. black or dark reddish brown (0); light brown (1).

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