



ISSN 2320-7078

JEZS 2014; 2 (6): 165-171

© 2014 JEZS

Received: 18-10-2014

Accepted: 27-10-2014

Sweta Rawat

Department of Entomology, G.B.
Pant University of Agriculture
and Technology, Pantnagar-
263145, U.S. Nagar
(Uttarakhand), India.

M.A. Khan

Department of Entomology, G.B.
Pant University of Agriculture
and Technology, Pantnagar-
263145, U.S. Nagar
(Uttarakhand), India.

Meena Agnihotri

Department of Entomology, G.B.
Pant University of Agriculture
and Technology, Pantnagar-
263145, U.S. Nagar
(Uttarakhand), India.

Taxonomic studies of five redescribed species of Eulophid parasitoids (Hymenoptera: Eulophidae: Eulophinae) collected from Uttarakhand

Sweta Rawat, M.A. Khan and Meena Agnihotri

Abstract

Eulophidae is a large family of the superfamily Chalcidoidea and comprises promising biocontrol agents for the control of insect pests causing harm to agricultural ecosystem. The present study has been done to provide the account and occurrence of 4 genera belonging to subfamily Eulophinae (Hymenoptera: Eulophidae) and Entedoninae (Hymenoptera: Eulophidae) viz., *Diglyphus* Walker, *Euplectrus* Westwood, *Dicladocerus* Westwood of Eulophinae subfamily and *Pediobius* Walker of Entedoninae subfamily comprising of 3 species of Eulophinae viz., *Diglyphus horticola* Khan, *Euplectrus bristilis* Khan, *Dicladocerus viggianii* Khan and 2 species of Entedoninae viz., *Pediobius antennalis* Khan and *Pediobius scutularis* Khan collected from Pantnagar, Uttarakhand (India).

Keywords: Hymenoptera, Chalcidoidea, Eulophidae, Eulophinae, Entedoninae, Uttarakhand.

1. Introduction

India is among the twelve mega bio-diversity countries of the world. Hymenoptera (ants, bees, and wasps) are one of the few megadiverse insect orders. Among the parasitic Hymenoptera, wasps in the superfamily Chalcidoidea are ecologically and economically the most important insects for the control of other insect populations^[1]. Among these insects, the members of the family Eulophidae is ecologically and economically most important parasitoids from controlling crop pests. Eulophidae is large family of super family chalcidoidea consisting of about 350 genera and more than 3,000 species^[2].

Fauna of Eulophidae is relatively rich, especially in the genera. Some genera include numerous species, and eulophids are present in all land ecosystems, individual species often in great numbers. Most of the species are entomophagous. The Eulophid subfamily Eulophinae includes species which mainly develop as ectoparasites of various insects burrowing or mining plant tissues, including leaf-miners. Of the four recognized subfamilies of Eulophidae the Entedoninae is certainly the most derived one. It seems to be derived from some ancestral forms close to the present Eulophinae, but not very close to Tetrastichinae or Euderinae. Most possibly all species are endoparasites, often attacking eggs or young larvae of mainly Coleopterous, Lepidopterous and Dipterous hosts developing in plant tissues. Only few species (e.g. *Pediobius*) attack pupae, then often as hyperparasites^[3]. The exact biological data are still rather scarce, mainly because of the difficulties in identification. Thus, knowledge of sound taxonomy is the most important cornerstones to the biological control. The present work on taxonomic studies on parasitoids of subfamily Eulophinae (Eulophidae: Hymenoptera) and Entedoninae (Eulophidae: Hymenoptera) has been carried out to collect information on taxonomic biodiversity and biology of parasitoids.

2. Material and methods

Taxonomic studies on parasitoids cannot be done correctly without fresh material acquired by collection and rearing. During the course of investigation, collection and rearing was done throughout the year during 2013 from Pantnagar region of Uttarakhand (India).

Collections of different hymenoptera parasitoids were made by visiting various fields of important agricultural and horticultural crops including the nearby forest areas in the vicinity of Pantnagar and other nearby areas. Different stages of various host insects including eggs were detached along with the plant parts on which they were attached to.

Correspondence:

Sweta Rawat

Department of Entomology,
G.B. Pant University of
Agriculture and Technology,
Pantnagar-263145, U.S. Nagar
(Uttarakhand), India.

These stages were then reared in glass jars and plastic vials in constant temperature cabinet running at 70 °F and with 70 percent RH, otherwise the parasitoids were reared under room temperature and a complete record was maintained. The information recorded consisted of number of parasitoids emerged, per parasitisation, host insect, host plant, date of collection, locality and date of emergence. Permanent slides of the preserved specimens were made by following the normal process of dehydration, clearing and dissection was made in the clove oil, various dissected parts were placed on a micro slide in a drop of Canada balsam and thus mounting was made under 22 mm cover slip to enable a detailed study of the different morphological structures. The length of whole specimen is given in millimeters; all other measurements are relative and were taken directly from the divisions of a linear scale of a micrometer placed in the eye piece of a compound microscope for slide mounted parts. Body colour of insect was noted before clearing and mounting the specimen on slide in balsam. The permanent slides were examined under Trinocular microscope in order to make drawings and detailed study of each structure with the help of Camera Leucida. The terminology given by Gibson (1997) and Graham (1987) is followed in this paper. OOL, ocellar-ocular distance; POL, post-ocellar distance; SMV, submarginal vein; MV, marginal vein; PMV, Post marginal vein; F1, F2,...., funicle segments 1, 2,....; C1-3, claval segments. This approach has revealed some characters which otherwise are likely to be overlooked in tag dry mount specimens. For description of eulophid parasitoids conventional terminology has been adopted.

3. Results and Discussion

3.1 Subfamily- Eulophinae

3.1.1 Genus: *Diglyphus* Walker

(Type species: *Diglyphus poppoea* Walker)

Redescription of the species.

3.1.1.1 *Diglyphus horticola* Khan (PLATE -1, Fig.1-7)

Female : Body length 1.58 mm; body colour dark brown with golden reddish tinge; body narrow; head brown and eyes red; antennae symmetrically brown; thorax dark brown, fine reticulate sculpture, bearing some long setae; wings hyaline; Coxa dark brown colour with golden reddish tinge, femur and tibia have a pattern of dark brown and white colour. Tarsi segments are light brown except last segment brown coloured; gaster sessile, elongate.

Head: Wider than long in frontal aspect (0.44: 0.36), head frontal grooves present; frontovertex width slightly more than ½ the total head width (0.23: 0.44); POL slightly shorter than OOL (0.06: 0.07); compound eyes small, antennal toruli situated just at the lower level of eye margin; malar sulcus straight; mandibles pentadentate with three sharp teeth, the inner two short and saw-like; lower margin of clypeus broad.

Antenna : 7 segmented excluding 2 anelli; antennal formula 11223; scape cylindrical, 6 times as long as wide (0.22: 0.04), pedicel more than 2 times as long as wide (0.08: 0.03) and shorter than the length of the FS1; funicle 2 segmented, FS1 is 2 times as long as wide (0.10: 0.05), FS2 slightly longer than wide (0.07: 0.06); club 3 segmented, less than 3 times as long as wide (0.19: 0.07), larger than preceding two funicle segments combined (0.20: 0.18).

Thorax : Anterior margin convex of pronotum, with projected corners; mesoscutum as wide as long (0.29: 0.29); mesoscutum having 2 pairs of setae, notauli incomplete, axilla slightly advanced; axillae not meeting to each other at mid of transcutal articulation; axillae well defined; scutellum smaller than mesoscutum (0.20: 0.29), as wide as long (0.20: 0.20); with longitudinal grooves and 3 pairs of setae situated on scutellum; metanotum broad; propodeum without median carina and with paraspicular carinae; spiracle rim exposed.

Fore wings: 3 times as long as wide (1.55: 0.52); longer than hind wing length (1.55:1.30); costal cell long, broad; SMV with 5 setae directed upwards, longer (0.48) than MV (0.25); MV bearing small setae on front edge; PMV more longer than SV (0.15: 0.12); marginal fringe medium; basal vein present; cubital vein present, subcubital line of hairs also present.

Hind wings: More than 4 times longer than wide (1.20: 0.03) with a tapering apex; 3 hooklets present; wing length more than two times the length of vein (1.20: 0.18).

Fore Legs: Fore Legs hairy, tibial spur short;

Mid legs: Tibial spur small; spur shorter than basitarsi.

Hind legs: Hind legs hairy; spur short.

Gaster: Elongate; brown coloured with golden reddish reflection, metasoma longer than mesosoma, ovipositor sheaths exerted; second valvifer long; third valvulae short; outer plate is broader at anterior portion, outer plates narrow at the base.

Materials studied

13 female one dissected and mounted on a slide, India, Uttarakhand., Pantnagar, Mustard, 28 -1-2012 .Hym. Eulo. Nr. S14 (Sweta Rawat).

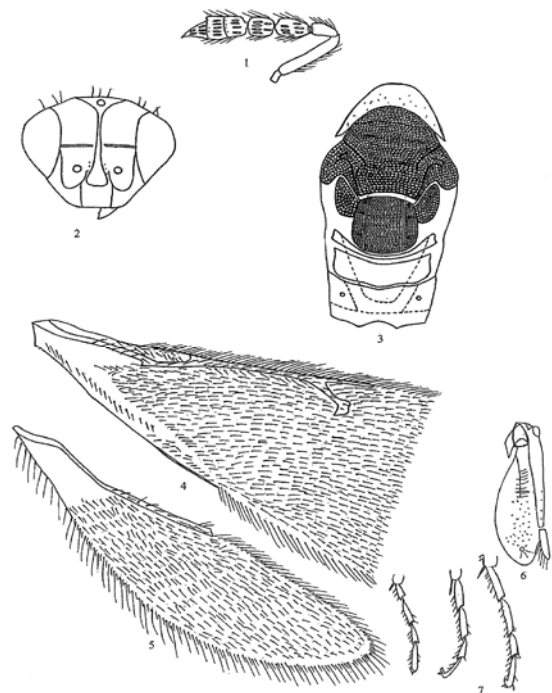


Plate 1: FIGURES (1-7). *Diglyphus horticola* Khan female 1. Antenna; 2. Head in frontal view; 3. Thorax; 4. Fore wing; 5. Hind wing; 6. ovipositor; 7. Legs (Fore leg, Mid leg and Hind leg).

3.1.2 Genus *Euplectrus* Westwood

(Type species: *Euplectrus maculiventris* Westwood)

Redescription of the species.

3.1.2.1 *Euplectrus bristilis* Khan *et al.*, (PLATE -2, Fig.1-10)

Female (Fig.1-10). Body length 1.79 mm; body colour; head dark brown and eyes reddish brown; antennae uniformly light yellow in colour; thorax dark brownish black, wings hyaline; legs uniformly yellow in colour; gaster dark brown in colour.

Head (Fig. 2): Wider than long in frontal aspect (0.61: 0.46); frontovertex width less than $\frac{1}{2}$ the total head width (0.39: 0.61); ocelli arranged in obtuse angled triangle; compound eyes small, antennal toruli situated just at the lower level of eye margin; malar sulcus absent; malar space larger than eye width (0.17: 0.11); mandibles bidentate, maxillary and labial palp 2 and 1 segmented respectively; lower margin of clypeus broad.

Antenna (Fig. 1): 8 segmented excluding 2 anelli; 1, 1, 2, 4, 2; scape cylindrical, slightly swollen, more than 3 times as long as wide (0.23: 0.07); pedicel slightly less wide as long (0.04: 0.06) and shorter than the length of the FS1 (0.06: 0.11); funicle 4 segmented, FS1 slightly more than 2 times as long as wide (0.11: 0.05), FS2 slightly more longer than wide (0.11: 0.08), FS3 slightly more longer than wide (0.08: 0.07), FS4 as long as wide (0.08: 0.08); club 2 segmented, more than 2 times as long as wide (0.16: 0.07), slightly shorter than preceding two funicle segments combined.

Thorax (Fig. 5): Pronotum bearing 1 pair margins of setae at its anterior margin, anterior margin convex; with/without projected corners; mesoscutum more than $1\frac{1}{2}$ times as wide as long (0.52: 0.33); mesoscutum having scattered setae, axilla somewhat triangular in shape; axillae meeting to each other at mid of transcutal articulation; scutellum smaller than mesoscutum (0.23: 0.33), wider than long (0.34: 0.23) with blunt apex and three pairs of setae situated on scutellum; metanotum is broad in the mid; propodeum with prominent median carina, submediand carinae and plicae; spiracle rim fully exposed.

Fore wings (Fig. 9): More than 2 times as long as wide (1.95: 0.80); less than $1\frac{1}{2}$ times longer than hind wing length (1.95: 1.44); costal cell long, broad; SMV with 4 setae directed upwards, shorter (0.46) than MV (0.76); MV bearing long setae on front edge; PMV slightly longer than SV; marginal fringe short; basal vein present with 4 hairs; cubital vein present, subcubital line of hairs also present.

Hind wings (Fig. 8): More than 4 times longer than wide (1.44: 0.33) with blunt apex; vein length (0.91: 1.44) more than one half the length of wing.

Fore Legs (Fig. 10): Fore legs with 4 strong hairs on the first tarsi segment;

Mid legs (Fig. 10): Tibial spur medium, slightly shorter than basitarsi.

Hind legs (Fig. 10): Two long tibial spurs present, longest tibial spur is longer than first basal segment.

Gaster: ovate; petiole is as long as wide (0.12: 0.12); metasoma as long as wide (0.78: 0.78); first valvifer is

triangular distinctly; second valvifer long (0.39); third valvifer (0.08) with uniform width; ovipositor (Fig. 7) sheath exerted, one pair of cercal setae long and remaining small; gaster wider on anterior region with pointed tip at the posterior region.

Material Examined. 2 female one dissected and mounted on a slide, India, Uttarakhand., Pantnagar, Cowpea, 24-9-2012. Hym. Eulo. Nr. S22 (Sweta Rawat).

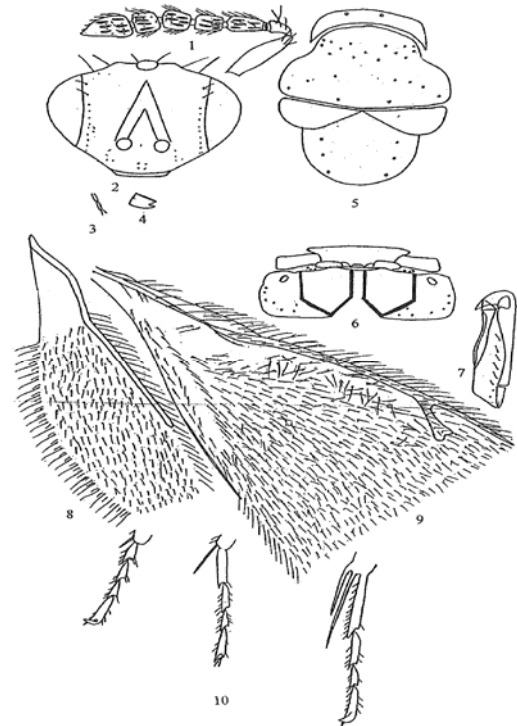


Plate 2. FIGURES (1-10). *Euplectrus bristilis* Khan *et al.*, female 1. Antenna; 2. Head in frontal view; 3. Maxillary palp; 4. Mandible; 5. Thorax; 6. Propodeum; 7. Ovipositor; 8. Hind wing; 9. Fore wing; 10. Legs (Fore leg, Mid leg and Hind leg)

3.1.3 Genus *Di cladocerus* Westwood

(Type species: *Di cladocerus westwoodii* Westwood)

Redescription of the species.

3.1.3.1 *Di cladocerus viggianii* Khan (PLATE -3, Fig.1-7)

Female (Fig. 1-7): Body length 2.28 mm; body colour dark blackish brown; head dark brown and eyes silvery; antennae uniformly brown in colour; thorax dark brown, wings hyaline; legs coax, femur and tibia dark brown; tarsi segments light yellow; gaster dark brown, elongate, petiolate.

Head (Fig. 2): wider than long in frontal aspect (0.56: 0.45), head frontal grooves present; frontovertex width more than $\frac{1}{2}$ the total head width (0.29: 0.56); ocelli arranged in obtuse angled triangle; POL slightly more/less than 2 times as long as OOL; antennal toruli situated just at the lower level of eye margin; malar sulcus absent; malar space larger than eye width; mandibles bidentate with acute teeth and serration, maxillary and labial palp 2 and 1 segmented respectively; lower margin of clypeus broad.

Antenna (Fig. 1): 8 segmented excluding 1 anellus, 1,1,1,3,3; apical tip of antenna without spicule scape, cylindrical with numerous sensilla, 6 times as long as wide (0.25: 0.04); pedicel less than 2 times as long as wide (0.09: 0.05) and

shorter than the length of the FS1; funicle 3 segmented, FS1 2 times as long as wide (0.12: 0.06), FS2 longer than wide (0.10: 0.07), FS3 slightly longer than than wide (0.05: 0.04); club 3 segmented, more than 2 ½ times as long as wide (0.21: 0.08), longer than preceding two funicle segments combined.

Thorax (Fig. 3): Pronotum with scattered setae at its margins of setae at its posterior margin; mesoscutum 1½ times as wide as long (0.37: 0.30); mesoscutum having scattered setae, notauli complete, axilla slightly advanced; axillae not meeting to each other at mid of transcutal articulation; scutellum smaller than mesoscutum (0.23: 0.31), wider than long (0.25: 0.23) without longitudinal grooves and 3 pairs of setae situated on scutellum; metanotum broad in the mid; propodeum with median carina spiracle rim fully exposed.

Fore wings (Fig. 4): Less than 3 times longer than wide (1.76: 0.71); more than 2 times longer than hind wing length; coastal cell long, broad, setose; SMV with number of setae, longer (0.60) than MV (0.44); MV bearing small setae on front edge; PMV less than 2 times longer than SV (0.19: 0.12); marginal fringe medium; basal vein present with 6 setae; cubital vein present, subcubital line of hairs also present.

Hind wings (Fig. 5): More than 4 times as long as wide (1.33: 0.33) with tapering apex; vein length more than one half the length of wing (0.81: 1.33).

Fore Legs (Fig. 6): Strong hairs on the tarsal segments, tibial spur shorter than basitarsi.

Mid legs (Fig. 6): Legs are hairy, tibial spur almost half the basitarsi.

Hind legs (Fig. 6): Legs are very hairy, 4 pegs present.

Gaster: Elongate, petiolate; less than 1½ times as wide as long (0.55: 0.82), gaster surface hairy, metasoma shorter than mesosoma (0.82: 1.20); first valvifer triangular, second valvifer long (0.85), third valvifer long (0.16); outer plates of ovipositor (Fig. 7) distinctly shorter than valvifer third; ovipositor sheaths slightly exerted; cercal setae long.

Material Examined. 2 female one dissected and mounted on a slide, India, Uttarakhand., Pantnagar, H.R.C., sweepnet collection, Ber orchard, 23-3-2012. Hym. Eulo. Nr. S02 (Sweta Rawat).

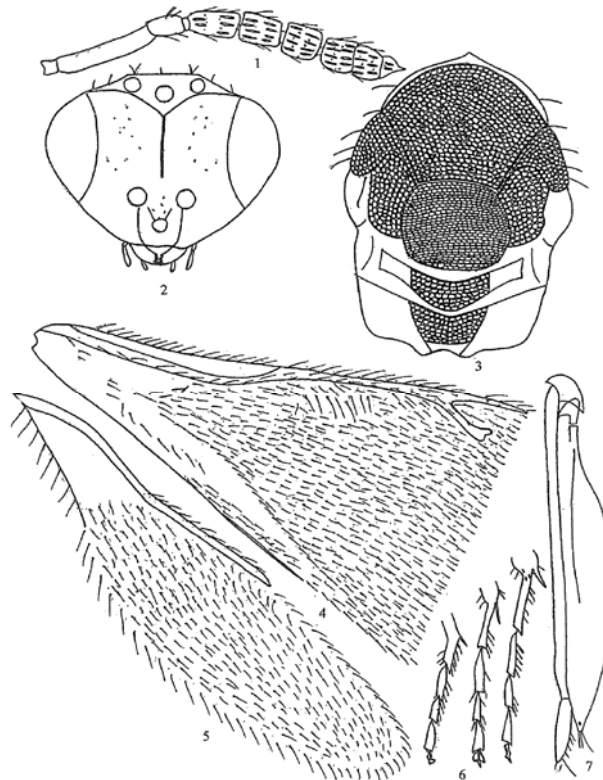


Plate 3: FIGURES (1-7). *Di cladocerus viggianii* female 1. Antenna; 2. Head in frontal view; 3. Thorax; 4. Fore wing; 5. Hind wing; 6. Legs (Fore leg, Mid leg and Hind leg); 7. Ovipositor.

3.2 Subfamily- Entedoninae

3.2.1 Genus: *Pediobius* Walker

(Type species: *Entedon (Pediobius) imbrues* Walker)

Redescription of the species.

3.2.1.1 *Pediobius scutellaris* Khan et al., (PLATE -4, Fig.1-7)

Female (Fig. 1-7): Body length 2.59 mm; body colour black with green metallic lusture; head black and eyes brown; antennae symmetrically brown in colour; thorax black with

green metallic reflection, finely reticulated; wings hyaline; legs black with green metallic reflection except the tarsi milky white in colour ; gaster, elongate, black with green lusture.

Head (Fig. 2): Wider than long in frontal aspect (0.53: 0.43) head frontal grooves present; frontovortex width slightly more than 1 ½ the total head width (0.53: 0.29); antennal toruli situated just at the lower level of eye margin; malar sulcus

absent; malar space shorter than eye width (0.08: 0.01); mandibles bidentate, maxillary and labial palp 1 and 1 segmented respectively; lower margin of clypeus broad.

Antenna (Fig. 1): 7 segmented excluding 2 anelli, 1,1,2,3,2; scape cylindrical, slightly more than 4 times as long as wide (0.05: 0.22); pedicel 2 times as long as wide (0.06: 0.03) and larger than the length of the FS1; funicle 3 segmented, FS1 more than 2 times as long as wide (0.10: 0.04), FS2 less than 2 times as long as wide (0.07: 0.04), FS3 less than 1½ times as long as wide (0.04: 0.06); club 2 segmented, more than 3 ½ times as long as wide (0.17: 0.04), larger than preceding two funicle segments combined (0.17: 0.15).

Thorax (Fig. 3): Pronotum sculpture mesoscutum wider than long (0.19: 0.17); mesoscutum having 2 pairs of setae, notauli incomplete, axilla slightly advanced; axillae not meeting to each other at mid of transcutal articulation; scutellum longer than mesoscutum, less than 1 ½ times as wide as long 0.25: 0.27) without longitudinal grooves and 1 pair of setae situated on scutellum; metanotum is medium; propodeum with median carina and with paraspicular carinae; spiracle rim exposed.

Fore wings (Fig. 4): Less than 3 times as long as wide (1.47: 0.56); less than 1 ½ times longer than hind wing length (1.47:1.08); coastal cell short, narrow; SMV with 2 long dorsal setae directed upwards shorter (0.31) than MV (1.20); MV

bearing long setae on front edge; PMV slightly longer than SV (0.07 : 0.05); SV with four unicus marginal fringe long; basal vein present with three setae; cubital vein present, subcubital line of hairs also present.

Hind wings (Fig. 5): more than 4 times as long as wide (1.08: 0.26) with blunt apex; vein length less than the length of wing (0.17: 1.08).

Fore Legs, Mid legs, Hind legs (Fig. 6): Legs not very hairy; coxa, femur tibia are black with green metallic reflection except tarsi milky white in colour.

Gaster: elongate; petiolate; more than 2 times as wide as long, gaster surface hairy, metasoma longer than mesosoma (1.52: 0.59); ovipositor (Fig. 7) sheaths slightly exerted, first valvifers triangular; second valvifer (0.65) more than 6 times as long third valvulae (0.06), anterior margin of basal part of second valvifers not much curved; third valvulae very short (0.06); cercal setae medium, outer plate somewhat of uniform width.

Material Examined. 5 female one dissected and mounted on a slide, India, Uttarakhand., Pantnagar, Outside biocontrol lab, Sweepnet collection near castor plantation,30-2-2012.Hym. Eulo. Nr. S15 (Sweta Rawat).

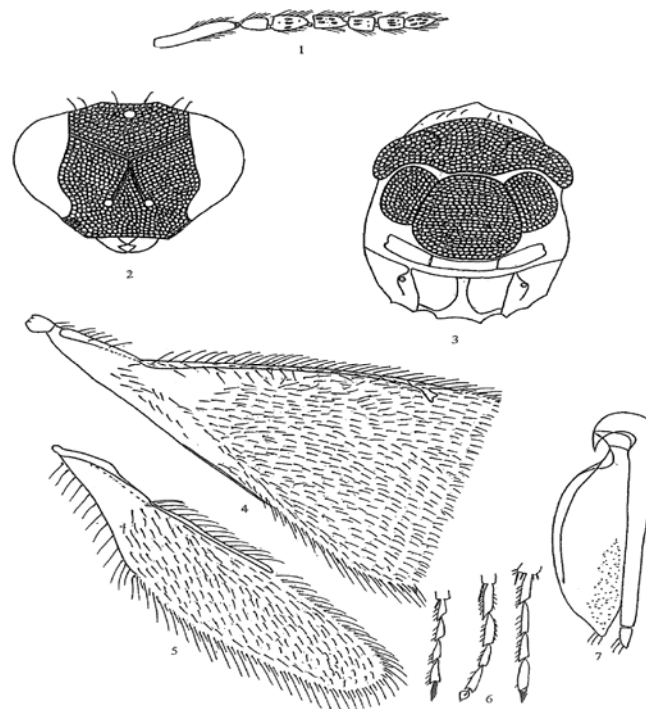


Plate 4. FIGURES (1-7). *Pediobius scutellaris* Khan et al., female 1. Antenna; 2. Head in frontal view; 3. Thorax; 4. Fore wing; 5. Hind wing; 6. Legs (Fore leg, Mid leg and Hind leg); 7. Ovipositor.

Redescription of the species.

3.2.1.2 *Pediobius antennalis* Khan et al., (PLATE -5, Fig.1-7)

Female (Fig. 1-8): Body length 1.97 mm; body colour dark brown with metallic lusture; head dark brown and eyes red ;

antennae symmetrically brown in colour except scape white in colour; thorax dark brown with metallic reflection, finely reticulated; wings hyaline; legs uniformly milky white in colour; gaster, dark brown broad and tapering towards the end.

Head (Fig. 2): Wider than long in frontal aspect (0.35: 0.32); frontovertex width slightly more than 1 ½ the total head width (0.22: 0.39); POL slightly more than 2 times as long as OOL (0.09: 0.04); antennal toruli situated just at the lower level of eye margin; malar sulcus absent; malar space shorter than eye width (0.08: 0.11); mandibles bidentate (Fig. 3); lower margin of clypeus broad.

Antenna (Fig. 1): 7 segmented excluding 1 anellus, 1,1,1,3,2; scape cylindrical, slightly more than 4 times as long as wide (0.18: 0.04); pedicel 2 times as long as wide (0.02: 0.04) and slightly shorter than the length of the FS1 (0.04: 0.05); funicle 3 segmented, FS1 slightly longer than 2 times wide (0.04: 0.03), FS2 longer than wide (0.05: 0.03), FS3 as long as wide (0.04: 0.04); club 2 segmented, more than 3 times as long as wide (0.17: 0.03), slightly shorter than preceding two funicle segments combined (0.17: 0.15).

Thorax (Fig. 4): Mesoscutum less than 2 times as wide as long (0.29: 0.20) with notauli furrow having 4 setae, axillae not meeting to each other at mid of transcutal articulation; axillae widely separated from each other, scutellum longer than mesoscutum, slightly wider than long (0.23: 0.20) without longitudinal grooves and 1 pair of setae situated on scutellum; metanotum is medium; propodeum without median carina and without paraspicular carinae; spiracle rim exposed.

Fore wings (Fig. 5): more than 2 times as long as wide (0.99: 0.39); less than ½ times longer than hind wing length (0.99: 0.80); coastal cell narrow; asetose; SMV with 3 long dorsal setae directed upwards shorter (0.21) than MV (0.33); MV bearing medium setae on front edge; PMV shorter than SV (0.03: 0.06); marginal fringe medium; cubital vein present.

Hind wings (Fig. 6): More than 4 times as long as wide (0.80: 0.19) with blunt apex; vein length more than 1 ½ the length of wing (0.48: 0.80)

Fore Legs, Mid legs, Hind legs (Fig. 7): Legs are not very hairy.

Gaster elongate; longer than wide (1.27: 0.47), ovipositor (Fig. 8) sheaths slightly exerted, first valvifer triangular; third valvulae long (0.07) almost equal to one sixth length of the second valvifer (0.47); outer plates of ovipositor narrow base and broadened in the middle.

Material Examined: 7 female one dissected and mounted on a slide, India, Uttarakhand., Pantnagar, 25-1-2012. sweepnet near castor plantation. Hym. Eulo. Nr. S10 (Sweta Rawat).

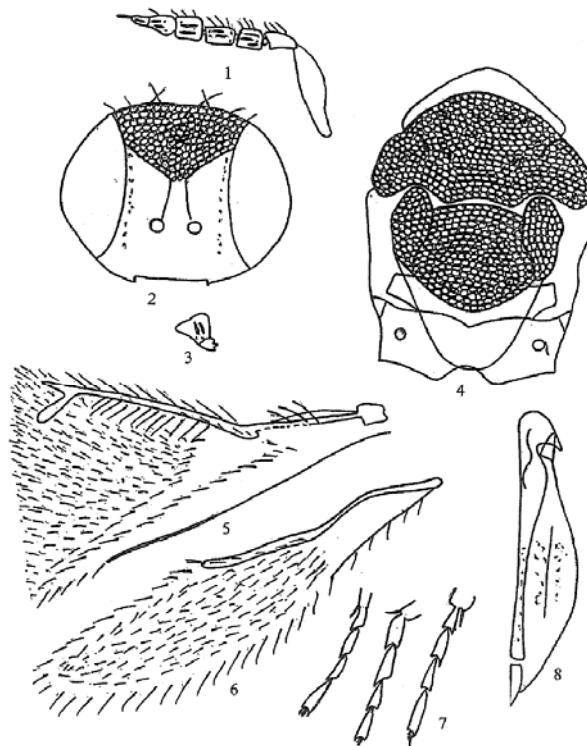


Plate 5. Fig (1-8). *Pediobius antennalis* Khan et al., female 1. Antenna; 2. Head in frontal view; 3. Mandible; 4. Thorax; 5. Fore wing; 6. Hind wing; 7. Legs (Fore leg, Mid leg and Hind leg); 8. Ovipositor.

4. Acknowledgements

We are thankful to Department of Entomology, G.B. Pant University of Agriculture and Technology and the National coordinator of Network Project on Biosystematics, Division of

Entomology, IARI New Delhi for providing research facilities and financial assistance.

5. References

1. LaSalle J. Hymenoptera: their diversity, and their impact on the diversity of other organisms. *Hymenoptera and Biodiversity* 1993, 1-26.
2. Noyes JS. Interactive Catalogue of World Chalcidoidea (2001 - second edition). CD-Rom. Taxapad and The Natural History Museum, London, UK, 2002.
3. Burks BD. The North American parasitic wasps of the genus *Tetrastichus* – A contribution to Biological control of insect pest. *Proc US Natn Mus* 1943; 93:505-608.
4. Gibson GAP. Chapter 2. Morphology and Terminology. *In: Gibson GAP, Huber JT & Woolley JB (Eds), Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera)*. National Research Council Research Press. Ottawa Ontario, Canada, 1997, 794.
5. Graham MWR, de V. A reclassification of the European Tetrastichinae (Hymenoptera: Eulophidae), with a revision of certain genera. *Bulletin of the British Museum (Natural History) Entomology Series* 1987; 55:1–392.