



ISSN 2320-7078
JEZS 2014; 2 (4): 87-92
© 2014, JEZS
Received: 04-07-2014
Accepted: 19-07-2014

Nitin Gajbe
G.B.Pant University of Agriculture &
Technology, Pantnagar, Uttarakhand,
India

M.A. Khan
G.B.Pant University of Agriculture &
Technology, Pantnagar, Uttarakhand,
India

S.M.Dadmal
NPIB-ICAR Project Department of
Entomology, Dr PDKV, Akola,
Maharashtra, India

Suvarna Khadakkar
NPIB-ICAR Project Department of
Entomology, Dr PDKV, Akola,
Maharashtra, India

Correspondence:
Nitin Gajbe
G.B.Pant University of Agriculture
& Technology, Pantnagar,
Uttarakhand, India
Email: nitingajbe11@gmail.com

Redescription of four species of Eulophid parasitoids (Hymenoptera: Eulophidae: Tetrastichinae) collected from Uttarakhand

Nitin Gajbe, M.A. Khan, S.M.Dadmal and Suvarna Khadakkar

Abstract

Eulophidae is ecologically and economically most important and largest family of superfamily chalcidoidea consisting of about 350 genera and more than 3,000 species of parasitoids for controlling the crop pests. The present study on subfamily Tetrastichinae (Eulophidae: Hymenoptera) has been made to provide occurrence and account of two genera viz., *Tetrastichus* and *Aprostocetus* which include redescription of 4 species *Tetrastichus triozei* Khan, *Aprostocetus dellus* (Narendran), *A. Gala* (Walker) and *A. percaudatus* (Silvestri) collected from Uttarakhand (India).

Keywords: *Aprostocetus*, Eulophidae, *Tetrastichus*, Uttarakhand

1. Introduction

Due to lack of the information, Entomologists are still unable to use the beneficial insects to the fullest. To overcome this problem, great attention must be laid on promoting basic studies like identification of various useful insect species. Poor knowledge of species diversity hampers the further research on the species within habitats and their interactions with other organisms. Surveying species diversity is thus a prerequisite for other biological disciplines, for example conservation biology and ecology. Among the parasitic Hymenoptera, wasps in the super family Chalcidoidea are ecologically and economically the most important insects for the control of other insect pest population^[1]. The species of Chalcidoidea, were distributed in 20 families and 86 subfamilies and the estimated number of species have ranged between 60,000 and 1, 00,000^[2]. Among these families, the members of Eulophidae are promising agents for the control of insect pests of agricultural importance world over. Eulophidae is large family of the superfamily Chalcidoidea comprising of about 300 genera in the World, among these 150 genera are found in the Indo-Australian region and about 60 genera in the Indian subcontinent^[3]. The insect biodiversity of Hymenoptera as compared to world fauna is poorly known and is the lowest among the 27 insects' orders known from India, and comprises only 5% of the Hymenoptera fauna recorded in India^[4].

The Eulophid subfamily Tetrastichinae is one of the largest and most widespread of all parasitic Hymenoptera. Species occur in virtually all terrestrial habitats in all geographic realms, and constitute an important component of terrestrial ecosystems. The first taxonomic work on Tetrastichinae was done by Burks^[5], who provided key to North American species of *Tetrastichus*. The member of subfamily Tetrastichinae are important parasitoids of number of pests in agriculture and horticulture crop ecosystem such as *Tetrastichus pyrillae* on sugarcane leafhopper, *Tetrastichus schoenobii* on eggs of Rice stem borer, *Citrostichus phyllocnistoids* on leaf miner which is a devastating pest of citrus. Recently^[6, 7] made an excellent contribution to the fauna of Indian Tetrastichinae which includes 34 genera and 272 species. Still many species are waiting to be discovered and employed in pest management system. Correct identification and records of their ecological distribution must be made. The lack of proper information on their basic studies and improper identification many times did not give the desired results of major control projects. With a view to furnish more information on basic studies of parasitoids, the present work on taxonomic studies on parasitoids of subfamily Tetrastichinae (Eulophidae: Hymenoptera) has been carried out.

2. Material and methods

2.1 Collection of parasitoids Collection, rearing and preservation work was carried out month

of March, April, May, October and November, 2011 from some areas of Uttarakhand (India)

Parasitized eggs and different stages of host insects along with damaged material like pieces of barks, leaves, stems, twigs, pods or other plant parts were collected. At the same time few unparasitized host specimens, if available, were also collected individually from the same plant and allowed to emerge to facilitate their correct identification. However, sweep net collections were also made in order to acquire large amount and variety of microhymenoptera in the shortest time, in most types of vegetation. A complete record was maintained indicating the reference number, locality, date of collection, name of the host plant and host insect.

The collected material was brought into the Biological Control Laboratory, Department of Entomology for proper rearing. The selected pieces of barks, leaves, stems twigs, pods or other plant parts were cut into small pieces and put in rearing jars, the mouth being tightly closed with very fine muslin cloth held with a rubber band. As per necessity, the leaves and other plant parts were wrapped with cotton soaked in water to maintain proper turgid conditions. A slip was fixed to each jar indicating the reference number. Collections made during the month of March, April, May and October and November in the years of 2011 were put in constant temperature cabinet running at 70 °F and with 70 percent RH to expedite the emergence of parasitoids, otherwise the parasitoids were reared under room temperature. The rearing jars were examined daily for the emerged parasitoids.

The emerged parasitoids were collected from jars and preserved in 75 percent alcohol in glass vials. Whenever larger number of parasitoids emerged in plastic tubes, an empty tube of the same size was put in end to end portion over the tube containing parasitoids. Then the tube with parasitoids was wrapped with black paper, and the whole assembly was put near an overhead light source. This technique enables the parasitoids to move to the empty tube in

response to light. Thus the all assembled parasitoids were preserved. The preserved specimens were then separated up to generic level under binocular microscope based on the monograph of Narendran (2007) on Indian Tetrastichinae [7]. Data on the number of specimens of each genus and species from each sample was also recorded.

2.2 Preparation of permanent slides, measurements and illustrations

Permanent slides were prepared to enable detailed study of the parasitoids. The normal process of dehydration was followed and clearing was made in the clove oil. The dissection was made in clove oil and 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. The permanent slides were examined under trinocular microscope in order to make drawings and detailed study of each structure with the help of Camera Lucida. 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- Tetrastichinae

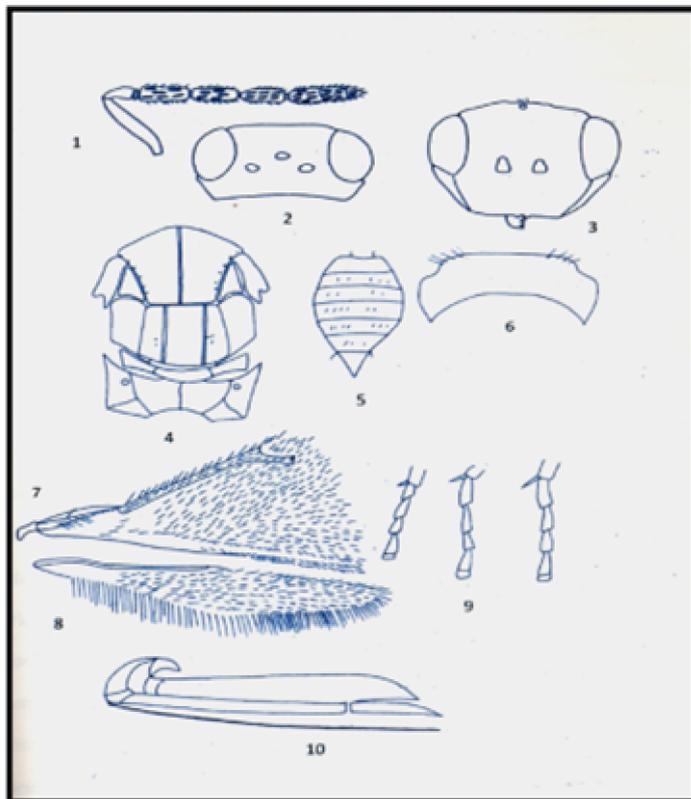
3.1.1 Genus: *Tetrastichus* Haliday

(Type species: *Cirrospilus attalus* Walker)

Redescription of the species.

3.1.1.1 *Tetrastichus triozei* (Khan *et al.*) (PLATE -1, Fig.1-10)

Female: Body length 2.32 mm, body colour dark brown, with faint iridescent bluish green luster, head dark brown with light bluish green luster, ocelli white and eyes black; antenna brown except scape yellow; thorax dark brown with very faint iridescent green luster; wings hyaline; legs uniformly yellow fore and hind coxae dark brown.



Tetrastichus triozei Khan

Plate 1 (Fig.1-10): 1. Antenna 2. Head, in frontal aspect 3. Head 4. Thorax 5. Abdomen 6. Pronotum 7. Forewing 8. Hindwing 9. Legs 10. Ovipositor

Head (Fig. 2, 3): wider than long in facial view (0.69:0.50), frontovertex much wider, more than half the total head width(0.38:0.69); ocelli arranged in obtuse angled triangle; POL distinctly more than two times as long as OOL; eyes smooth; antenna inserted just above the lower level of eyes, prominence between antennal torulli (0.08); malar space distinctly longer than eye width (0.22:0.13), malar sulcus distinct; lower eyes of clypeus with two dents medially; mandibles tridentate. Antenna: (fig.1) 8 Segmented excluding one annellus; scape more than 3 times as long as wide (0.24:0.07); pedicel 2 times as long as wide (0.09:0.045), slightly more than 1.5 times as long as FS1; funicle 3 segmented; FS 2 times as long as wide (0.14:0.07), FS2 as long as FS1, less than two times as long as wide (0.14:0.07), FS3 slightly shorter than (0.125:0.070) than FS2; club3 segmented; 3 times as long as wide (0.245:0.08), shorter than length of preceding two funicle segment combined.

Thorax (Fig. 4,6): Pronotum smooth its posterior margin with 10 pairs of setae anterior margin concave in the middle; mesoscutum more than 2 times as wide as long (0.68 : 0.31); mesoscutum having 6 pairs of adnotaular setae, notauli complete and deep, median longitudinal sulcus present; scutellum slightly smooth and shorter, 2 pairs of setae situated on scutellum, grooves deep and straight; dorsellum large; metanotum broad like a bend; propodeum with strong median inverted Y shaped paraspiracular carina, propodeal spiracle always nearer to the anterior margin of propodeum. Fore wings (Fig.7) : Long, slightly more than 3 times as long as wide (1.545: 0.490), less than 1.5 times longer than hind wing length, densely setose; costal cell long and broad with a row of 4 setae; SMV with 6 setae ,1 directed upwards and 5 downward, longer (0.43) than MV (0.40); MV bearing 14 long setae on front edge; PMV very short (0.02), SV (0.09) more than 4.5 times shorter than the length of MV (0.425); marginal fringe moderate in length; basal vein with 4 setae, basal cell bare; speculum moderate, closed below; subcubital line of hairs arising from the distance of $1/3^{\text{rd}}$ the base. **Hind wings (Fig.8):** More than 4 times as long as wide (1.22: 0.285) with blunt apex; vein length (0.69) more than

one half the length of wings; marginal fringe spaced by a distance equal to $1/5^{\text{th}}$ of their length. **Fore legs (Fig.9):** Coxa less than 2 times as long as wide (0.25: 0.15); femur more than 3.5 times as long as wide (0.32: 0.085), shorter than tibia, fore tarsus shorter than length of tibia (0.23:0.33) **Mid legs (Fig.9):** Coxa more than 2 times as long as wide (0.330: 0.150); shorter than 4.5 times as long as wide (0.350: 0.075); femur more than tibia; tarsus less than 1.5 times shorter than length of tibia (0.32: 0.47). **Hind legs (Fig. 9):** Hind coxa less than 2 times as long as wide (0.31: 0.16), femur less than 3.5 times as long as wide (0.375: 0.110); femur shorter than tibia, tarsus less than 1.5 times shorter than length of tibia (0.335: 0.480).

Gaster (fig.5) Large and ovate, gaster surface smooth, gaster sessile; metasoma more than 1.5 times longer than mesosoma (1.050 : 0.625); ovipositor sheaths slightly exerted; first valvifers triangular; anterior margin of basal part of second valvifers curved; third vulvulae more than 5 times as long as wide (0.255: 0.050); less than 3 times the length of second valvifers (0.745); outer plates of ovipositor longer than second valvifers, with a ridge along basal half of dorsal margin (Fig. 10).

Material studied: One female one dissected and mounted on a slide, India, Uttarakhand. Pantnagar, HRC, Pattarchatta, 21-IX-2010. Hym. (Eulophidae: Tetrastichinae) N0. 1 (Gajbe Nitin Dadaji).

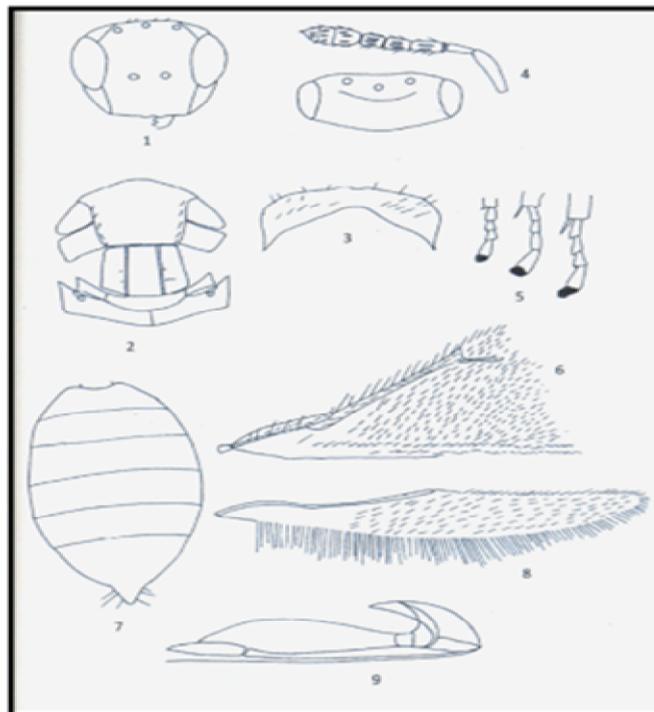
3.1.2 Genus *Aprostocetus* Westwood

(Type species: *Aprostocetus caudatus* Westwood)

Redescription of the species.

3.1.2.1 *Aprostocetus dellus* (Narendran) (PLATE -2, Fig.1-10)

Female: Length 1.1 mm. Dark brown, head brownish yellow; eyes brick red; ocelli red; antenna brown with scape and pedicellus pale; legs yellow with fore and hind coxae pale brown; wings hyaline, veins pale brown, pilosity of wings brown, setae on mesoscutum pale yellow and on scutellum pale brown.



Aprostocetus dellus (Narendran)

Plate 2 (Fig. 1-9): 1.Head 2.Thorax 3.Pronotum 4. Antenna 5.Legs 6.Forewing 7. Abdomen 8.Hindwing 9.Ovipositor

Head:(fig 1) Width in anterior view 1.11x as broad as long; lower margin of clypeus bidentate; POL2.7xOOL; OOL as long as OD; Eye bare, 1.33X as long as its width,2x as long as MS;MS straight; antennal formula 11433; scape not reaching front ocellus, shorter than eye length (10:12) pedicellus plus flagellum as long as width of mesosoma.

Mesosoma: (fig 2) 1.9x as long as wide; mesoscutum 1.6x as long as its posterior width, little shorter than its anterior width, surface longitudinally and moderately reticulate; ML present mesoscutum with 5 adnotaular setae on either side; scutellum 1.8x as wide as long, enclosed space between SMG 1.7x as long as its width SMG little nearer to SLG than each other; dorsellum not visible in dorsal view, dorsellum visible only as a narrow strip in posterior view; propodeum 10.5x its median length, median carina broad and distinct, rim of spiracle partially covered by callus, touching posterior border of metanotum, callus with two setae spur of midtibia 0.8x length of metatarsus; fourth tarsomere shorter than metatarsus; hind femur 5.75x as long as broad.

Forewing: (fig.3) 2.21x as long as broad; CC shorter than MV;

SMV with 5 dorsal setae, MV 3.8x as long as STV; marginal fringe 0.6x as long as STV; speculum closed behind by cubital setae.

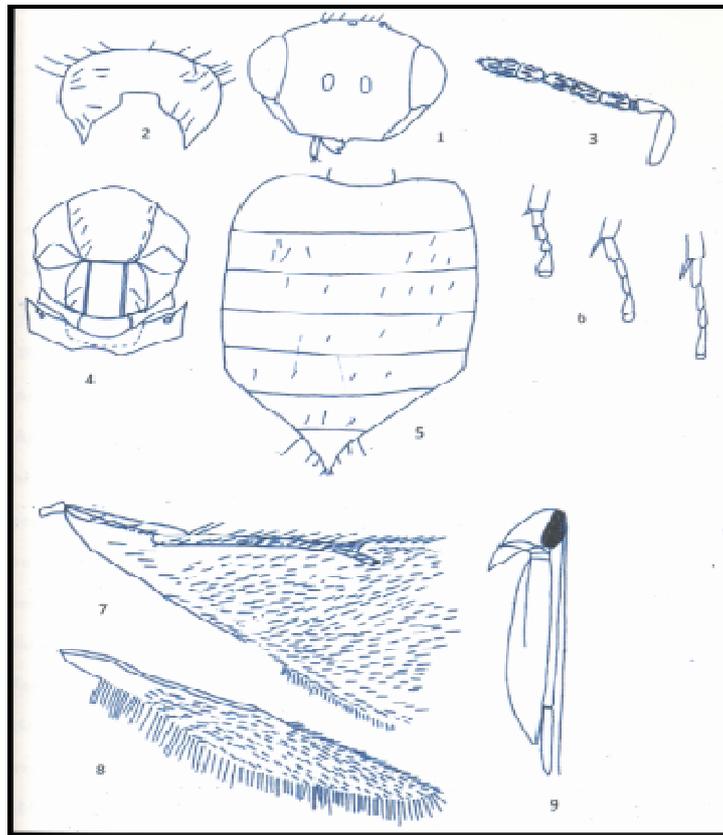
Gaster:(fig.5) sessile,1.26x as long as mesosoma, and a little longer than combined length of head and mesosoma in side view (24:23), 17.5x as long as dorsal visible part of ovipositor sheath; hypopygium exceeding middle of gaster, one of cercal setae on either side longer than other.

Male: Not known

Material studied: 2 female studied one dissected and one mounted on a slide, India, Uttarakhand, Pantnagar, HRC, Pattachatta, 16-9-2010, Hymenoptera (Eulophidae: Tetrastichinae) N0. 3.

3.1.2.2 *Aprostocetus gala* (Walker) (PLATE-3, Fig.1-9)

Female: Length1.71 mm. Yellow with following parts dark brown; antenna(with scape paler); upper part of scrobe, area near ocelli on vertex, apical corners of scapula, and axilla, notauli, anterior corners of propleuron and transverse bands on gaster, wings hyaline with pale brown veins; pubescence dirty white.



Aprostocetus gala (Walker)

Plate 3 (Fig.1-9): 1.Head 2.Pronotum 3. Antenna 4.Thorax 5.Abdomen 6.Legs 7. Forewing 8.Hindwing 9.Ovipositor

Head: (fig 1) collapsing a little longer than wide; POL 2x OOL; eye height in profile 2.3x malar space. Antennal formula 11233. Relative measurements length: width, scape= 22:5; pedicellus=10:3 F1=14:6; clava =22:7.

Mesosoma:(fig.4) Pronotum with a row of 10-12 setae on posterior margin; mesoscutum with 5 adnotaular setae on either side, a little longer than 1.4x scutellum; mesoscutum and scutellum faintly

reticulate. propodeum is little shorter than dorsellum,6x as broad as long, with a short median carina, spiracle rim not fully exposed, sub median areas weakly reticulate.

Wing: (fig7, 8) Forewing length1.91x, its maximum width ratio of CC: MV: PMV: STV as 27:30:0:9.5. submarginal vein with 4 dorsal setae; speculum closed behind by cubital line of setae.

Leg: (fig.6) Hind tibial spur slightly longer than hind metatarsus.

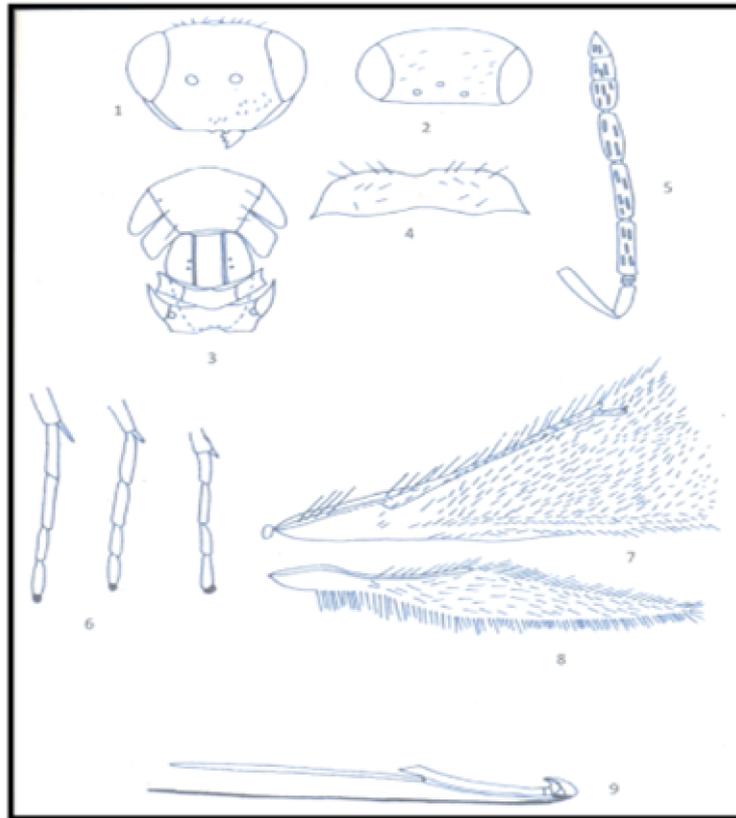
Gaster: (fig.5) slightly longer than head plus metasoma, with black cross bands; one of the cercal setae longer than the others.

Male: Not known

Material studied: 1 female dissected and mounted on a slide, India, Uttarakhand, Pantnagar, HRC, Pattarchatta, 26-IX-2010.Hym. (Eulophidae: Tetrastichinae) Nr. S07 (Gajbe Nitin Dadaji).

3.1.2.3 *Aprostocetus percaudatus* (Silvestri) (PLATE-4, Fig.no.1-9)

Female: 1.6 to 2.1mm(excluding ovipositor) and ovipositor 2.8-3.8mm.head yellowish with ocellar area and a spot above clypeus black, Mesosoma bright green to blue green; gaster green to blue green; sides with row of yellowish spots; antennae brown with scape and pedicellus sometimes paler beneath. Hindcoxae colour like mesosoma, legs yellow with fore tarsi brownish, extreme tips of tibia faintly brownish, tegulae yellow



Aprostocetus percaudatus (Silvestri)

Plate 4 (Fig. 1-9): 1.Head 2.Head in frontal aspect 3.Thorax 4.Pronotum 5.Antenna 6. Legs 7. Forewing 8.Hindwing 9.Ovipositor

Head: (fig 1) 1.27x as broad as mesoscutum, slightly more than 2x as broad as long; POL 1.6-1.7x OOL; OOL about 1.5x OD.

Antenna:(fig.5) with scape nearly as long as eye, reaching slightly above vertex; pedicellus plus flagellum 2.15x width of mesoscutum; pedicellus nearly 2x as long as broad, about or hardly more than half length of F1; funicle proximally hardly stouter than pedicellus, clava hardly broader than F3, somewhat shorter than F2 plus F3, 3.7-4.8x as long broad.

Mesosoma: (fig.3) 2x as long as broad; pronotum subconical, at least 0.33x length of mesoscutum. Midlobe of mesoscutum little longer than broad, convex, shiny, with 3 adnotaular setae on either side, subequal in length. Scutellum about 0.66x length of mesoscutum, about as long as broad, strongly convex, rather more finely and delicately sculptured than mesoscutum SMG about equidistant from each other and SLG, enclosing a space about 2.5x as long as broad; setae fine their length slightly less than distance between SMG, anterior pair in or little long aside middle .Dorsellum almost semicircular, 2-2.2x as broad as long

propodeum long at sides, even medially as long as or slightly longer than dorsellum; callus with 3-4 setae.

Legs: (fig.6) Long and slender, especially tibia and tarsi. Spur of mid tibia about 0.33x length of basitarsus which is 7-8x as long as broad; remaining tarsomere decreasing in length but all quite elongate.

Wing: (fig.7, 8) Forewing 2.6-3x as long as broad; MV thin, about 6x length of STV, its front edge with 13-15 setae which are shorter than STV, SMV with 4 dorsal setae.

Gaster: (fig.9) Proper sub linear, somewhat longer than head plus mesosoma, slightly normal than mesosoma, post cercal shorter than cerci, which are placed about middle of length of the tergite; projecting part of ovipositor sheaths varying from about 0.7 length of gaster to longer than the whole body.

Male: Not known

Material studied: 2 female one dissected and mounted on a slide, India, Uttarakhand, HRC, Pattarchatta, 16-VIII-2010. Hym. Eulophidae: Tetrastichinae) N0. 23 (Gajbe Nitin Dadaji).

4. References

1. LaSalle J. *Aprostocetus (Ootetrastichus) theioneurus* (Masi) (Hymenoptera: Eulophidae) a hyperparasitization the cereal stem borer *Chilo partellus* (Lepidoptera: Pyralidae) in Africa. *Zoologische Mededelingen* 1993; 67(27-43):445-451.
2. Gibson GAP, Heraty JM, Woolley JB. Phylogenetics and classification of Chalcidoidea and Mymarommatoida-a review of current concepts (Hymenoptera, Apocrita). *Zoologica Scripta.*, 2000; 28:87-124.
3. Narendran TC, Fousi K. A new genus and a new species of Eulophidae (Hymenoptera: Chalcidoidea) from the rice ecosystems of Central Kerala, India. *Journal of Ecobiology* 2002; 14(2):137-141.
4. Ghosh AK. Insect Biodiversity in India. *Oriental Insects* 1996; 30:1-10.
5. Burks BD. The North American parasitic wasps of the genus *Tetrastichus* – A contribution to Biological control of insect pest. *Proc U.S. Natn Mus* 1943; 93:505-608.
6. Hayat M, Shahi MH. Taxonomic notes on Indian Eulophidae (Hymenoptera: Chalcidoidea)-1. On the types of some tetrastichinae. *Orient Insects* 2004; 38:303-314.
7. Narendran TC. Indian chalcidoid parasitoids of Tetrastichinae (Hymenoptera: Eulophidae). *Zoological survey of India, Calcutta*, 2007, 386.