



Original Research Article

Description of a new species of *Cephalobellus* Cobb 1920 (Oxyurida: Thelastomatidae) from the host *Blatta orientalis* L. (Orthoptera: Blattidae)

Praveen Kumar Singh*, Pragati Rastogi and Hridaya Shankar Singh

Department of Zoology, MCM, C.C.S. University, Meerut, U.P. – 250 001, India.

*Corresponding author

ABSTRACT

Keywords

Blatta orientalis sp. nov., cylindrical body, cephalic annulations

Cephalobellus is an insect parasite, primarily found in Scarabaeid beetles and its larvae. It belongs to family Thelastomatidae (super-family – Thelastomatoidea; Order - Oxyurida). *Cephalobellus orientalis* sp. nov. has long cylindrical body with characteristic cephalic annulations and lateral line like depression in females. Also, the second cephalic annule in females is characteristically much broader. A pair of characteristic phasmid is present on anterior part of tail. Males have only three pairs of caudal papillae compared to other species (4-5 pairs). It has been recovered from a new insect host - *Blatta orientalis* L. (Orthoptera, Blattidae).

Introduction

Thelastomatid pinworms are the parasites of invertebrate hosts like insects, arthropods and others. Cobb (1920) reported and described *Cephalobellus* for the first time. It was recovered from larva of a beetle and described as - *Cephalobellus papilliger*. The first description was based only on male pinworms. Basir (1956) described six species of *Cephalobellus* from Europe, USA, India and Brazil. Dale (1964) described *C. costelytrae* from New Zealand. More than 25 different species of *Cephalobellus* have already been described (Camino and Reboredo, 2005; Adamson and Waerebeke, 1992) from various hosts from different regions of the world.

The scarabaeid beetles and its larvae are the main hosts of *Cephalobellus*. However, it has been reported from other hosts as well viz. tipulid fly, diplopods centipedes and some blattodeans. Jairajpuri (1984) reported two different species - *C. annulobellus* and *C. spicatus* from unknown coleopteran larvae from India. Also, Camino and Reboredo (2000 and 2005) reported another species - *C. lobulata* from the nymphs of mole cricket and *C. cyclocephalae* from a scarabaeid beetle respectively.

The present species - *Cephalobellus orientalis* sp. nov. (Oxyurida: Thelastomatidae) has been collected from a new host - *Blatta orientalis* (Orthoptera:

Blattidae) from Meerut region of India. *Cephalobellus orientalis* sp. nov. is characterized by its long cylindrical body with characteristic distinguishing feature of annulations at the cephalic (neck) region and a characteristic lateral line like depression (in place of lateral alae) in females. Also, the eggs are flattened at one side compared to the broadly elongated eggs of other species. A pair of phasmid (depression) is present at the proximal part of the tail in females. There are only three pairs of caudal papillae present at the posterior in males.

Materials and Methods

The insect hosts namely *Blatta orientalis* L. (Orthoptera, Blattidae) were collected from different areas of district Meerut region. The collected insect hosts were anaesthetized and dissected, and nematodes were collected from their hindgut. The collected nematodes were heat killed and fixed in warm TAF (Triethanolamine formalin) fixative (Courtney, *et.al.* 1955). The fixed nematodes were dehydrated using slow dehydration method by putting the fixed nematodes in alcohol-glycerine mixture and then kept in glass dessicator with anhydrous CaCl_2 for 5-7 days. Dehydrated nematodes were mounted in anhydrous glycerine with glass wool and sealed. Outline structures were drawn with the help of camera Lucida and photographs were taken using Motic image 2000 DMB 1 microscope. Morphometric measurements were taken using stage and ocular micrometers. Comparative studies of different specimens of collected nematode parasites were done using De Man's formula and parameters (De Man, 1884). The measurements and parameters are expressed in mean, range and standard deviation from the mean.

For Scanning Electron Microscopy, the heat killed nematodes were transferred into primary fixative – Karnovsky's fixative for overnight and then transferred in 2.5% gluteraldehyde. The fixed nematodes were washed with 0.1M phosphate buffer (pH - 7.2) at 4⁰C and gradually dehydrated in different grades of acetone. The dehydrated nematodes were dried by critical point drying method using liquid CO_2 . These dehydrated and dried specimens were mounted on aluminium stubs and gold coated. Scanning microscope photography was done using LEO435 VP scanning electron microscope and measurements were done with LEO-32 annotation programme.

Generic diagnosis

Female

Mouth opening sub-triangular, surrounded by eight labio-papillae. Buccal cavity short and may or may not be armed with three cuticular teeth. Oesophagus consists of an anterior cylindrical/clavate corpus, a distinct middle short isthmus, and a posterior valvular bulb. Excretory pore much behind the base of oesophagus. Vulva is located at middle to almost posterior third of the body. Ovaries are two in number and uteri are divergent. Eggs are numerous, oval or elliptical. Tail is conical.

Male

Males are much smaller than females. Tail ending in a slender caudal spike, caudal papillae 3-5 pairs (amended) with variable species specific disposition and distribution; (a pair of pre anal papillae, a pair of weakly developed papillae opposite the anus and a single median double papillae slightly posterior to the anus,

another pair of papillae on the base of caudal spike (tail). Excretory pore is posterior to the base of oesophagus.

Result and Discussion

Female

Body nearly cylindrical with body length 3.11-3.55 mm and mid-body width 0.22-0.26 mm. Cuticle is distinctly coarse and striated. Anterior 5-6 annuli are much more conspicuous and distinctly narrow; each annuli with width 0.0050-0.0055 mm. They are much more conspicuous as compared to rest of the body. After these anterior 5-6 compact annuli, the following annuli widen abruptly to 0.012-0.016 mm with consequent abrupt body expansion. Lateral alae completely absent; instead, a shallow lateral line (depression marked in SEM) is present. Head sub truncate, with 2nd annule characteristically much enlarged with width 0.015-0.018 mm (not usually present in other species). Mouth opening sub-triangular and surrounded by eight labial papillae. Amphids are present. Buccal cavity is 0.010-0.012 mm deep, hollow and without any prominent cuticular plates. Oesophagus is elongated and 0.38-0.40 mm in length with anterior cylindrical 0.26-0.30 mm long corpus, middle short, 0.02-0.03 mm isthmus and posterior round end bulb with dimension 0.11 mm x 0.11 mm. Corpus gradually increases in its diameter posteriorly. Oesophagus is 1/9th (11%) of the total body length. End bulb is round, followed by the dilated intestinal cardia. Form and shape of cardia is variable. Rectal glands are 3 pairs. Anus is sub terminal and 0.21 mm from posterior extremity of the tail. Tail is conical and slightly attenuated terminally. Tail is with characteristic single pair phasmid. Excretory system is "H-shaped". Excretory pore is at 0.71 mm

from anterior i.e. at 1/5th (Ex% = 21.7%) of the total body length. Nerve-ring is at 1/2 of length of oesophagus from the anterior end at 0.16-0.20 mm (NR% = 5.18%) from the anterior end. Vulva is near middle of the body at 1.7 mm from anterior (V% - 49.99%). Vagina anteriorly directed. Ovaries are two and uteri are divergent. Eggs are numerous, elongated and characteristically flattened on one side and convex on the other; with dimensions 0.07 - 0.08 mm x 0.030-0.035 mm.

Male

Body is moderately slender, 0.9-1.1 mm long and with mid body maximum width of 0.075 mm. Head is sub-truncate and buccal cavity is very short and indistinct. Oesophagus cylindrical with length 0.16 mm. Isthmus is indistinct. Oesophageal bulb is valvulated with dimension of 0.040x0.030 mm. Lateral alae present and distinct extending from mid-oesophageal region at the anterior to near the anus region at the posterior. Excretory pore indistinct and diffused, present at posterior to the base of oesophagus. Body wall is faintly striated with indistinct striations. Nerve ring at 1/10th of the body. Anus is sub-terminal at 0.03 mm from tip of tail. Tail is short, attenuate and sharply pointed at tip in the form of a slender caudal spike. Testis is single and reflexed. Spicule is single and 0.25 mm in length. Posterior end of the body has only three pairs of caudal papillae; one pair of pre-anal and two pairs of post-anal papillae (compared to 4-5 pairs in other species).

Body dimension (Mean ± S.D. in mm)

Holotype Female

Length = 3.550 mm; Width = 0.280 mm; a (L/W) = 12.679; Oesophagus = 0.400 mm; b (L/E) = 8.875; Tail = 0.230 mm; c (L/T) =

15.435; Nerve ring = 0.200 mm; NR% = 5.63%; Excretory pore = 0.780 mm; Ex% = 21.97%; Vulva = 1.670 mm; V% = 47.04%; Egg = 0.070 mm x 0.030 mm.

Holotype Male

Length = 0.920 mm; Width = 0.075 mm; a (L/W) = 12.267; Oesophagus = 0.156 mm; b (L/E) = 5.897; Tail = 0.030 mm; c (L/T) = 30.667; Nerve ring = 0.090 mm; NR% = 9.78%; Excretory pore = indistinct; Ex% = nil; Caudal papillae 3 pairs – pre-anal -1 pair, post-anal - 2pairs; Spicule = 0.020 mm.

Paratype Females (n = 6): Length = 3.31 ± 0.21 mm; Width = 0.24 ± 0.02 mm; a (L/W) = 13.46 ± 0.47; Oesophagus = 0.38 ± 0.008 mm; b (L/E) = 8.56 ± 0.46; Tail = 0.211 ± 0.017 mm; c (L/T) = 15.67 ± 0.450; Nerve ring = 0.17 ± 0.014 mm; NR% = 5.18%; Excretory pore = 0.71 ± 0.040 mm; Ex% = 21.70%; Vulva = 1.65 ± 0.077 mm; V% = 49.99%; Egg = 0.70 mm x 0.03 mm;

Paratype Males (n = 3): Length = 0.94 ± 0.14 mm; Width = 0.075 ± 0.015 mm; a (L/W) = 12.71 ± 0.82; Oesophagus = 0.16 ± 0.01 mm; b (L/E) = 5.76 ± 0.59; Tail = 0.033 ± 0.0057 mm; c (L/T) = 28.50 ± 1.87 mm; Nerve ring = 0.091 ± 0.007 mm; NR% = 9.68%; Caudal papillae 3 pairs – pre-anal -1 pair, post-anal - 2pairs. Anal Spicule = 0.025 mm.

Taxonomic summery

Type Host: *Blatta orientalis* L. (Orthoptera, Blattidae)

Habitat: Hind gut of the host

Type Locality: Meerut region, U. P. (India)

Type Species: *Cephalobellus papilliger* (Cobb, 1920);

Holotype: *Cephalobellus orientalis* sp. nov.; both female and male Holotypes are deposited at Dept. of Zoology, MCM, C.C.S. University, Meerut (U.P. India)

Paratypes: Paratype females labeled as *C. orientalis* female 1-6 and paratype males labeled as *C. orientalis* male 7-9 are deposited at Dept. of Zoology, MCM, C.C.S. University, Meerut (U.P. India)

Etymology: The present species name, *Cephalobellus orientalis* sp. nov. is based on oriental Zoogeographical region of host collection (India – Meerut).

Species diagnosis: the new species is characterized by the characteristic distinguishing feature of cephalic annulations and presence of unique lateral line like depression in females and 3 pair anal papillae in males. The eggs are flattened on one side as compared to the elongated eggs of other species. The 2nd cephalic annule in females is much wider.

Comparison and discussion

Morphologically *C. orientalis* sp. nov. is much more similar to *C. annulobellus* and *C. spicatus* reported from India (Jairajpuri, 1984) in having a characteristic close-set of annuli at the cephalic region but they differ in their morphometric dimensions. The cephalic close-set of annuli comprises of 5-6 close-set annules of width 0.0050-0.0055 mm in *C. orientalis* sp. nov; while it comprises 7-8 annules with width 0.016-0.020 mm and 0.021-0.029 mm in *C. annulobellus* and *C. spicatus* respectively. In addition, it differs from all other species in having its 2nd annule much more expanded (0.016-0.020 mm). It also differs in its host, *C. orientalis* sp. nov has been recovered from new host - *Blatta orientalis* (Black-roaches) while *C.*

annulobellus and *C. spicatus* were reported from larvae of some unknown beetle (Coleoptera – Insecta); all other species of *Cephalobellus* are also reported from different scarabaeid beetles and others hosts - this is a speciation and diversification imposed by host.

C. orientalis sp. nov also differs from others species as:-

- Labial disc is present in *C. orientalis* sp. nov and lack in *C. spicatus*. Oesophageal corpus is narrow in the proximal and becomes wider in the distal portion.

- Presence of lateral line (visible in SEM photomicrograph) like depression in *C. orientalis* sp. nov. It is absent/not been reported in other species (even in other thelastomatides).

- The eggs are slightly elongated and flattened on one side and convex on another compared oval or ellipsoidal in other *Cephalobellus* sp.

- Caudal papillae are only three pairs (one pre and two pairs of post-anal papillae) compared to 4-5 pairs in others viz. 4 pairs in *C. brevicaudatus* and 5 pairs in *C. annulobellus* and *C. spicatus*.

- The number of the annules in the anterior characteristic close sets of annules is six complete and one annule is half round (SEM microphotograph). Also, the enlarged and expanded 2nd annule and the half (1/2) annule (visible in SEM) is the morphological departure from other species of *Cephalobellus*.

- Oesophagus is relatively shorter (1/9th) in case of *C. orientalis* sp. nov compared *C. annulobellus* and *C. spicatus* (1/7th).

- Tail in females is also relatively shorter in proportion to the body 1/15th compared to *C.annulobellus* (1/11th) and longer than tail of *C.spicatus* (1/19th). The presence of a pair of phasmid (SEM) is nowhere mentioned.

- *C. lobulata* differs from *C. orientalis* sp. nov in having its vulva at posterior third to the body (V%= 78.3%) and the anterior 1st and 2nd annuli lobbed.

- *C. orientalis* differs from *C.fluxi* (Dale, 1966) in having only 3 pairs of caudal papillae (4 pairs in *C. fluxi*), possessing lateral alae in males (lack in *C. fluxi*) and posterior excretory pore (it is at level of oesophageal bulb in *C.fluxi*).

Thus, with these departures in morphological, morphometric parameters and host ecology; the *Cephalobellus orientalis* sp. nov. is a new species of *Cephalobellus*.

Key to different species of *Cephalobellus* (Cobb, 1920)

1. Females with close-set of cephalic annuli at the cervical region with 5-7 narrow annuli 2

Females without close-set of cephalic annuli at the cervical region 4

2. Female with labial disc at the anterior 3
 Females without labial disc at the anterior and male having caudal spike in tail.

- Caudal papillae 5 pairs *C. spicatus* Jairajpuri & Parveen, 1984
3. Female with labial disc and males with only **3 pairs** of caudal papillae *C. orientalis* sp.nov.
 Female with labial disc and males with **5 pairs** of caudal papillae *C. annulobellus* Jairajpuri & Parveen, 1984
4. Eggs laid with gelatinous substances *C. ovumglutinosus* Van Waerebeke, 1978
 Eggs laid without any gelatinous substances 5
5. Females with vulva at around mid body 7
 Females with vulva posterior to mid body 6
6. Female with V% = 60% of the body length and excretory pore relatively much anterior Ex% = 16% and males with 4 pairs of genital papillae *C. cyclocephalae* Camino and Reboredo, 2005
- Females with vulva posterior to 2/3rd of the body length i.e. V% > 67%. 1st and 2nd annuli are lobbed, males with 5 pairs of genital papillae *C. lobulata* Camino and Reboredo, 2000
7. Excretory pore much posterior i.e. > 20% of the body 8
 Excretory pore much anterior i.e. < 20% of the body 9
8. Males without lateral alae. Females with much shorter tail and vulva posterior to mid-body *C. brevicaudatus* (Leidy, 1851) Christie, 1933
 Males without lateral alae. Female tail much longer and filliform. Buccal cavity hexagonal with 3 teeth *C. hexadontus* Van Waerebeke, 1970
9. Males with only one pair of double papillae on tail 10
 Males with 2-3 pairs of double papillae on tail 12
10. Spicule in male >40µm long and eggs are oval with egg Length/width ratio 1.5 *C. papilliger* Cobb, 1920
 Spicule in male < 35µm long 11
11. Eggs are much elongate and ellipsoidal with egg Length/width ratio 2.1-2.6 and excretory pore slightly posterior Ex%=20% *C. tipulae* Leibersperger, 1960
 Eggs much oval with egg length/width ratio 1.4-1.6 and excretory pore much anterior i.e. Ex% = 13-14% *C. costelytrae* Dale, 1964
12. Male with two double papillae and eggs are less ellipsoidal with egg length/width ratio = 1.75 13
 Male with three double papillae and eggs are more elongate ellipsoidal with egg length/width ratio = 2.42-2.50 *C. potasiae* Leibersperger, 1960
13. Male with 2 double papillae and tail **with spike** *C. fluxi* Dale, 1966
 Male with 2 double papillae and tail **without spike** *C. osmodermæ* Leibersperger, 1960

Table.1 Comparative morphometric measurements of *Cephalobellus orientalis* sp. nov.(Female)

Parameters	Length (mm)	Width (mm)	a=L/W	b=L/O	c=L/T	V%	NR%	Ex%	Egg ratio = Length/width	Caudal papillae in males
<i>Cephalobellus papilliger</i> Cobb, 1920	3.50-6.00	0.250	14.0-24.0	5.8-10.0	14.0-20.0	49-50%	6-10%	19-20%	1.56	4 (1+2+1*)
<i>Cephalobellus annulobellus</i> Jairajpuri & Parveen, 1984	2.40-2.90	0.20-0.210	12.0-13.8	6.7-7.0	11.400	46-51%	5.5-6%	18-20%	2.27-2.48	5 (1+4)
<i>Cephalobellus brevicaudatus</i> (Leidy, 1851) Christie, 1933	2.50-5.70	0.26-0.55	9.6-10.5	8.4-8.6	17.8-23.1	55-65%	7-8%	27-31%	3.5-4.5	-
<i>Cephalobellus costelytrae</i> Dale, 1964	3.42-5.16	0.17-0.31	16.7-20.1	5.7-10.5	10.5-11.0	46-53%	5-6%	13-14%	1.41-1.58	-
<i>Cephalobellus fluxi</i> Dale, 1966	1.32-1.86	0.10-0.17	13.200	3.6-4.4	13.200	57-60%	10-12%	21-25%	1.74-1.79	4 (1+1+2*)
<i>Cephalobellus hexodontos</i> Van Waerebeke, 1970	3.12-4.55	0.32-0.62	7.3-9.5	8.0-9.0	14.600	56%	3-4%	16-23%	2.39-2.47	-
<i>Cephalobellus osmodermæ</i> Leibersperger, 1960	1.65-2.23	-	-	5.3-6.0	6.2-7.2	52-53%	9-10%	20-21%	1.79-1.80	-
<i>Cephalobellus ovumglutinosus</i> Van Waerebeke, 1978	1.08-2.08	0.12-0.28	7.4-9.0	4.1-6.3	5.4-5.7	54-56%	6%	19%	1.39-1.47	4 (1+3)
<i>Cephalobellus potosiae</i> Leibersperger, 1960	2.92-7.36	0.15-0.20	19.5-36.8	6.1-10.5	19.5-36.8	53-57%	5-8%	20-23%	2.42-2.50	4 (1+3*)
<i>Cephalobellus spicatus</i> Jairajpuri & Parveen, 1984	4.10-4.15	0.31-0.33	12.6-13.2	9.9-11.4	18.9-22.8	51-53%	4%	20%	2.23-2.45	5 (1+3+1*)
<i>Cephalobellus tipulae</i> Leibersperger, 1960	2.02-4.57	0.16-0.26	12.6-17.8	4.5-7.5	12.6-17.6	47-56%	7-12%	20-31%	2.1-2.6	4 (1+2+1*)
<i>Cephalobellus lobulata</i> Camino and Reboredo, 2000	1.42-1.80	0.092-0.102	15.4-17.64	5.16-6.06	7.2-8.8	75-80%	-	18-21%	2.1	5 (3+2)
<i>Cephalobellus cyclocephalæ</i> Camino and Reboredo, 2005	1.89-2.17	0.098-0.104	19.28-20.86	6.47-6.56	18.54-21.7	58-62%	-	15-16%	2.08-2.17	4 (1+3)
<i>Cephalobellus orientalis</i> sp.nov.	3.11-3.55	0.22-0.28	12.6-14.1	8.07-9.10	15.04-16.3	47-51%	4.8-5.4%	20.0-23.8%	2.0-2.28	3 (1+2)

Legends: L = Body Length; W = Max.Body Width; a = Body length/Max. Body width; b = Body length/Oesophagus; c = Body length/Tail length; V% = Position of Vulva x 100/Body length; NR%= Position of Nerving from anterior x 100/Body Length; Ex%= Position of Excretory pore from anterior x 100/Body length; **Egg Ratio**= Egg length/Width; **Caudal Papillae in Males (preanal +postanal + *double papillae)**

Plate - 1

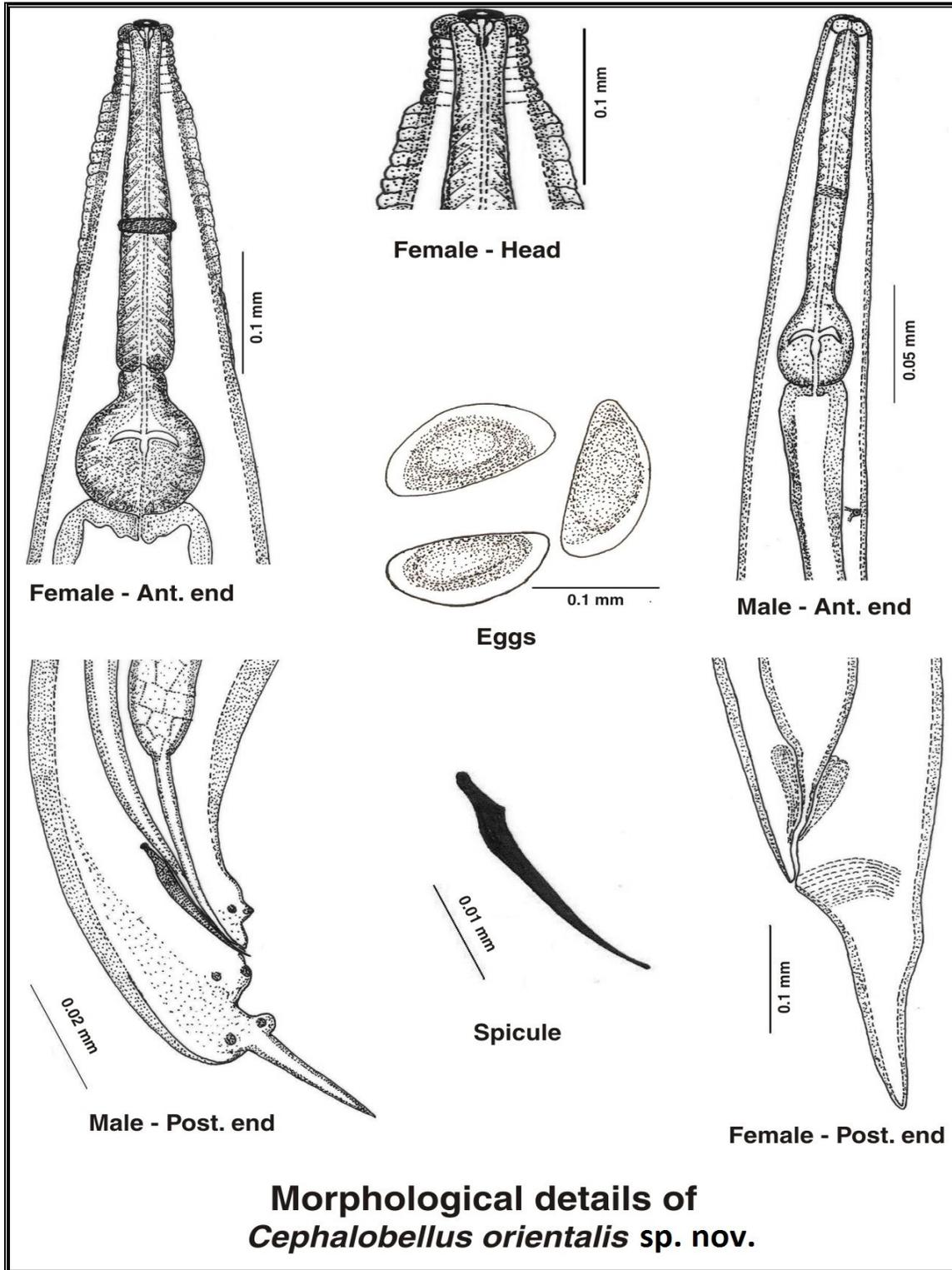
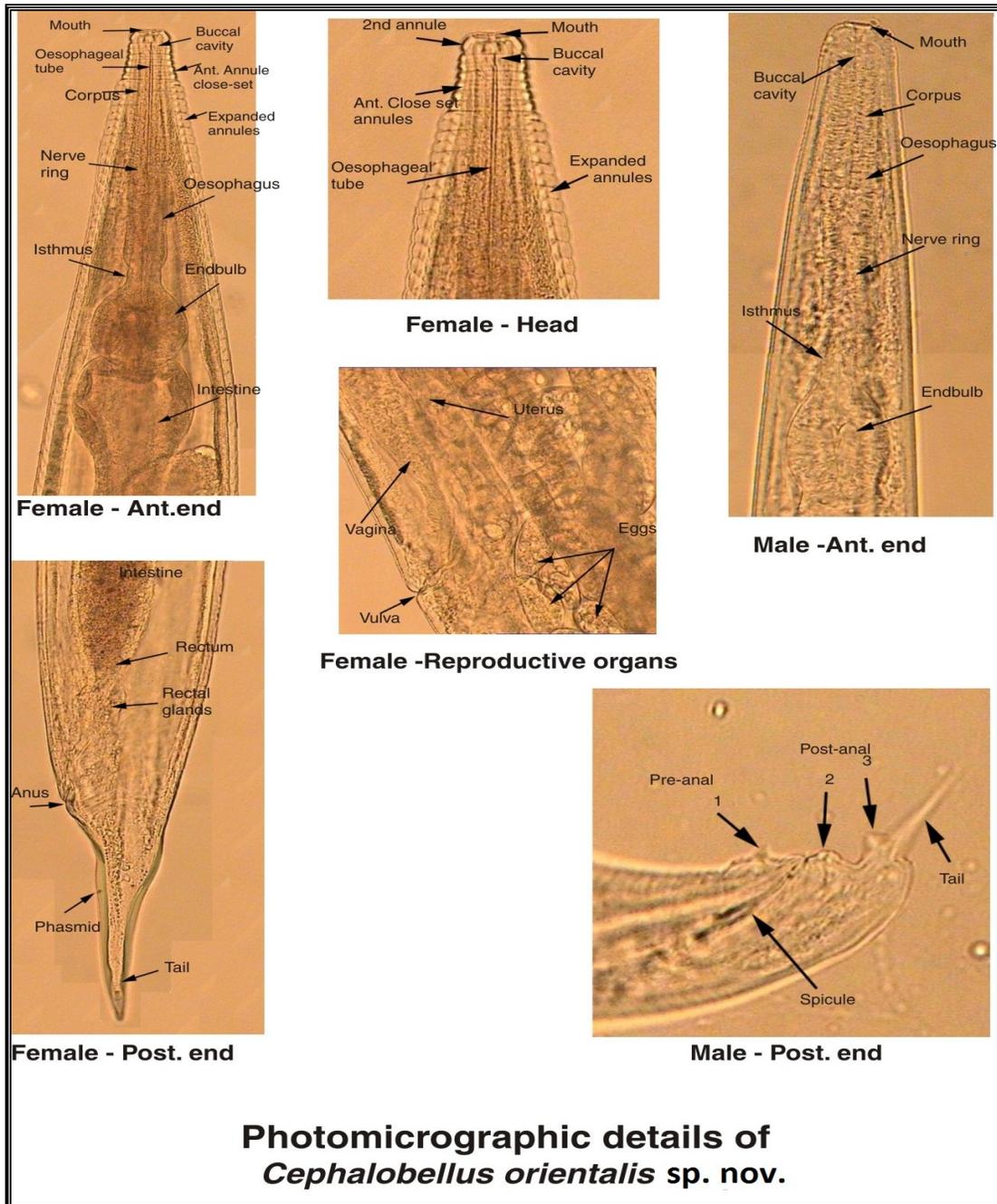


Plate – 2



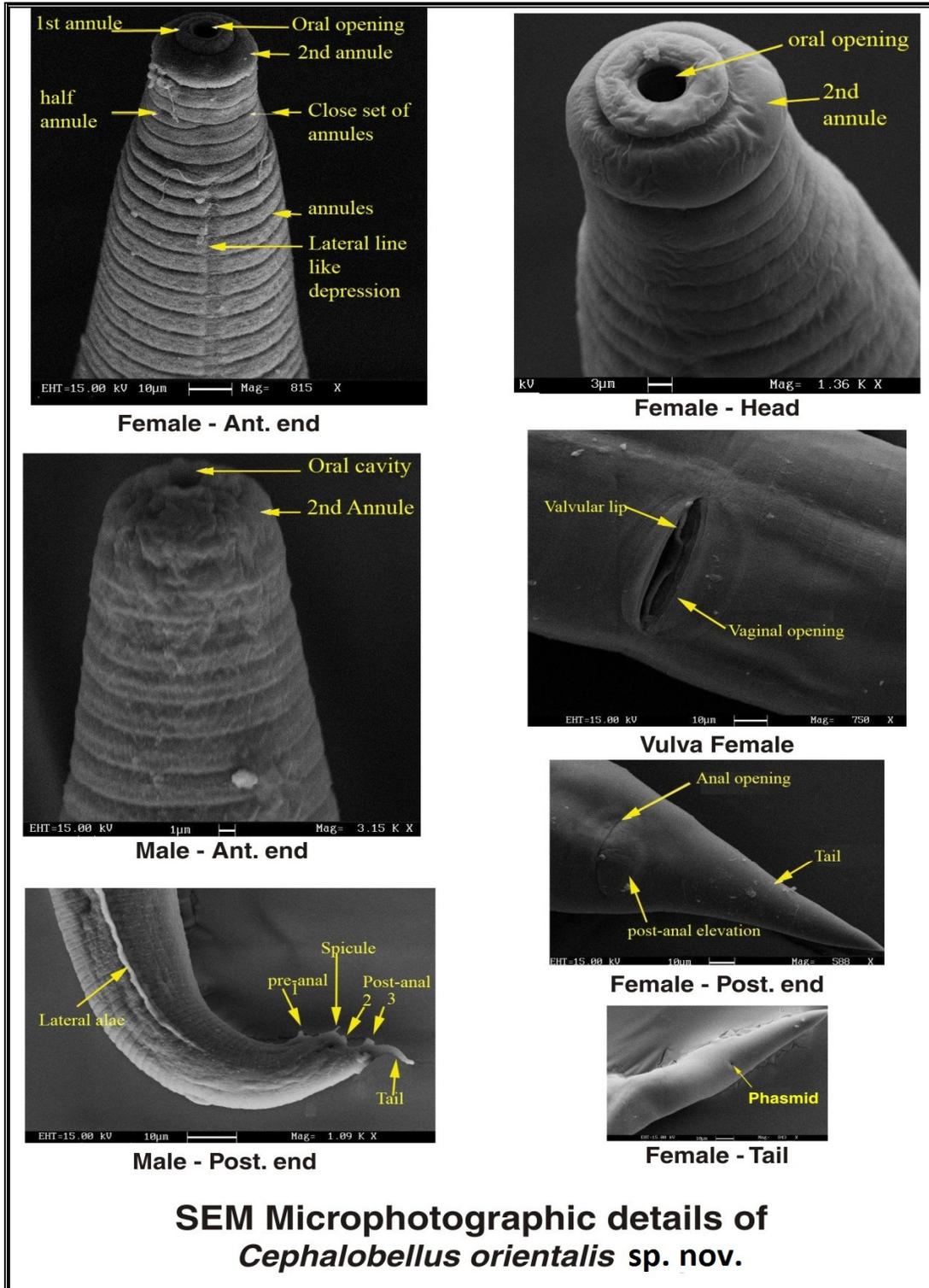
Type Host: *Blatta orientalis* L. (Orthoptera, Blattidae).

Type Habitat: Posterior gut of host

Type Locality: Meerut, U. P. (India).

Type Species: *Cephalobellus papilliger* (Cobb, 1920).

Plate - 3



The key to species and the morphometric table are about only selected species. It do not include species inquirenda and other species with inconsistent status (species synonym to others or insufficiently described) chiefly based on Camino and Reboledo (2005), Adamson and Van Waerebeke (1992) and Jarry and Jarry (1968).

Acknowledgement

The author is thankful to Dr. Aron Jex, Faculty of Veterinary, University of Melbourne, Australia for his help in identifying the species and giving various inputs. The author is also gratefully obliged to Council of Scientific and Industrial Research (C.S.I.R.), Ministry of Human Resource Development, New Delhi for its financial support as fellowship during my research work. The author is highly obliged to the Instrumentation facility centre AIIMS, New Delhi for Scanning Electron Microscopy.

References

- Adamson, M. L. and Van Waerebeke, D. 1992. Revision of the Thelastomatoidea, Oxyurida of invertebrate hosts 1. Thelastomatidae. *Systematic Parasitology*, 21: 21-64.
- Basir, M. A. 1956. Oxyuroid parasites of Arthropods. A monographic study. 1. Thelastomatidae 2. Oxyuroidea. *Zoologica*, 38: 1-79.
- Camino, N. B. and Reboledo G. R. 2000. *Cephalobellus lobulata* n. sp. (Oxyurida: Thelastomatidae) A parasite of *Neocurtilla claraziana* Saussure (Orthoptera: gryllotalpidae) from Argentina. *Memorias do Instituto Oswaldo Cruz*. 95: 49-51.
- Camino, N. B. and Reboledo, G. R. 2005. A new Oxyurida (Thelastomatidae) from *Cyclocephala signaticollis* Burmeister (Coleoptera: Scarabaeidae) from Argentina. *J. Parasitol.*, 91: 890-892.
- Cobb, N. A. 1920. One hundred new nemas (type species of 100 new genera). *Contributions to the Science of Nematology*, pp. 217-343. Waverly Press, Baltimore.
- Dale, P. S. (1964). A new species of *Cephalobellus* (Nematoda, Thelastomatidae) from larva of *Costelytra zelandica* (Coleoptera:Melonthinae). *New Zealand Journal of Science*, 7:596-601.
- Dale, P.S. (1966). *Cephalobellus fluxi* n.sp., a new thelastomatid nematodes from a tipulid larva. *New Zealand Journal of Science*, 9. 129-134.
- De Man J. G. 1884. Die frei der reinen Erde und in sussen Wasser Lebenden nematoden neiderlandischen fauna. *Eine Systematische Faunistische Monographie, Leiden*, 206 pp.
- Jarry, D. M. and Jarry, D. T. (1968). Tentative de clarification a propos de 60 especes des genres *Cephalobellus et Thelastoma* (Nematoda, Oxyuroidea). *Annales de Parasitologie humaine et compare*.43, 339-352.
- Jairajpuri, D. S. and Parveen, R. 1984. Two new species of *Cephalobellus* Cobb (Thelastomatidae: Nematoda) from coleopteran larvae from India. *Systematic Parasitology*, 6: 213-218.
- Van Waerebeke, D. 1978. Description de *Cephalobellus ovumglutinosus* n. sp. et de *Leidynema portentosae* n. sp. (Nematoda: Thelastomatidae), parasites intestinaux de blattes, et redéfinition du genre *Leidynema* Schwenk, 1926 (in Travassos, 1929). *Revue de Nematologie*, 1: 151-163.