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First report of two unrecorded Nematode species (Nematoda: Cephalobina) from India

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Abstract
The Cephaloboidea are a relatively distinctive group of widely distributed bacterial-feeding soil nematodes, most frequently represented by the family Cephalobidae. These nematodes, which are often striking in their labial morphology, are found in soils worldwide and are typically the most abundant microbivores in soil ecosystems. The present study has been conducted to survey the distribution and identification of soil inhabiting nematodes from the root zones of different plantations. Two species of free living nematodes belonging to suborder cephalobina have been discovered, *Stegellata ophioglossa* Andrassy, 1967 was isolated from the rhizosphere of *Sorghum* plantation in Aligarh, U.P. India while *Zeldia tridentata* Allen and Noffsinger, 1972 was found from the rhizosphere of Guava & Cashew-nut plantations in Odhisa, India. *S. ophioglossa* is characterized by small body, Cuticle with transverse and longitudinal striations, giving it a tessellated appearance. Distinct lateral fields with three incisures. Labial probolae with wide base, 4-6µm long, bifurcate. Prongs divergent and equal, mono-prodelphic reproductive system and flat tail terminus. *Z. tridentata* has a robust body, gradually tapering toward both the ends, cuticle with transverse annules, each annule with two rows of punctations, conoid female tail with acute terminus.

Keywords
Free Living, Nematode, Cephalobidae, Stegellata, Zeldia, India

Introduction
The superfamily Cephaloboidea represents a distinctive assemblage of widely distributed, bacterivorous soil nematodes, most commonly dominated by the family Cephalobidae, which comprises over 275 nominal species belonging to 24 genera. Members of this group are often characterized by their remarkable labial morphology and occur in soils across the globe. They are particularly abundant in nutrient-poor environments, such as desert ecosystems (Freckman

and Mankau, 1986) and the dry valleys of Antarctica (Freckman and Virginia, 1997), where they frequently constitute the dominant microbivorous nematode fauna. Despite their high abundance and cosmopolitan distribution, cephalobids have historically been among the most challenging nematodes to diagnose, identify, and classify. During a survey of soil nematodes in India, one unrecorded species of free living nematodes was found from sorghum fields in Aligarh, U.P. and one species from Guava & Cashewnut plantations near Chilika Lake, Odhisa, India

Materials and Methods

Nematodes were extracted from soil samples using the sieving and decantation method in combination with the modified Baermann funnel technique (Flegg, 1967). The recovered specimens were fixed in formalin–acetic acid (FA, 4:1) for 24 hours and subsequently transferred to glycerine–alcohol solution (5 parts glycerine and 95 parts of 30% alcohol) for gradual dehydration in a desiccator. Fully dehydrated nematodes were mounted in anhydrous glycerine on glass slides following the wax-ring mounting technique (de Maeseneer & d'Herde, 1963). Morphological observations, drawings, and photomicrographs were obtained using an Olympus BX-50 differential interference contrast (DIC) microscope.

Descriptions

Stegellata ophioglossa Andrassy, 1967

(Fig. 1)

Measurements: See Table 1.

Females: Body small, straight to slightly ventrally curved after fixation. Cuticle with transverse and longitudinal striations, giving it a tessellated appearance. Lateral fields distinct, occupying about 1/5th of the midbody diam.. Incisures three, outer ones crenate. Lip region with six separate lips having rounded margins. Labial probolae with wide base, 4-6µm long, bifurcate to about 1/3rd of their length. Prongs divergent and equal in size, forming a semicircular arc. Amphidial apertures round. Stoma cephaloboid, cheilostom wide, with small ovoid rhabdia. Gymnostom narrower than cheilostom, and as wide as stegostom. Metastegostom with a minute tooth like projection on dorsal rhabdia. Pharyngeal corpus cylindrical, with distinct lumen, 3.3-4.5 times isthmus length. Corpus-isthmus junction distinctly demarcated. Basal bulb ovoid or pear-shaped with well a developed grinder. Nerve ring surrounding the base of corpus at 60-67% of neck length. Excretory pore opposite the trailing end of nerve ring or at 62-71% of neck length. Hemizonid just posterior to the excretory pore. Dierids at about 65-71% of neck length, lying in the anterior half of isthmus. Cardia short, conoid, surrounded by intestinal tissue. Intestine with wide lumen at its anterior region.

Reproductive system mono-prodelphic. Ovary posteriorly directed without any flexure. Oocytes arranged in two rows in the germinal zone and in a single row in the proliferative zone. Oviduct short, tubular. Spermatheca less than the corresponding body diam long, without sperms. Uterus simple, tube like, undifferentiated. Post-uterine sac less than one vulval body diam. long. Vagina, thick walled, with sclerotization. Vulva transverse, slit like. Rectum 1.2-1.6 anal body diam. long. Tail cylindrical, 2.6-3.5 anal body diam. long, with approximately 20 ventral annuli. Tail terminus flat. Phasmids one anal body diam. posterior to anus.

Males: Not found.

Habitat and locality: Soil sample collected from the root zone of *Sorghum* sp. from village Nohati, Madrak and from the root zone of *Trifolium alexandrinum* from village Pisava, Chandaus, Aligarh, U.P., India.

Voucher specimens

17 females on slides *Stegellata ophioglossa* (N)/1-9 and 12 females on slides *Stegellata ophioglossa* (P)/1-4 deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Remarks

S. ophioglossa is a terrestrial nematode, this species have previously been recovered from sandy soils and dune sands. It is widely distributed and has been described from Europe (Hungary, Italy), Asia (Uzbekistan, Mongolia), Africa (Senegal) and South America (Venezuela). This is the first report of *S. ophioglossa* from India, where, it was recovered from sandy as well as from loamy soil. Despite the change in type of habitat the measurements and descriptions of our specimens agree well with that of *Stegellata ophioglossa* Andrassy, 1967. However slight variations from the original description were observed in the height of labial probolae (4-6 µm *vs* 8-11 µm), relatively smaller pharynx (96-112 µm *vs* 110-130 µm), smaller post-vulval uterine sac (less than corresponding body diam. *vs* as long as or longer than corresponding body diam.)

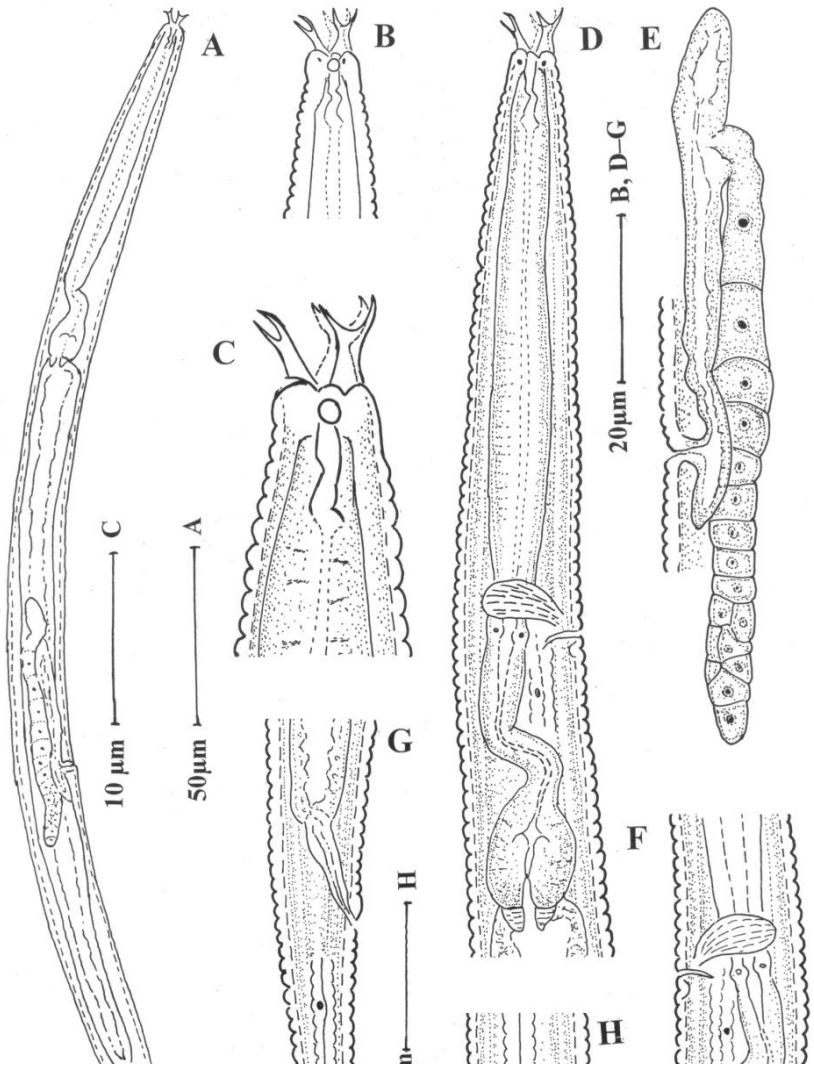

Fig . 1. *Stegellata ophioglossa* **A.** Entire female; **B, C.** Anterior end; **D.** Pharyngeal region; **E.** Female reproductive system; **F.** Pharyngeal region showing dierids; **G.** Female posterior region; **H.** Lateral lines.

Table 1: Measurements (in µm) of *Stegellata ophioglossa* Andrassy, 1967
Mean and S.D. given in parenthesis

Characters	Females (n= 10) Nohati population	Females (n=12) Pisava population
L	327 – 386 (347 ± 16)	341 – 409 (347 ± 16)
a	18.3 – 23 (21 ± 1.5)	19.2 – 22 (20.2 ± 0.8)
b	3.1 – 3.7 (3.4 ± 0.2)	3.2 – 3.7 (3.4 ± 0.2)
c	10.3 – 11.9 (11.1 ± 0.5)	10 – 11.4 (10.6 ± 0.5)
c’	2.6 – 3.4 (3 ± 0.2)	2.9 – 3.7 (3.1 ± 0.2)
V	62 – 64.5 (63 ± 0.5)	61 – 63.5 (62 ± 0.5)
Maximum body width	15 – 18 (16.5 ± 1)	15.5 – 20 (18 ± 1)
Lip width	6 – 7 (6 ± 0.3)	6 – 7 (6.9 ± 0.3)
Length of stoma	9.0	9.0 – 10 (9.5 ± 0.5)
Corpus	66.5 – 72.5 (70 ± 2)	69.5 – 77 (72 ± 2)
Isthmus	14.5 – 21.5 (18 ± 1.5)	18.5 – 24.5 (22 ± 1.5)
Basal bulb length	14 – 16 (14.5± 0.5)	13 – 17 (14.5± 1)
Pharynx	96 – 112 (102.5 ± 4.5)	104 – 114 (108 ± 3)
Excretory pore from ant. end	67.5 – 73.5 (69 ± 1.5)	69.5 – 75 (73 ± 1.5)
Nerve ring from ant. end	61.5 – 68.5 (65.5 ± 2.5)	68 – 73 (70.5 ± 1.5)
Dierid from ant. end	72.5 – 79 (74.5 ± 2.5)	75 – 82 (78.5 ± 2)
Basal bulb width	9 – 12 (10 ± 0.5)	10 – 13 (11 ± 0.5)
Anterior sac (Spermatheca)	10 – 14 (12 ± 1.5)	7 – 10 (9 ± 1)
Genital branch	36.5 – 65.5 (45.5 ± 7.5)	32.5 – 48.5 (40 ± 4)
Post uterine branch	8 – 12 (10 ± 1.2)	8 – 11 (10 ± 1)
VBD	14 – 17 (15.5 ± 1)	15 – 19 (17 ± 1)
Vulva- anus distance	89 – 113 (98 ± 6.5)	92 – 119 (105 ± 7)
Rectum	13 – 15 (14 ± 0.5)	14 – 16 (15 ± 0.5)
Tail	28.5 –34.5 (31 ± 1.5)	30.5 –37.5 (35 ± 2)
ABD	9 – 12 (10.5 ± 1)	10 – 12 (11 ± 0.5)
Phasmids from anus	9 – 10 (9.5 ± 0.5)	7 – 15 (10.5 ± 2)

Zeldia tridentata Allen and Noffsinger, 1972
(Fig.2)

Measurements: See Table 2.

Females: Body robust, gradually tapering toward both the ends, straight or slightly curved ventrally. Cuticle with transverse annules, 1.6 – 2 µm wide at the pharynx base and midbody and 1.6 - 1.8 µm wide at tail. Each annule with two rows of punctations. Lateral fields with three lines, outer ones crenate, areolated in the pharyngeal region. Lip region 10-11 µm wide, 4-5µm high. Labial probolae low, with round margins and shallow grooves. Primary axils deep, with dentate guard processes. Amphidial apertures oval. Cheilostom with prominent cylindrical walls, each cheilorhabdion associated with a structure having three teeth. Gymnostom longer than cheilostom, metastegostom with a small tooth like process on dorsal wall. Pharyngeal corpus cylindrical, 7.9-9.2 times isthmus length. Isthmus shorter than basal bulb. Basal bulb ovoid, 21-26 x 18-21 µm, with a grinder at its middle or slightly anterior. Cardia conoid, surrounded by intestinal tissue. Intestine with wide lumen. Nerve ring at 59-66% of neck length, surrounding the distal part of the corpus. Excretory pore just posterior to nerve ring or one to two annules anterior to hemizonid. Deirids in the posterior region of corpus, or at 67-78 % of neck length.

Reproductive system mono-prodelphic, ovary reversed, on right side of intestine, with or without additional flexures posterior to vulva. Oocytes usually arranged in a single row throughout the ovary length. Spermatheca scarcely developed. Oviduct short. Uterus tubular, without any differentiation. Post-uterine sac short, 0.3-0.5 times vulval body diam. long. Vagina with thick walls, slightly anteriorly directed. Rectum 21-28 µm long. Tail elongate conoid, 4-5 anal body diam. long, with acute terminus. Phasmids 1-3 µm posterior to anus.

Male*:* Not found

Habitat and locality

Soil sample collected from an orchard of guava and cashew-nut near Chilika lake, Orissa, India

Voucher specimens

9 females on slides *Zeldia tridentata*/1-2 deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Remarks

Z. tridentata is distinguished from other species of the genus by the presence of three teeth associated with each cheilorhabdion and the longer tail. This species is widely distributed throughout the world and has been collected from Jamaica, Philippine Islands, Srilanka, Taiwan, Thailand, and Venezuela. Most of the species of the genus were collected from the soil or sand around the root zone of different plants. This is the first report of *Z. tridentata* from India. The present population was collected from the sandy soil, around the root zone of Guava and Cashew Nut plantations.

The measurements and descriptions of our specimens agree well with that of *Zeldia tridentata* Allen & Noffsinger, 1972. However differences from original population were found in the lateral fields (outer incisures crenated *vs* smooth). Rashid *et al.,* 1984, collected two females of this species from Itapebi, Lombardia, Brazil, (Host: *Theobroma cacao*). They Illustrate and redescribed the species and added more details to the original description. In Brazilian population, cuticular punctations were not observed, however the punctations have been reported in the original descriptions and are distinctly visible in our population also. They also mentioned the ovary with a double flexure posterior to vulva but in our population the specimens without any flexure were also found along with the specimens having double flexure. In Brazilian population the phasmid lies at about 5-6 annules posterior to anus however, in our population phasmid lies just posterior to anus.

Table 2: Measurements (in µm) of *Zeldia tridentata* Allen and Noffsinger, 1972 Mean and S.D. given in parenthesis

Characters	Females (n= 9)
L	635-779 (724±46)
a	19.0-23.5 (20.8±1.3)
b	3.7-4.0 (3.9±0.1)
c	8.5-9.0 (8.8±0.2)
c’	4.1-4.9 (4.5±0.3)
V	61-62 (61.5±0.3)
Maximum body width	30.5-40.5 (35±3.0)
Lip width	10-11 (11±0.5)
Lip height	4-5 (4.5±0.5)
Length of stoma	15-17 (15.5±0.5)
Corpus	135.5-155.5 (147±6.5)
Isthmus	14-19 (16.5±1.5)
Basal bulb length	20-25.5 (23.5±1.5)
Pharynx	170-200 (187±9.0)
Excretory pore from ant. end	109-126.5 (121±5.5)
Nerve ring from ant. end	105-121.5 (116.5±5.5)
Dierid from ant. end	124-149 (137.5±9.0)
Cardia	5-6 (5±0.5)
Basal bulb width	18-21 (19±1)
Anterior sac (Spermatheca)	7-14 (10.5±2.5)
Genital branch	70-135 (9±21)
Post uterine branch	12-18 (13.5±2.0)
VBD	31.5-40.5 (35.5±3.5)
Vulva- anus distance	166-209 (194±14)
Rectum	21-28 (24.5±2.0)
Tail	73-87 (82.5±4.0)
ABD	16-21 (17.5±1.5)
Phasmids from anus	1-3 (2±0.7)

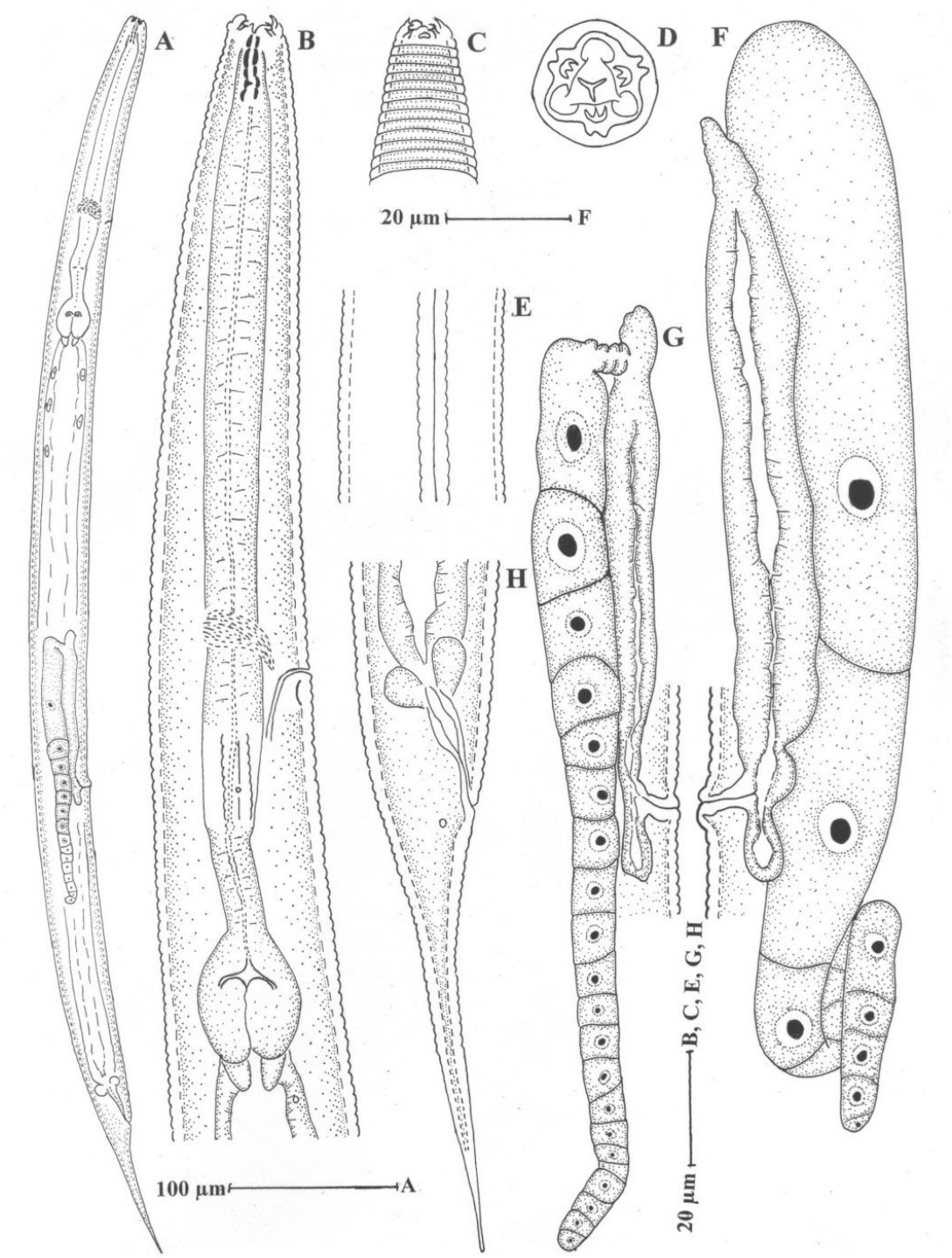

Fig. 2. *Zeldia tridentata* **A.** Entire female; **B.** Pharyngeal region; **C.** Anterior region showing amphid and cuticular punctations**, D.** Enface view; **E**. Lateral lines; **F, G**. Female reproductive system; **H**. Female posterior region

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