

Two new species of *Hemicycliophora* de Man, 1921 from Honduras with observations on five other species (Nematoda : Tylenchida)

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SUMMARY

Two new species of *Hemicycliophora* are described with detailed illustrations and SEM photomicrographs. *H. quercea* n. sp. is unique because body extends to terminus of exterior sheath but is most closely related to *H. tenuistriata* differing by its shorter length and stylet (0.80 mm (0.71-0.86) and 75.5 μ m (70.5-79.0) respectively for *H. tenuistriata*) and by the prominent single longitudinal incisure in lateral field (lacking in *H. tenuistriata*). *H. pinocheli* n. sp. is most closely related to *H. belemnisi* and *H. lutosa* differing from the former by its greater stylet length, number of body annules and by absence of males; from *H. lutosa* it differs by larger stylet, rounded lip region and absence of males. Further observations on five other species: *H. triangulum* Loof, 1968; *H. chathamii* Yeates, 1972; *H. sheri* Brzeski, 1971; *H. vidua* Raski, 1958 and *H. chilensis* Brzeski, 1974 with SEM photomicrographs also are given.

RÉSUMÉ

Deux nouvelles espèces d'*Hemicycliophora* de Man, 1921 provenant du Honduras
et observations sur cinq autres espèces (Nematoda : Tylenchida)

Deux nouvelles espèces d'*Hemicycliophora* sont décrites et illustrées (dessins et photographies au MEB). *H. quercea* n. sp. montre un caractère unique dans le genre : le corps s'étend en effet jusqu'à l'extrémité du feuillet cuticulaire externe ; cette espèce est très proche de *H. tenuistriata* mais en diffère par un corps et un stylet plus courts (0,80 mm (0,71-0,86) et 75,5 μ m (70,5-79,0) chez *H. tenuistriata*) et par un champ latéral comportant une seule incisure, prédominante, qui est absente chez *H. tenuistriata*. *H. pinocheli* n. sp. est le plus voisin de *H. belemnisi* et *H. lutosa*, différant de la première espèce par un stylet plus long, le nombre d'anneaux du corps et par l'absence de mâles ; et de la seconde par le stylet plus long, la région labiale arrondie et l'absence de mâles. Des observations complémentaires et des photographies sont données concernant cinq autres espèces : *H. triangulum* Loof, 1968 ; *H. chathamii* Yeates, 1972 ; *H. sheri* Brzeski, 1971 ; *H. vidua* Raski, 1958 et *H. chilensis* Brzeski, 1974.

Representatives of *Hemicycliophora* de Man, 1921 are widely distributed. To date the species described number to one hundred from all over the world. Brzeski (1974) and Brzeski and Ivanova (1978) have published keys to species of the genus. Siddiqi (1980) lists seventy-eight species after proposing synonymies and new genera.

Specimens collected from Honduras represent two new species and are described below. In addition, observations on morphology and distribution of five described species also are given.

Materials and Methods

Nematodes collected from Honduras were available as permanent mounts in glycerine. Other specimens were killed in hot water and preserved in four percent formalin. These were later transferred to FAA and

dehydrated to glycerine following Cobb's method of 0.25% glycerine in 30% alcohol, then 5% glycerine in 30% alcohol. These were then stored in small BP1 dishes in closed Petri dishes and evaporated gradually to glycerine. Final dehydration was achieved in dessication chambers over CaCl₂ crystals. Specimens then were mounted in dehydrated glycerine. *En face* views and transverse-sections were cut by hand and mounted in glycerine-jelly.

SEM studies were made both from formalin fixed as well as glycerine processed specimens. Formalin fixed specimens were transferred to FAA, then to absolute ethyl alcohol by vapor exchange in a 32° oven. Specimens then were transferred to a graded series of amyl acetate in absolute alcohol from 30% to absolute amyl acetate. After a 15 s sonication in pure amyl acetate to clean the specimens, they were processed through critical point drying with CO₂.

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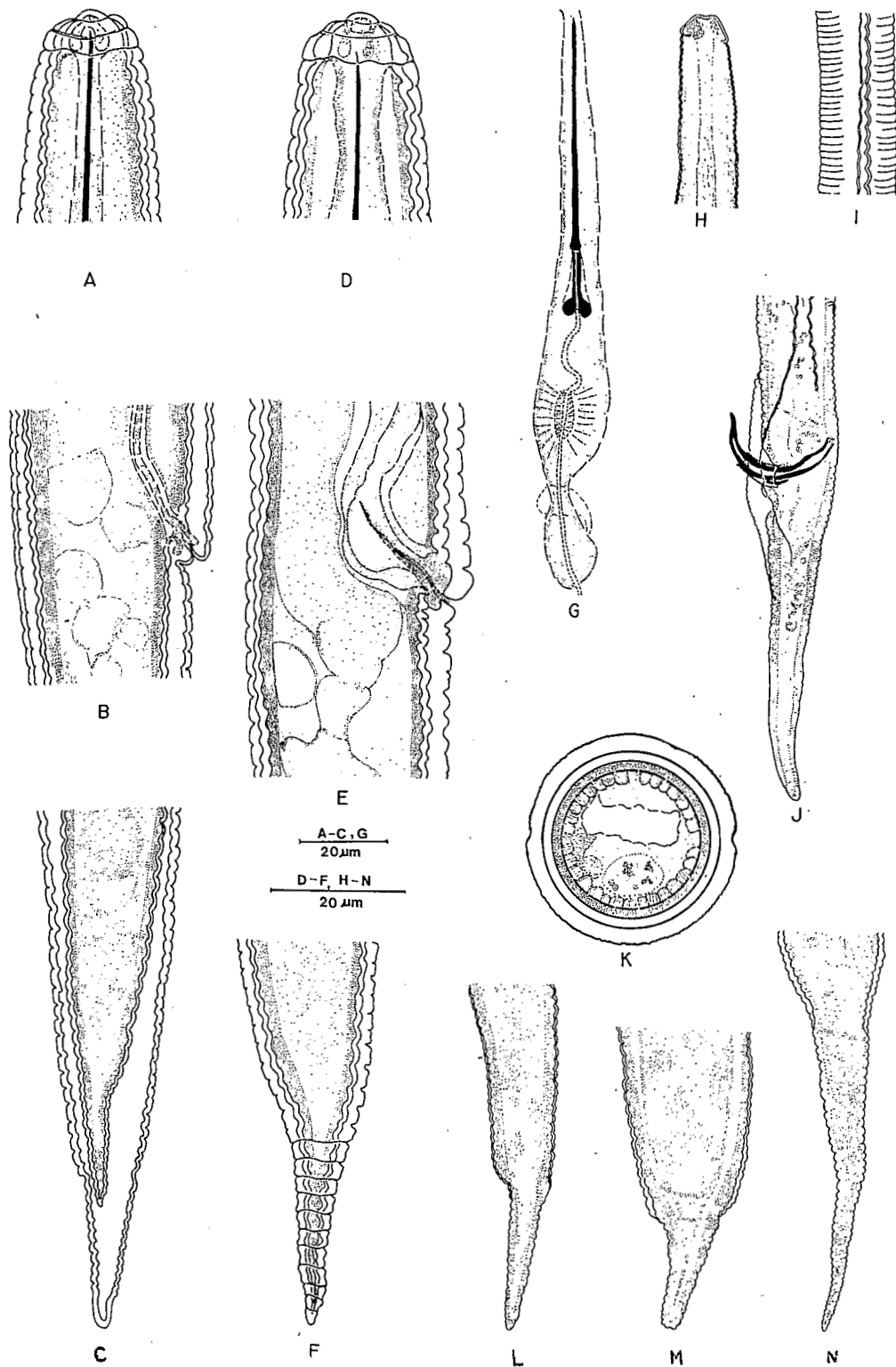


Fig. 1. (A-C). *Hemicycliophora pinocheti* n. sp. Female : A : Head region. B : Vulval region. C : Tail. (D-L) *Hemicycliophora quercea* n. sp. Female. D : Head region. E : Vulval region. F : Tail. G : Esophagus. Male. H : Head region. I : Mid-body showing lateral field. J : Tail region, showing spicules and caudal alae. K : Cross-section of female mid-body, showing cleft of lateral field. L : Juvenile tail. M : *Hemicycliophora triangulum* Loof, 1968, juvenile tail. N : *Hemicycliophora* sp., larval tail.

These then were mounted on aluminium foil stubs and coated with 300A° of gold sputtered on in several layers. The glycerine processed specimens were first brought down in a graded series beginning with 85% glycerine in 30% alcohol to FAA and then reprocessed as for above specimens. ISI (International Scientific Instruments) Model 3S-130 DS scanning electron microscope (SEM) was used for detailed study of the specimens at 10KV.

Hemicycliophora quercea n. sp.

(Fig. 1, D-L; Fig. 2, D, G, J-L)

MEASUREMENTS

Females (paratype; n = 11): L = 0.65 mm (0.60-0.72); a = 25 (22-28); b = 5.5 (5.0-5.7); c = 9.5 (9.0-10.0); V = $36^{(31-40)}$ 82 (81-83); stylet = 64 μ m (60-68); cone = 51 μ m (49-54); R = 189 (181-198); R_V = 144 (134-152); R_{an} = 154 (145-163); R_{eso} = 34 (33-35); R_{exp} = 37 (36-38).

Males (paratype; n = 5): L = 0.56 mm (0.52-0.60); a = 33 (31-37); c = 7.7 (6.9-8.5); spicules = 37.6 μ m (34-43); gubernaculum = 5.9 μ m (5.0-6.5).

Juveniles, 3rd stage (paratype; n = 4): L = 0.39 mm (0.37-0.41); a = 22 (20-23); b = 3.8 (3.4-4.1); stylet = 51 μ m (50-53); cone = 41 μ m (40-42); R = 212 (201-222).

Holotype (female). L = 0.66 mm; a = 24; b = 5.4; c = 10; V = 3481^- ; stylet = 63 μ m; cone = 51 μ m; R = 186; R_V = 143; R_{an} = 160; R_{eso} = 36; R_{exp} = 40.

Allotype (male). L = 0.54 mm; a = 32; c = 6.9; spicules = 37 μ m; gubernaculum = 6.0 μ m.

DESCRIPTION

Female: Body curved slightly on fixation. Cuticular sheath closely adpressed to the inner body, both with coarse annules measuring 0.5 to 0.6 μ m between striae. Sheath annules flattened, squared; more so at tail end. Outer cuticular sheath and inner body cuticle remain together right up to terminus. Lateral field marked by single distinct lateral line bordered by two faint lines at various locations on body. Cuticle with numerous longitudinal markings between striae, throughout body length, deeper in some areas, almost equidistantly placed, very faint in other areas. Cephalic region rounded on sides, truncate on anterior end, giving the appearance of a squared labial disc. Cephalic region with three annules; first annule smaller, next two annules wider. Stylet of moderate thickness; knobs well developed, smooth, sloping backwards slightly. Hemizonid two annules long almost in line with posterior bulb. Excretory

pore posterior to hemizonid, 132 μ m (125-142) from anterior end. Vulval lips modified with anterior lip extending over posterior lip to a length of approximately two annules. Cuticular sheath in most specimens outstretched, without annulation in region of vulva. Ovary single, outstretched anteriorly, with an oval spermatheca, containing rounded sperms about 2-3 μ m in diameter. Body evenly conoid posterior to vulva, inner body extends to terminus of outer cuticle.

Male: Body slender with fine cuticular annules; curved ventrally especially in posterior region. Lateral field with two lines, dorsal line more strongly marked than ventral line. SEM photograph shows lateral field (Fig. 2, L) as very thick and raised. Probably this is why two lines appear as such in light microscope (Fig. 1, H). Cephalic region continuous to slightly offset from body, trapezoid in appearance, due to four large lobes with a flat oral disc on top. Excretory pore well defined, 113 μ m (106-117) from anterior end. Hemizonid few annules anterior to excretory pore at 102 μ m (98-105) from cephalic region. Spicules curved strongly; gubernaculum simple, rod-shaped. Caudal alae well developed, with broader annulations than body cuticle. Tail evenly conoid, ending in a fine rounded terminus.

Juveniles: Similar to adult females, but outer cuticle fits loosely over body. Also tail region differs in that body is cylindroid up to final 20 μ m of tail, then marked constriction sets off conoid tail with well marked annules. Inner body cuticle and outer cuticle merge at region where tail constricts. Developing gonad ovate with 6-8 cells.

TYPE LOCALITY

Soil from Puerto Lempira, La Mosquitia, Honduras, from around *Quercus oleoides*.

TYPE MATERIAL

Holotype: Female collected by G. Ostmark on Sept. 11, 1976, deposited on slide number 2040 in University of California Nematode Collection (UCNC), Davis, California, U.S.A. *Allotype*: Male, same data as holotype female, deposited on slide number 2041 UCNC, Davis. *Paratypes*: ten females, five males, and four juveniles deposited as follows: six females, five males and four juveniles at UCNC, Davis; one female each at: USDA Nematode Collection, Beltsville, Maryland, U.S.A.; Nematology Department, Rothamsted Experimental Station, Harpenden, England; Agricultural University, Wageningen, The Netherlands; National Nematode Collection, Indian Agricultural Research Institute, New Delhi, India.

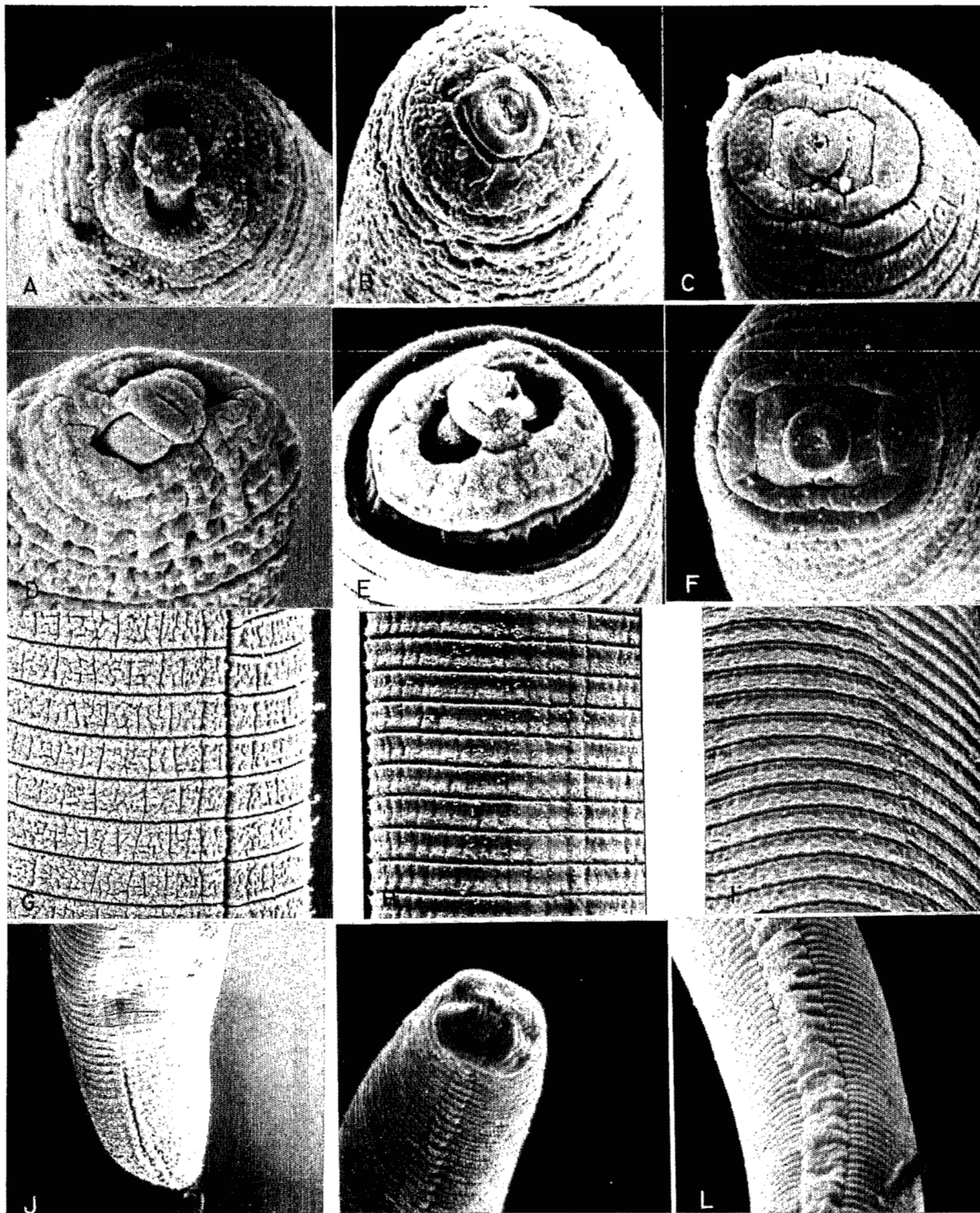


Fig. 2. A : *Hemicycliophora chilensis* Brzeski, 1974. Female head region. 2 000 \times . B : *Hemicycliophora sheri* Brzeski, 1974. Female head region. 2 255 \times . C : *Hemicycliophora vidua* Raski, 1958 (paratype). Female head region. 2 555 \times . (D, G, J) *Hemicycliophora quercea* n. sp. Female. D : Head region. 2 495 \times . G : Mid-body showing lateral field and cuticular markings. 1 820 \times . J : Tail region showing extension of lateral field. 790 \times . (E, H) *Hemicycliophora pinocheti* n. sp. Female. E : Head region. 2 445 \times . H : Mid-body showing faint traces of lateral field. 1 050 \times . (F, I) *Hemicycliophora vidua* (Minnesota collection). Female. F : Head region. 2 565 \times . I : Mid-body. 2 775 \times . (K, L) *Hemicycliophora quercea*. Male. K : Head region. 2 070 \times . L : Mid-body showing raised lateral field. 2 355 \times .

DIAGNOSIS

Hemicycliophora quercea n. sp. is unique from all described species of *Hemicycliophora* because body extends to terminus of exterior sheath. Otherwise, it keys to *H. tenuistriata* from which it differs by its shorter length and stylet (0.80 mm (0.71-0.86) and 75.5 μm (70.5-79.0) respectively for *H. tenuistriata*) and by the prominent single longitudinal incisure in lateral field (lacking in *H. tenuistriata*).

***Hemicycliophora pinocheti* n. sp.**

(Fig. 1, A-C; Fig. 2, E, H)

MEASUREMENTS

Females (Paratype; n = 10) : Inner body : L = 1.04 mm (1.01-1.08); a = 33 (30-34); b = 5.6 (4.9-6.0); c = 13 (10-13); V = 85 (84-87). Outer cuticle : L = 1.09 mm (1.06-1.10); a = 27 (24-31); stylet = 103 μm (94-117); cone = 87 μm (80-101); R = 296 (284-322) (Inner); 304 (282-320) (Outer); R_V = 233 (216-246); R_{an} = 246 (243-248); R_{eso} = 51 (46-60); R_{exp} = 56 (53-61); R_{stylet} = 29 (27-31).

Juveniles (n = 8) : Inner body : L = 0.84 mm (0.81-0.89); a = 32 (30-35); b = 4.8 (4.7-4.9). Outer body : L = 92 μm (0.90-0.95); a = 27 (26-28); stylet = 97 μm (91-103); cone = 83 μm (79-90).

Holotype (female) : Inner body : L = 1.04 mm; a = 34; b = 5.8; c = 10; V = 84; Outer cuticle : L = 1.08 mm; a = 28; stylet = 103 μm ; cone = 87 μm ; R = 291 (Inner); 320 (Outer); R_V = 227; R_{an} = 248; R_{eso} = 53; R_{exp} = 55; R_{stylet} = 29.

DESCRIPTION

Females : Body curved slightly ventrad on fixation, outer cuticle loosely covering body, more so towards posterior end. Annules on outer cuticular sheath flatter and less rounded than on inner cuticle. Lateral field with two distinct lines, starting at region of posterior esophageal bulb, ending a short distance posterior to vulva. Frequently there appears a third line in form of anastomosis to areolation, to a faint line, but varies at different parts of cuticle. Cephalic region rounded, of two annules, with rounded cuticular plate in center. In lateral view the two annules appear as one large annule with slight indent in mid-region. Amphidial opening large, semicircular to ovate. Stylet slender with smooth ovate basal knobs directed backwards with a small cavity in middle. Excretory pore clearly visible, 205 μm (189-225) from anterior end. Hemizonid posterior to excretory pore, two annules long. Vulval lips modified, anterior lip extending over posterior one. Ovary single with

ovate spermatheca, almost empty or usually bearing a few rounded sperms, averaging 2 μm in size. Anus not clearly seen, only vague traces of anal area can be detected. Tail conoid, gradually and evenly narrowing from the vulval region posteriad, ending in smooth rounded terminus. Annules extending to tip, becoming more coarse and sheath annules more flat posteriad. Cuticle smooth with no markings other than lateral field.

Juveniles : Similar to the adults.

Males : Unknown.

TYPE LOCALITY : Soil around citrus at Choloma-Certes, Honduras.

TYPE MATERIAL

Holotype : Female collected by J. Pinochet on August 27, 1976, deposited on slide number 2042 in UCNC, Davis. *Paratypes* : nine females and eight juveniles deposited as follows : five females and eight juveniles at UCNC, Davis; one female each at : USDA Nematode Collection, Beltsville, Maryland, U.S.A.; Nematology Department, Rothamsted Experimental Station, Harpenden, England; Agricultural University, Wageningen, The Netherlands; National Nematode Collection, Indian Agricultural Research Institute, New Delhi, India.

DIAGNOSIS

Hemicycliophora pinocheti n. sp. is closely related to *H. belemnii* Germani & Luc, 1973, but differs by its larger stylet and greater number of annules. It is also related to *H. lutosa* Loof & Heyns, 1969, but differs in its larger stylet (74-94 μm in *H. lutosa*), rounded lip region (truncate in *H. lutosa*), and position of vulva (V = 84-87 in *H. pinocheti* n. sp. and 80-84 in *H. lutosa*).

***Hemicycliophora triangulum* Loof, 1968**

(Fig. 1, M)

MEASUREMENTS

Females (n = 19) : L = 0.70 mm (0.67-1.00); a = 29 (24-32); b = 5.6 (5.4-5.9); c = 10.3 (9.3-11.3); V = 83 (81-84); stylet = 77 μm (73-83); cone = 65 μm (61-68); R = 225 (208-240); R_V = 175 (164-188); R_{an} = 185 (183-186); R_{exp} = 45 (44-46); R_{hem} = 42-43.

Juveniles, 4th Stage (n = 10) : 0.74 mm (0.70-0.80); a = 25 (23-26); b = 5.4 (4.1-6.5); stylet = 67 μm (65-69); cone = 55 μm (52-57); R = 238 (201-268).

OBSERVATIONS

This species was reported by Loof (1968) from various localities in the Netherlands. He also reports populations from Western Belgium, Germany and Switzerland. The above dimensions are from specimens collected by W. Thames and Augustin Sanchez from a five year pasture soil of rye and clover mix at Overton, Texas. The populations mentioned in Loof's paper also mostly collected from meadows, grass-soil, etc.

There is no report on juveniles of this species given. In most respects, the juveniles are similar to adult females, but differ in tail shape, which is uniformly rounded to terminus, there it constricts markedly to conoid shape ending in conoid-flat tip, with coarse annulations to tip. Outer cuticle merges with inner body cuticle at constriction.

Hemicycliophora chathamii Yeates, 1978

OBSERVATIONS

This species was originally described from Chatham Island. Seventy-five females, seventeen males and fourteen juveniles of the same species have been collected from various localities from the Antipodes Island, Auckland Island, Waiapu forest Soil, New Zealand. In all dimensions and appearance these specimens are similar to original description of *H. chathamii*.

Hemicycliophora chilensis Brzeski, 1974

(Fig. 2, A)

MEASUREMENTS

Females : Inner body : L = 0.85 mm (0.83-0.87) ; a = 29 (25-30) ; b = 5.1 (4.7-5.7) ; c = 8.9-9.5 ; V = 84-85. Outer cuticle : L = 0.89 mm (0.86-0.91) ; a = 23 (21-24) ; stylet = 89 μ m (84-95) ; cone = 74 μ m (73-79) ; R = 251 (247-256) (Inner) ; 268 (262-274) (Outer) ; R_V = 200 (197-205) ; R_{an} = 216 (213-220) ; R_{eso} = 49 (47-50) ; R_{exp} = 51 (48-53) ; R_{stylet} = 25 (24-27).

OBSERVATIONS

This species was named by Brzeski (1974) from the single specimen identified as *H. thienemanni* (Schneider, 1925) Loos, 1948 by Andr assy (1967). Specimens from soil about roots of *Tagetes* spp. in a greenhouse at Bogota, Colombia, collected by R. Barrigo-Oliviera resembles this species in all respects differing in total length only.

Hemicycliophora vidua Raski, 1958

(Fig. 2 C, F, I)

OBSERVATIONS

This species was described from Antioch, California. Later Brzeski (1974) reported this species as widely distributed in Northern parts of U.S.A. and Southern Canada. A population of this species was collected by S. A. Sher from around cottonwood in Minnesota. Identification of this species brought up the fact that *H. vidua* and *H. sheri* Brzeski, 1974 are very similar in dimensions. Differential diagnosis mention that they could be separated by labial disc, being flat at anterior end in *H. vidua* and rounded in *H. sheri*. In lateral view not much difference could be detected on the light microscope.

SEM photographs were made from a paratype specimen of *H. vidua*, from topotypes of *H. sheri* and from the Minnesota collection show the cephalic region of *H. sheri* (Fig. 2, B) is distinct from the paratype of *vidua* (Fig. 2 C), and that the Minnesota collection (Fig. 2 F) is similar to *H. vidua*.

Hemicycliophora sp.

(Fig. 1 N)

OBSERVATIONS

Specimens which appear to represent a new species were collected by B. F. Lownsbery from Amador County, California, U.S.A. Too few adult specimens were preserved in good enough condition to permit proper study of their morphology. The juvenile tail is interesting, however, showing a shape similar to juveniles of *H. triangulum* and *H. quercea* n. sp. (Fig. 1 L-N). Juveniles of *H. epicharoides* Loof, 1968 (Marinari *et al.*, 1982) also show a similar characteristic of merging cuticles on tail. Although juveniles of some species have tail with outer sheath, presence of juveniles with only one cuticle appears to be common in *Hemicycliophora*.

Discussion

Above studies show close relationship among the species of *Hemicycliophora* and their extensive distribution. However, these studies also prove that lateral view and dimensions of species alone do not always help in keying out the species. As more populations are studied, species dimensions are overlapping, and hence makes their identification more difficult. Markings on the body that are used in keying out species are frequently very faint in glycerine-mounted specimens. Lateral field and cephalic

region configuration become difficult as, being rounded, these tend to turn on mounting, rather than giving lateral view. *En face* view and cross sections of body help in these studies, more by SEM photographs where possible. Differences in *en face* views can be seen (Fig. 2) and also intensity of body markings.

Further, description of juveniles, which have not been made in any of new species description, also seem important. Two groups of juveniles can be noted : first, juveniles that resemble adult and have outer cuticular sheath separated from body to around tail ; secondly, juveniles in which rounded body constricts to conoid tail and the two cuticles merging together at region of constriction.

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REFERENCES

- ANDRÁSSY, I. (1967). Nematoden aus Chile. Argentinien und Brasilien, gesammelt von Prof. Dr. H. Franz. *Opusc. zool. Bpest*, 7 : 3-34.
- BRZESKI, M. W. (1974). Taxonomy of Hemicycliophorinae (Nematoda : Tylenchida). *Zesz. probl. Post. Nauk. Roln.*, 154 : 237-330.
- BRZESKI, M. W. & IVANOVA, T. S. (1978). Taxonomic notes on *Hemicycliophora* De Man (Nematoda : Hemicycliophoridae). *Nematol. medit.*, 6 : 147-162.
- GERMANI, G. & LUC, M. (1973). Contribution à l'étude du genre *Hemicycliophora* De Man, 1921 (Nematoda : Tylenchida) comportant la description de cinq nouvelles espèces. *Cah. ORSTOM, Sér. Biol.*, 21 : 67-84.
- LOOF, P.A.A. (1968). Taxonomy of *Hemicycliophora* species from West and Central Europe. *Meded. Landbhogesch. Wageningen*, 68-14 : 1-43.
- MARINARI, A., VINCIGUERRA, M., VOLVOS, T. N. & ZULLINI, A. (1982). Nematodi Delle Dune Costiere D'Italia. Quaderni sulla « Struttura delle zoocenosi terrestri. » 3. Ambienti Mediterranei. I. Le Coste Sabbiose. Pubblicazione AQ/1/73 : 27-50.
- RASKI, D. J. (1958). Four new species of *Hemicycliophora* De Man, 1921 with further observations on *H. brevis* Thorne, 1955 (Nematoda : Criconematidae). *Proc. helminth. Soc. Wash.*, 25 : 125-131.
- SIDDIQI, M. R. (1980). Taxonomy of the plant nematode super-family Hemicycliophoroidea, with a proposal for Criconematina, new suborder. *Revue Nématol.*, 3 : 179-199.

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