

Description of *Trophotylenchulus saltensis* n. sp.,
with a comment on the status of *Trophotylenchulus* Raski,
1957 and a proposal for *Ivotylenchulus* n. gen.
(Nematoda : Tylenchida)

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SUMMARY

Trophotylenchulus saltensis n. sp., found parasitizing olive (*Olea europaea* L.) in Salt, Jordan, is described and illustrated. It differs from previously described *Trophotylenchulus* species by the lower V coefficient (70.5 vs. ≥ 76). *Trophotylenchulus* Raski, 1957 is considered a valid genus and is differentiated from *Tylenchulus* Cobb, 1913 s. str. mainly by the cephalic region of females, juveniles bearing a circumoral elevation which is lacking in the latter genus, and the more anterior position of the excretory pore in females, males and juveniles (> 45 vs. < 65 , ≤ 40 vs. > 50 and ≤ 45 vs. > 47 % of body length, respectively); other differentiating characteristics are mentioned. Two new combinations are proposed: *Trophotylenchulus obscurus* (Colbran, 1961) nov. comb. and *Trophotylenchulus clavicaudatus* (Colbran, 1966) nov. comb. *Ivotylenchulus* n. gen. is proposed for *Trophotylenchulus manganoti* (Luc, 1957) Goodey, 1963 (syn. *Tylenchulus manganoti* Luc, 1957): it is differentiated from other genera of Tylenchulinae Skarbilovich, 1947 by the absence of a spicular sheath and the apparently protrusible gubernaculum in the male; other diagnostic characteristics are given. Keys to the genera and species of Tylenchulinae are proposed.

RÉSUMÉ

Description de *Trophotylenchulus saltensis* n. sp., commentaire sur le statut
de *Trophotylenchulus* Raski, 1957 et proposition d'*Ivotylenchulus* n. gen. (Nematoda : Tylenchida)

Trophotylenchulus saltensis n. sp., parasite de l'olivier (*Olea europea* L.) à Salt, Jordanie, est décrit et illustré. Il diffère des espèces de *Trophotylenchulus* décrites par une vulve plus antérieure ($V = 70.5$ vs. ≥ 76). *Trophotylenchulus* Raski, 1957 est considéré valide et différent de *Tylenchulus* Cobb, 1915 s. str. par la structure de la région céphalique des femelles et des juvéniles comportant une élévation circumorale (absente chez *Tylenchulus*) et par la position antérieure du pore excréteur chez les femelles, les mâles et les juvéniles (15 vs. 75; 40 vs. 50 et 45 vs. 50% de la longueur du corps, respectivement). *Trophotylenchulus obscurus* (Colbran, 1951) nov. comb. et *Trophotylenchulus clavicaudatus* (Colbran, 1966) nov. comb. sont proposés. *Ivotylenchulus* n. gen. est proposé pour *Trophotylenchulus manganoti* (Luc, 1957) Goodey, 1963 (syn. *Tylenchulus manganoti* Luc, 1957); ce nouveau genre diffère des deux autres composant les Tylenchulinae Skarbilovich, 1947 par l'absence d'enveloppe spiculaire et un gubernaculum apparemment protrusible. Des clefs des genres et espèces de Tylenchulinae sont données.

A new species of *Trophotylenchulus* Raski, 1957 was found parasitizing olive (*Olea europaea* L.) in Salt, Jordan. It is described herein as *T. saltensis* n. sp., together with a comment on the status of *Trophotylenchulus* and a proposal for *Ivotylenchulus* n. gen.

Materials and methods

Vermiform specimens of *T. saltensis* used in this study were killed by heat, fixed in TAF, immersed in hot (60-65°) lactophenol containing cotton blue stain and finally processed to anhydrous glycerol by the rapid method of Baker (1953): sedentary females of the nematode (one complete and others damaged) were dissected out of roots that had been immersed in boiling lactophenol containing cotton blue; thereafter, they were processed to anhydrous glycerol by

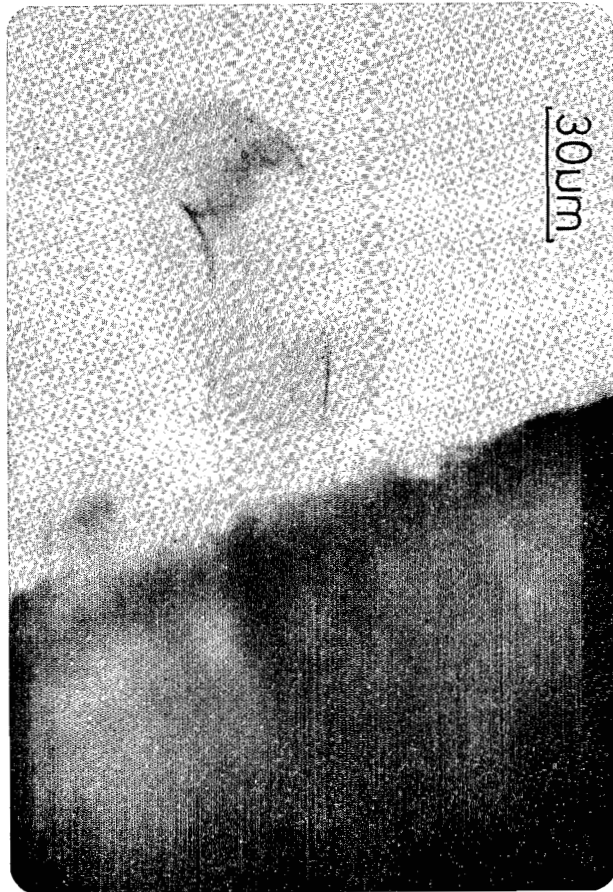


Fig. 1. *Trophotylenchulus saltensis* n. sp. Female in semi-endoparasitic feeding position on olive root.

Baker's (1953) method. A Zeiss Photomicroscope III, fitted with a camera lucida and an ocular micrometer, was used for photographing, drawing and measuring the specimens. Standard error of the mean has been calculated for each of the main measurements and coefficients.

Trophotylenchulus saltensis n.sp. (Fig. 1 & 2 A-S)

DIMENSIONS

Holotype female (mature): L = 0.44 mm; a = 7.9; b = 3.7; c = 10.7; c' = 4.5; V = 70.5; stylet⁽¹⁾ = (approx.) 11.5 μm; m = (approx.) 60; O = ?; MB⁽²⁾ = 45.

Paratype males (n = 3): L = 0.41 ± 0.01 (0.39-0.42) mm; a = 37.3 ± 0.88 (36-39); b = 3.6 ± 0.38 (3.0-4.3); c = 8.9 ± 0.33 (8.3-9.4); c' = 5.9 ± 0.20 (5.6-6.3); T = 30.7 ± 2.33 (27-35); stylet = 8.3 ± 0.44 (7.5-9.0) μm; m = 50 ± 2.49 (47-52); O = ?; MB (n = 2) = 48 (44-52); spicule = 14.5 ± 0.50 (13.5-15.0) μm; gubernaculum (n = 1) = 4.2 μm.

Paratype preparasitic (? = second-stage) juveniles (n = 13): L = 0.41 ± 0.004 (0.38-0.44) mm; a = 31.6 ± 0.42 (29-35); b = 3.8 ± 0.02 (3.7-4.0); c (n = 4) = 8.9 ± 0.24 (8.4-9.5); c' (n = 4) = 5.3 ± 0.19 (4.8-5.7); stylet = 13.5 ± 0.07 (13.0-14.0) μm; m = 54.7 ± 0.41 (52-57); O = 32.6 ± 1.18 (26-41); MB = 49.9 ± 0.26 (48-51).

DESCRIPTION

Mature female: Sedentary root parasite, with anterior part embedded in the cortical tissue. Posterior part considerably enlarged (mainly dorsally), coiled and ventrally arcuate. Lateral fields, phasmids, deirids, cephalids and hemizonid not observed; cuticular annulation fine, annules 1.0-1.5 μm in width at mid-body (less distinct anteriorly and posteriorly). Cephalic region unstriated, with rounded sides and a conspicuous circumoral elevation. Cephalic

⁽¹⁾ Stylet dislodged from its natural position and with a slightly distorted telenchium which is difficult to discern. Its length, therefore, is given as an approximation, as is the m coefficient.

⁽²⁾ MB = distance between anterior end and centre of median bulb × 100 / distance between anterior end and posterior end of oesophagus.

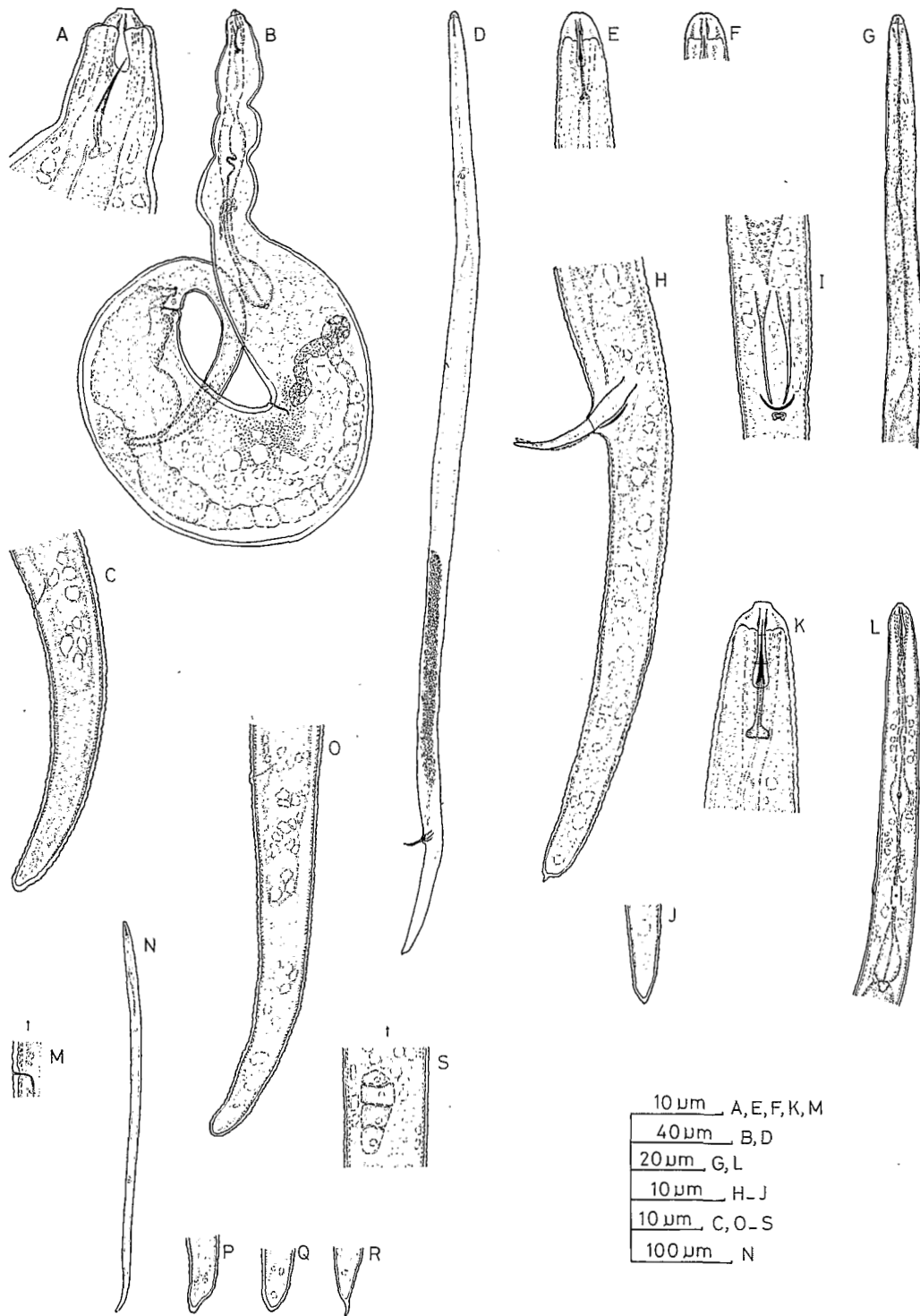


Fig. 2. *Trophotylenchulus saltensis* n. sp. Female (holotype) A : anterior region (stylet dislodged from its natural position). B : whole specimen. C : caudal region. Male (paratypes). D : whole specimen. E, F : anterior region. G : oesophageal region. H : caudal region. I : cloacal region (ventral). J : tail terminus. Preparasitic juvenile (paratypes). K : anterior region. L : oesophageal region. M : excretory pore and duct. N : whole specimen. O : caudal region. P, Q, R : tail terminus. S : genital primordium. (Arrows in M & S indicate direction of anterior end).

framework lightly sclerotized. Stylet moderately developed, with rounded knobs inclined posteriorly; metenchium (= conus) 7 μm long. Vestibule extension extending posteriorly from the basal plate, 5.5 μm in length. Orifice of dorsal oesophageal gland not observed. Oesophagus criconematoid: precorpus relatively broad, extending anteriorly around the basal portion of stylet; postcorpus (= median oesophageal bulb) with valvular apparatus and anteriorly amalgamated with precorpus; isthmus slender with nerve ring encircling it; basal bulb elongate-pyriform; gland nuclei indiscernible. Oesophago-intestinal valve (cardia) greatly reduced. Intestine apparently without a lumen, extending anteriorly around the posterior portion of the basal bulb. Rectum and anus present but poorly developed (probably non-functional), with intestine extending posteriorly beyond the anal level. Excretory pore at 41 % of body length and 182 μm from the anterior end; excretory duct connected to a ventral excretory cell. Post-vulval region 120.5 μm (93-122 in three incomplete specimens) in length. Gonad monodelphic, prodelpic. Uterus thick-walled. Spermatheca not seen. Post-vulval sac about $\frac{1}{2}$ ($\frac{1}{2}$ - $\frac{3}{4}$ in three incomplete specimens) vulval body width. Ovary extending anteriorly, with flexures; oocytes arranged in a single file in the proximal portion and in two rows in the distal portion of ovary. Tail elongate-conoid, ventrally arcuate, with 37 indistinct annules on ventral side. Tail terminus smooth, rounded.

Male: Vermiform. Body cylindroid, almost straight when killed by heat (Fig. 2D). Lateral fields inconspicuous. Deirids and phasmids not observed. Cephalic region unstriated, conoid-rounded and continuous with the body; circumoral elevation absent. Cephalic framework lightly sclerotized. Stylet weakly developed. Vestibule extension extending posteriorly from the basal plate, 3-4 μm in length. Oesophagus degenerate. Hemizonid extending over two annules, immediately posterior to level of nerve ring. Excretory pore observed in one specimen, at 37 % of body length and 149 μm from anterior end. Excretory duct posteriorly directed relative to excretory pore. Testis single, anteriorly outstretched; spermatocytes arranged in multiple rows. Spicules cephalated, angled distally and with pointed tips; gubernaculum curved in lateral view, apparently non-protrusible; bursa absent. Cloacal aperture situated on a distinct protuberance (= spicular sheath); hypopygmata small, double, situated on the posterior cloacal lip. Caudal region elongate-conoid, with a pointed terminus which may be extended in the form of a projection.

Preparasitic (? = second-stage) juvenile: Vermiform. Body cylindroid, almost straight when killed by

heat. Lateral fields obscure, each with two faint incisures. Deirids present, at about level of hemizonid. Phasmids not observed. Cephalic region unstriated, continuous with the body and with a circumoral elevation. Stylet moderately developed, with rounded knobs inclined posteriorly. Cephalic framework hexaradiate, slightly sclerotized. Anterior cephalids relatively large, situated mostly within the second body annule; posterior cephalids not observed. Vestibule extension 6.5-7.5 μm in length. Orifice of dorsal oesophageal gland 3.5-5.5 μm from stylet base. Oesophagus criconematoid; oesophago-intestinal valve conspicuous, trilobed. Intestine vacuolated, apparently extending posteriorly beyond the anal level. Rectum and anus poorly developed (probably non-functional). Hemizonid conspicuous, extending over three annules and situated immediately posterior to the level of nerve ring. Excretory pore observed in six specimens, at 38.4 ± 0.33 (37-39) % of body length and 157.1 ± 3.25 (153-170) μm from the anterior end. Excretory duct posteriorly directed relative to the excretory pore. Genital primordium four-celled, posterior to excretory pore (Fig. 2 S). Tail elongate-conoid, ventrally arcuate with 37-55 annules (ventral side); terminus smooth and bluntly-rounded, pointed or with a distinct projection.

TYPE HOST AND LOCALITY

Olive (*Olea europaea* L.), Salt, Jordan.

TYPE MATERIAL

Collected by the author on 19th September, 1981. Holotype female, three paratypes males and thirteen paratype juveniles deposited at Rothamsted Experimental Station, Harpenden, Herts., England.

RELATIONSHIP

Trophotylenchulus saltensis n. sp. differs from previously described *Trophotylenchulus* species in the lower V coefficient (70.5 vs. ≥ 76). *T. saltensis* n. sp. is also differentiated from *T. clavicaudatus* (Colbran, 1966) nov. comb. by the longer body of the female (0.44 vs. 0.341-0.383 mm) and juvenile (0.41 vs. 0.331-0.371 mm), the shorter stylet of the male (8.3 vs. 10.0-12.4 μm) and the morphology of the tail terminus of the juvenile which is bluntly-rounded, pointed or with a distinct projection in the former species and mostly slightly clavate in the latter. It also differs from *T. obscurus* (Colbran, 1961) nov. comb. in the longer body of the female (0.44 vs. 0.264-0.333 mm)

and juvenile (0.41 vs. 0.250-0.300 mm), the presence of a post-vulval sac in the female (reportedly absent in *T. obscurus*), the longer spicules of the male (14.5 vs. 11 μm) and the mucronate or mammillate tail terminus of the male (bluntly-rounded in *T. obscurus*). It is also distinguished from *T. floridensis* Raski, 1957 by the shorter stylet and spicules of the male (8.3 vs. 10-12 μm) and 14.5 vs. 20 μm , respectively) and the mucronate or mammillate tail terminus of the male (bluntly-rounded in *T. floridensis*).

The status of *Trophotylenchulus* and proposal for *Ivotylenchulus* n. gen.

Raski (1957) erected the genus *Trophotylenchulus* for a single species, *T. floridensis* Raski, 1957. Thereafter, the validity of this genus has been controversial. Thorne (1961), Paramonov (1962), Goodey (1963), Golden (1971) and Hooper (1978) included *Trophotylenchulus* in their systems of classification of Tylenchida Thorne, 1941, but Maggenti (1962), Geraert (1966), Andr assy (1976) and Samsen and Ali (1978) synonymized it with *Tylenchulus* Cobb, 1913. The synonymy of these two genera is rejected herein and *Trophotylenchulus* is considered a valid genus. Thus, the morphology of the cephalic region, particularly the form and size of the pseudolips and labial disc (? = fused lips), is of the utmost significance in the classification of the generic and higher ranks of Criconematina Siddiqi, 1980 (see De Grisse & Loof, 1965; Loof & De Grisse, 1973; Andr assy, 1979). The cephalic region of females and juveniles of *Trophotylenchulus* is surmounted by a discoid circumoral elevation, but this structure is absent in *Tylenchulus sensu stricto*: according to Geraert (1966), the circumoral elevation of *Trophotylenchulus* species is a consequence of fusion of the four submedian lobes which, presumably, have originated by enlargement of, or as outgrowths on, the submedian pseudolips or as outgrowths of the labial disc⁽¹⁾; apparently, such lobes are poorly developed in *Tylenchulus* thereby not forming an elevation. In addition, *Trophotylenchulus* differs significantly from *Tylenchulus* by the coiled body form of the obese females (irregularly swollen and ventrally arcuate in *Tylenchulus*), the more anterior position of the excretory pore in the females, males

and juveniles (< 45 vs. > 65 \leq 40 vs. > 50 and \leq 45 vs. < 47 % of body length, respectively), the excretory duct of males and juveniles which is posteriorly directed relative to the excretory pore in *Trophotylenchulus* and anteriorly directed in *Tylenchulus* and the distal portion of the male spicules distinctly angled (ventrally arcuate but not angled in *Tylenchulus*). The presence of hypopygmata on the posterior cloacal lip of males of *T. saltensis* (absent in *Tylenchulus semipenetrans* Cobb, 1913) may also be diagnostic of the genus.

In *Tylenchulus clavicaudatus* Colbran, 1966, the female is coiled, a circumoral elevation occurs on the cephalic region of females and juveniles (Fig. 3, A & B), the excretory pore of females is situated at less than 45 % of body length (calculated from Fig. 1, A of Colbran (1966)) and that of males and juveniles at less than 40 % of body length, the excretory duct is posteriorly directed relative to the excretory pore in males and juveniles, the distal portion of male spicules is apparently angled and the posterior cloacal lip of males bears two 'processes' (= hypopygmata). This species, therefore, belongs to *Trophotylenchulus* and a new combination is proposed, *Trophotylenchulus clavicaudatus* (Colbran, 1966) nov. comb. (syn. *Tylenchulus clavicaudatus* Colbran, 1966).

Females of *Tylenchulus obscurus* Colbran, 1961 are coiled and their excretory pore is situated at less than 45 % of body length (calculated from Fig. 1 of Colbran (1961) and according to Table 1 of Samsen & Ali (1978)); also the excretory pore of males and juveniles is situated at 38-45 % of body length and the excretory duct is posteriorly directed relative to the excretory pore in males and juveniles. These characteristics indicate a close relationship between *T. obscurus* and *Trophotylenchulus* species. Although a circumoral elevation on the cephalic region of females and juveniles of this species is not indicated in the original description by Colbran (1961), it is present in the juveniles (see Colbran, 1966) and probably also in the females. Colbran (1961) noted that the males have slightly arcuate spicules, but the accompanying illustration of a male (Fig. 2 of Colbran (1961)) indicates that the retracted spicules may be angled distally (the form of the spicules of *Trophotylenchulus* species is most accurately assessed when protruded). *T. obscurus*, therefore, is transferred to *Trophotylenchulus*, thereby forming a new combination, *Trophotylenchulus obscurus* (Colbran, 1961) nov. comb., (syn. *Tylenchulus obscurus* Colbran, 1961).

Goodey (1963) transferred *Tylenchulus manganoti* Luc, 1957 to the genus *Trophotylenchulus*. However, the excretory pore of the female, male and juvenile is situated at more than 45 % of body length, the

⁽¹⁾ Luc (1957) stated that the circumoral elevation of *Tylenchulus manganoti* Luc, 1967 (herein transferred to *Ivotylenchulus* n. gen.) is derived from fusion of lips.

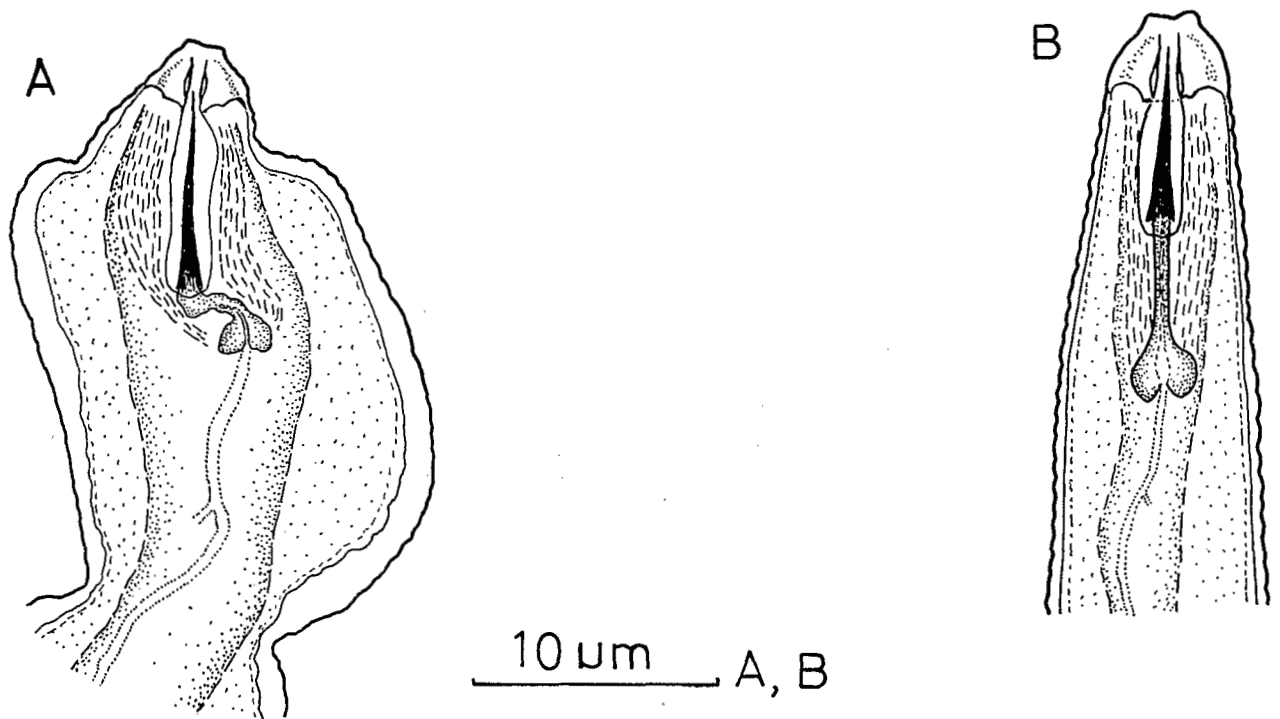


Fig. 3. *Trophotylenchulus clavicaudatus* (Colbran, 1966) nov. comb. Mature female. A : anterior region. Preparasitic juvenile. B : anterior region.

excretory duct of the male and juvenile is anteriorly directed relative to the excretory pore, the male spicules are slightly curved (not angled distally), the male gubernaculum is apparently protrusible through the cloacal aperture (fixed in other *Trophotylenchulus* spp.) and the spicular sheath of males of *Trophotylenchulus* species is absent. Consequently, this species is excluded from *Trophotylenchulus*.

T. mangenoti also differs significantly from *T. semipenetrans* and *T. furcus* van den Berg Spaul, 1981, the only other species in *Tylenchulus*. Thus, the mature females are more prominently ventrally arcuate, the cephalic region of females and juveniles is surmounted by a circumoral elevation, the excretory pore of mature females is situated more anteriorly (< 65 vs. > 65 % of body length), the male gubernaculum is apparently protrusible through the cloacal aperture in the former, but not in the latter, species and the prominent spicular sheath of males of *Tylenchulus* spp. is lacking in *T. mangenoti*. These differences are considered significant at the generic level and, consequently, a new genus, *Ivotylenchulus* n. gen., is proposed in the subfamily Tylenchulinae Skarbilovich, 1947 to accommodate *T. mangenoti*. The new genus is diagnosed below.

*Ivotylenchulus** n. gen.

DIAGNOSIS

Tylenchulinae. Sexual dimorphism present. Mature females sedentary root parasites, with marked ventral curvature (almost coiled) and with posterior part considerably enlarged (mainly dorsally). Lateral fields, deirids and phasmids not observed. Cephalic region with circumoral elevation. Stylet moderately developed, with rounded knobs inclined posteriorly. Oesophagus of the criconematoid type. Anus present. Excretory pore situated at 45-61 % of body length; excretory cell ventrolateral in position. Ovary single, reflexed, within which the oocytes are arranged in a single file proximally and in two rows distally. Males vermiform, cylindroid. Cephalic region lacking a circumoral elevation. Stylet weakly developed and oesophagus degenerate. Excretory pore situated at

* The prefix „Ivo” of the new generic name is derived from Ivory Coast, where the type species was found.

> 60 % of body length. Excretory duct anteriorly directed relative to the excretory pore. Spicules almost straight and cephalated; gubernaculum apparently protrusible through the cloacal aperture; spicular sheath and bursa absent. Testis single, anteriorly outstretched, with spermatocytes arranged in multiple rows. Tail elongate-conoid. Preparasitic juvenile vermiform, cylindroid. Cephalic region with circumoral elevation. Stylet moderately developed; oesophagus of the criconematoid type. Excretory pore situated at 57-62 % of body length. Excretory duct anteriorly directed relative to excretory pore. Lateral field with two incisures. Deirids present, at about the level of hemizonid (see Maggenti, 1962). Anus pore-like.

- Cephalic region of females and juveniles with circumoral elevation; excretory pore of females at less than 65 % of body length. 2
- 2. Excretory duct of males and juveniles posteriorly directed relative to excretory pore; excretory pore of juveniles at ≤ 45 % of body length; spicular sheath of males present.
Trophotylenchulus Raski, 1957
- Excretory duct of males and juveniles anteriorly directed relative to excretory pore; excretory pore of juveniles at > 55 % of body length; spicular sheath of males absent.
Ivotylenchulus n. gen.

Key to species of *Trophotylenchulus* Raski, 1957

- 1. $V < 75$ *T. saltensis* n. sp.
- $V > 75$ 2
- 2. Female body length = 0.44 mm; juvenile body length ≥ 0.4 mm; male spicule = 20 μm
T. floridensis Raski, 1957
- Female body length ≤ 0.38 mm; juvenile body length < 0.4 mm; male spicule = 11-15 μm 3
- 3. Female body length ≥ 0.34 mm; male spicule = 14-15 μm ; juvenile tail terminus slightly clavate.
T. clavicaudatus (Colbran, 1966) nov. comb.
- Female body length < 0.34 mm; male spicule = 11 μm ; juvenile tail terminus bluntly-rounded.
T. obscurus (Colbran, 1961) nov. comb.

Key to species of *Tylenchulus* Cobb, 1913

- 1. Juvenile tail terminus distinctly bifid; male body length > 0.41 mm
T. furcus Van den Berg & Spaull, 1982
- Juvenile tail terminus narrowly conoid; male body length ≤ 0.41 mm
T. semipenetrans Cobb, 1913

TYPE AND ONLY SPECIES

Ivotylenchulus manganoti (Luc, 1957) nov. comb.
 Syn. *Tylenchulus manganoti* Luc, 1957
Trophotylenchulus manganoti (Liic, 1957)
 Goodey, 1963

RELATIONSHIP

Ivotylenchulus n. gen. is differentiated from *Trophotylenchulus* and *Tylenchulus* (the other genera of Tylenchulinae) by the apparently protrusible gubernaculum and the absence of a spicular sheath in the male. In addition, it differs from *Trophotylenchulus* by the more posterior position of the excretory pore of all stages (> 45 vs. ≤ 45 % of body length), the excretory duct of males and juveniles which is anteriorly directed relative to the excretory pore and the slightly curved spicules of the male (not angled distally), and from *Tylenchulus* by the more anterior position of the female excretory pore (< 65 vs. > 65 % of body length) and the presence of a circumoral elevation on the cephalic region of females and juveniles.

Key to genera of Tylenchulinae Skarbilovich, 1947

- 1. Cephalic region of females and juveniles without a circumoral elevation; excretory pore of females at more than 65 % of body length.
Tylenchulus Cobb, 1913

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