


On the Plant-parasitic Nematode Genera *Merlinius* gen. n. and *Tylelenchorhynchus* Cobb and the Classification of the Families Dolichodoridae and Belonolaimidae n. rank

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Abstract: *Merlinius* gen. n. is proposed for 32 species of *Tylelenchorhynchus*, *sensu lato*, which have six incisures in the lateral fields, rather cylindroid spicules with prominently notched distal end, a non-protruding gubernaculum and a moderately developed bursa. *Tylelenchorhynchus* Cobb is redefined and *T. uliginosus* sp. n. and *T. papyrus* sp. n. are described from swampy areas in Uganda. The diagnoses, composition and relationships of Dolichodoridae and Belonolaimidae n. rank are detailed. *Tylelenchus* Filipijev is placed in a new subfamily Tetylenchinae under Tylenchidae.

In his review of the genus *Tylelenchorhynchus* Cobb, 1913, Allen (1955) pointed out the existing diversity in the morphological characters exhibited by various species and prophesied the creation of new genera within this group; two related genera, *Nagelus* and *Geocenamus*, have since been proposed by Thorne and Malek (1968). Tarjan (1964) and de Guiran (1967) gave differential keys for 68 and 71 valid species of *Tylelenchorhynchus* respectively and 25 more new species have since been described. I had the opportunity of studying the specimens of over fifty valid species in this genus including the type species, *T. cylindriceus* Cobb (made available by Dr. Allen) and *T. dubius* (Bütschli) from Holland, Belgium and England which was regarded as type by Filipijev (1934) for his new subgenus *Bitylenchus*, later (1936) synonymized by him with *Tylelenchorhynchus*.

This study shows that whereas *T. dubius* and *T. cylindriceus* are congeneric, a number of other species show considerable differences in their morphology which are considered of generic status. Consequently, *Merlinius* gen. n. is here proposed for those species of *Tylelenchorhynchus*, *sensu lato*, which have six incisures in the lateral fields, deirids frequently present, a small trough-shaped nonprotrusible gubernaculum and characteristic spicules which
markedly differ from those of *Tylenchorhynchus*. Both the genera are described below.

**Merlinius**

**gen. n.**

**DIAGNOSIS:** Tylenchorhynchinae: Dolichodoridae. Lateral fields with six incisures. Deirids frequently present. Lip region symmetrical, with four or more annules but without a perioral disc. Amphids prominent pores or oblique slits close to oral opening. Labial framework lightly to heavily sclerotized. A single papilla on outer margins of each submedian lip. Protrudor muscles of spear attached to the base of labial framework. Basal bulb large, with well developed cardia. Vulva usually with double epitygma and lateral membranes; cloaca with two pedunculate papilla-like protuberances ventro-laterally, here named as hypoptygma. Ovaries symmetrical. Female tail cylindroid to subcylindroid; male tail enveloped by a moderately developed bursa. Spicules stout, rather cylindroid; distal end broadly rounded, notched and devoid of large ventral flanges. Gubernaculum small, trough-shaped in lateral view, not protrusible.

**Type species**


**Other species**

*Merlinius affinis* (Allen, 1955) comb. n.

syn. *Tylenchorhynchus affinis* Allen, 1955

*M. alpinus* (Allen, 1955) comb. n.

syn. *T. alpinus* Allen, 1955

*M. bavaricus* (Sturhan, 1966) comb. n.

syn. *T. bavaricus* Sturhan, 1966

*M. berberides* (Sethi and Sarwar, 1968) comb. n.

syn. *T. berberides* Sethi and Sarwar, 1968

*M. bogdanovikatjkovi* (Kirjanova, 1941) comb. n.

syn. *T. bogdanovikatjkovi* (Kirjanova, 1941)

*Anguillulina bogdanovikatjkovi* Kirjanova, 1941

*M. conicus* (Allen, 1955) comb. n.

syn. *T. conicus* Allen, 1955

*M. cylindricaudatus* (Ivanova, 1968) comb. n.


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1 Named in honor of Dr. Merlin W. Allen, University of California, U. S. A.
M. varians (Thorne and Malek, 1968) comb. n. syn. T. varians Thorne and Malek, 1968

Tylenchorhynchus brachycephalus Litvinova, 1946 is a problematical species. The female measuring 0.70–0.77 mm long has head-end and tail-end like those of Helicotylenchus whereas the male measuring 0.93–1.20 mm is apparently a Merlinius. However the female is reported to have six incisures in the lateral field which is contrary to the definition of Helicotylenchus.

Relationship: Merlinius differs from Tylenchorhynchus in having six incisures in the lateral field, usual presence of deirids, the males having characteristic spicules lacking large ventral flanges and small, nonprotruding gubernaculum.

Nagelus Thorne and Malek, 1968 lacks a labial framework, has asymmetrical lip region, angular spear knobs and protractor muscles of the spear attached to the cuticularized inner walls of the labial cavity.

Geocenamus Thorne and Malek, 1968 is characterized by having a refractive labial disc from which a slender spear guide extends back almost one-third length of the exceedingly slender spear. According to Thorne and Malek (1968) the head and spear of Geocenamus are reminiscent of those of Dolichodorus rather than Tylenchorhynchus.

I have seen deirids in the following species: Merlinius affinis, M. alpinus, M. brevidens, M. conicus, M. dubius, M. grandis, M. icarus, M. microdorus and M. nanus. Figure 1 (J–V) gives further information on certain species of this genus.

Genus Tylenchorhynchus Cobb, 1913 syn. Bitylenchus Filipjev, 1934

Diagnosis (emended): Tylenchorhynchinae: Dolichodoridae. Lip region symmetrical, offset or continuous with body; labial framework lightly to heavily sclerotized; labial disc absent. Lateral fields with 3–5 incisures. Deirids rarely present. Spear usually well developed with prominent basal knobs and anteriorly tapering portion appearing nontubular and needle-like distally; protractor muscles attached to the base of the labial framework. Median and basal bulbs of esophagus well developed. Convoluted tubules running along entire intestinal region present in many species. Spicules cephalated, ventrally arcuate, with distal portion pointed and prominently flanged ventrally. Gubernaculum large, rod-like in lateral view, sometimes with proximal portion dorsally bent, capable of protruding through anus. Bursa terminal, well developed.

Type species: Tylenchorhynchus cylindricus Cobb, 1913.

Two new species of this genus, T. uliginosus and T. papyrus, collected from swampy areas in Uganda are described below. These come close to T. rhopalocercus Seinhorst, 1963, which was transferred by Seinhorst (1968) to the genus Trichotylenchus Whitehead, 1959. I have collected specimens of T. rhopalocercus from sugarcane soil samples originating in Jebba, Nigeria and these fit the original description. The species has a definite basal esophageal bulb and is, therefore, retained in Tylenchorhynchus.

Tylenchorhynchus uliginosus sp. n. (Fig. 2, A–I)

Measurements

Females (25): L = 0.40–0.64 mm; a = 30–37; b = 4.4–5.6; c = 10.5–13.0; V = 52–58; spear = 14–16 μm.

Female (holotype): L = 0.6 mm; a = 34; b = 4.8; c = 12; V = 55–58; spear = 15.5 μm.

Males (10): L = 0.48–0.54 mm; a = 31–37; b = 4.4–5.5; c = 12–14; T = 55–62; spear = 14–15 μm; spicules (measured along dorsal line) = 19–21 μm; gubernaculum = 9.5–10.5 μm.

Description

Female: Body in an open “C” form when relaxed by gentle heat; transverse striae rather coarse, 1.25 μm apart near middle. Lateral fields aerolated, about one-fourth body width; three incisures; outer ones crenate. Phasmids distinct, variable in position from a little anterior to slightly posterior to middle of tail. Lip region conoid-rounded, with 6–7 annules; framework lightly sclerotized, with outer margins extending 2–3 body annules from basal plate. En face of female head shows six papillae in inner and eight in outer circle of which four nearer to amphids are most prominent and large, and circular openings of the amphids (Fig. 2, B). Three-fourths of anterior part of spear needle-like, not tubular; orifice of dorsal esophageal...
gland 2 μ behind spear base. Esophagus typical (Fig. 2, F), cardia apparently made up of two large cells. Excretory pore near anterior end of basal esophageal bulb. Hemizonid two body annules long, just anterior to excretory pore. Vulva with double epitygma; vagina extending half-way across body (Fig. 2, D); spermatheca packed with round sperms 2 μ in diameter; ovaries with 1–2 rows of oocytes. Tail elongate-clavate, 4.6–5.0 × anal body-width long; tail terminus with thick cuticle, coarsely striated.

MALE: Essentially similar to female. Bursa large, finely crenate arising at about 1½ spicular lengths in front of anus. Phasmids near middle of tail. Lateral field, spicule and gubernaculum as shown in Figure 2, I.

RELATIONSHIP: This species is close to T. rhopalocercus Seinhorst, 1963, T. bifasciatus Andrassy, 1961 and T. palustris Merny and Germani, 1968. T. rhopalocercus has females with 0.62–0.81 mm long body, spear measuring 17–19 μ long and tail almost six anal body-widths long. T. bifasciatus has 0.65–0.73 mm long body, 19–20 μ long spear and female tail only 2.6–2.7 anal body-widths long. T. palustris has fewer labial annules and female tail measuring 2.7–3.9 anal body-widths long and having unstriated terminus.

TYPE HABITAT AND LOCALITY: Collected by Prof. W. B. Banage from swampy soil near a fish pond in Kabanyolo, near Kampala, Uganda.

TYPE MATERIAL: Holotype female, four paratype females and two paratype males at Nematology Department, Rothamsted Experimental Station, Harpenden, England; two paratype females and two paratype males at each of the following centers: Nematology Department, University of California, Davis, California, USA; Nematology Department, Landbouwhogeschool, Wageningen, The Netherlands; Department of Zoology, Aligarh Muslim University, Aligarh, India; the remainder at the Commonwealth Bureau of Helminthology, St. Albans, England.

_Tylenchorhynchus papyrus_ sp. n.

_Fig. 3, A–F_

**Measurements**

**FEMALES (5):** L = 0.80–0.94 mm; a = 37–43; b = 5.5–6.6; c = 12.5–16.0; V = 52–55.

**FEMALE (HOLOTYPE):** L = 0.93 mm; a = 40; b = 6.6; c = 14.3; V = 28–52–30; spear = 23.5 μ.

**MALES (4):** L = 0.69–0.75 mm; a = 35–40; b = 5.1–5.7; c = 14–15; T = 55–65.

**Description**

**FEMALE:** Body ventrally arcuate, transverse striae 1.2–1.8 μ apart near mid-body. Lateral fields with three incisures. Lip region conoid-rounded, with 7–8 annules; framework lightly sclerotized. Spear very thin 23–24 μ long, with minute, backwardly directed basal knobs, its anterior part longer than the posterior. Dorsal esophageal gland opening 2.5–3.0 μ behind base of spear. Hemizonid three body annules long, a little behind nerve ring. Excretory pore in the region of the hemizonid or just behind. Basal esophageal bulb rather elongate, its base applied to anterior face of intestine. Cardia large, rounded to slightly discoidal. Large spherical granules present in the intestinal cells. A post-intestinal sac absent but coiled tubules possibly associated with excretory system extend into tail cavity a little behind anal region. Tail elongate-subclavate with striated terminus, 3.7–4.2 times anal body-width long; phasmids at middle of tail or further anterior (Fig. 3, E). Vulva depressed. Spermatheca irregularly rounded. Ovaries with single row of oocytes.

**MALE:** General characters as for female. Spear averaging 23.5 μ long. Spicules 26–29 μ long as measured along their dorsal side, with large ventral flanges; gubernaculum 13 μ long, with a large dorsal spine at proximal end; lateral fields aerolated, disappear before the phasmids; bursa distinctly crenate (Fig. 3, C). Phasmids prominent, anterior to middle of tail.

**RELATIONSHIP:** _T. papyrus_ sp. n. differs from _T. bifasciatus_ in having a longer spear, a subclavate female tail measuring over three anal body-widths long and in the more anterior position of the phasmids (in latter species spear = 19–20 μ long, tail = 2.6–2.7 times anal body-widths and phasmids in female behind the middle of the tail). _T. rhopalocercus_ has spear 17–19 μ, spicules 21 μ and gubernaculum 8 μ long and the female tail is almost six anal body-widths in length.

**TYPE HABITAT AND LOCALITY:** Collected by Professor W. B. Banage from soil in Papyrus swamp, Namulonge, Uganda.
Type material: Holotype female and a pair of paratypes (1 ♂, 1 ♀) at Nematology Department, Rothamsted Experimental Station, Harpenden, Hertfordshire, England; a pair of paratypes (1 ♂, 1 ♀) at Nematology Department, University of California, Davis, California, USA and the remainder at Commonwealth Bureau of Helminthology, St. Albans, England.

The systematic position of Tylenchorhynchinae Eliava, 1964 is not clear at the moment. Allen and Sher (1967) assigned this subfamily along with Dolichodorinae, Telotylenchinae, Belonolaiminae, Hoplolaiminae, Pratylenchinae etc., to the family Tylenchidae. Paramonov (1967) considered it under Hoplolaimidae along with Hoplolaiminae, Rotalychochidae, Belonolaiminae, Dolichodorinae and Trolphurinae. Husain and Khan (1967) defined it as a subfamily of Trolphuridae considering under it the genus Telotylenchus Siddiqi, 1960. Thorne and Malek (1968) questioned this latter action and gave an emended diagnosis of the subfamily to exclude Telotylenchus.

As elaborately discussed by Paramonov (1967, 1968) there are sufficient reasons, both morphological and ecological, to support the view that the subfamilies Dolichodorinae, Tylenchorhynchinae, Trolphurinae, Trolphurinae, Belonolaiminae, Telotylenchidae, and Aphanomylenchinae do not belong in the family Tylenchidae but are closer to Hoplolaimidae in being sufficiently advanced ectoparasites of plant roots. However, the first four of these have a fundamentally different type of esophagus than the rest, in that the esophageal glands do not lie free in the body cavity but form a compact basal esophageal bulb joined to the intestine through a prominent cellular cardia. The former group of subfamilies is regarded to constitute the family Dolichodoridae (Chitwood and Chitwood, 1950) Skarbilovich, 1959 and the latter is here proposed to form a separate family Belonolaimidae (Whitehead, 1959) n. rank. Diagnoses, composition and relationships of these two families are given below.

Dolichodoridae (Chitwood and Chitwood, 1950) Skarbilovich, 1959

Diagnosis (emended): Tylenchoidea. Lateral fields with six or less incisures. Labial framework lightly to heavily sclerotized, absent in Nagelus. Spear usually well developed and over 15 μ in length, with prominent basal knobs; its protractor muscles almost parallel to body axis. Amphids labial; deirids sometimes present; phasmsis pore-like, near middle of tail. Median esophageal bulb strongly muscular. Esophageal glands enclosed in and forming basal esophageal bulb. A cellular cardia present, projecting into lumen of intestine. Ovaries usually paired; spermatheca a small pouch; sperms small, rounded, with little cytoplasm. Bursa completely enveloping tail except in Trolphurinae, with phasmid extending as a false rib. Tail in female elongate (very rarely under twice anal body-width), conoid, cylindrical or filiform. Ectoparasitic on roots of higher plants.

Dolichodoridae is related to Trolphuridae in having a basal esophageal bulb enclosing the esophageal glands but is differentiated by its sclerotized labial framework, well developed spear with tubular arrangement of the protractor muscles, a strongly muscular median esophageal bulb and large bursa which is usually terminal. Members of this family represent a higher stage over those of Trolphuridae in their adaptation to the parasitism of the roots of the spermatophytes (see Paramonov, 1967 and 1968).

Key to subfamilies and genera of Dolichodoridae

1. Tail in both sexes filiform, bursa adanal .... Tylenchorhynchinae Paramonov, 1967; Tylodoms Meagher, 1964
   Tail in both sexes not filiform, bursa terminal ........................................... 2

2. Bursa trilobed .......... Dolichodorinae Chitwood and Chitwood, 1950 .... 3
   Bursa simple ................................................... 4

3. Spear abnormally long, lip region four-lobed ........ Dolichodorus Cobb, 1914
   Spear not as long, lip region smoothly rounded .......... Brachy- dorus de Guiran and Germani, 1968

4. Body cuticle abnormally thick especially on tail, indistinctly striated .... Trolphurinae Paramonov, 1967 .... 5
   Body cuticle not abnormally thick, distinctly striated .......... Tylencorhynchinae Eliava, 1964 .... 6
5. Ovaries paired, spear abnormally long
   ---------------------------------------- Macrotrophurus Loof, 1958
   Ovary single, spear not as long
   ---------------------------------------- Tropurus Loof, 1956
   (syn. Clavaurotylenchus Cavens, 1958)

6. Lateral fields with 6 incisures
   7
   Lateral fields with 3–5 incisures
   ---------------------------------------- Tylenchorhynchus Cobb, 1913

7. Protractors of spear attached to the
cuticularized inner walls of the
labial cavity, labial framework ab-
sent .... Nagelus Thorne and Malek, 1968
Protractors of spear attached to the
base of the labial framework

8. Labial disc very conspicuous
   ------------------- Geocenamus Thorne and Malek, 1968
   Labial disc absent .... Merlinus gen. n.

Belonolaimidae (Whitehead, 1959) n. rank

   DIAGNOSIS: Tylenchoidea. Body with promi-
   nent transverse striae; lateral fields with four
   incisures or less. Female tail elongate-conoid
   or cylindroid, very rarely under twice anal
   body-widths in length, with phasmids located
   near middle; male tail completely enveloped
   by bursa. Lip region offset or continuous, not
   low or flattened, with light to heavy sclerotiza-
   tion. Amphids labial, a single papilla on outer
   margins of each submedian lip. Spear well
developed, with tubular protractor muscles.
Median esophageal bulb strongly muscular;
basal bulb absent. Esophageal glands free,
forming a long overlap over anterior end of
intestine; dorsal gland enormously enlarged,
extending past subventrals which are often
greatly reduced. Cardia reduced or absent.
Ovaries paired, opposed, outstretched. Spicules
and gubernaculum well developed. Ectopara-
sitic on roots of higher plants.

Belonolaimidae differs from Hoplolaimidae
(Filipjiev, 1934) Wieser, 1953 in having the
dorsal esophageal gland prominently large
and extending well past the subventrals which
are considerably reduced and the elongate tails
in both sexes with phasmids located near the
middle. From Pratylenchidae (Thorne, 1949)
Siddiqi, 1983 this family differs in having a
lip region which is neither low nor flattened, a
large dorsal esophageal gland extending past
the subventrals and in not being endoparasites
of roots.

Key to subfamilies and genera of
Belonolaimidae

1. Phasmids absent, esophageal glands
mostly on ventral side of intestine
   .... Aphasmatylenchinae Sher, 1965;
   Aphasmatylenchus Sher, 1965
   Phasmids present, esophageal glands
mostly on dorsal and lateral sides of
intestine
   ---------------------------------------- 2

2. Lip region four-lobed with lateral lips
considerably reduced
   ----- Belonolaiminae Whitehead, 1959 ... 3
   Lip region not so
   ------ Telotylenchinae Siddiqi, 1960 ... 4

3. Labial disc circular .... Belonolaimurus
   Steiner, 1949
   Labial disc lemon-shaped due to
   lateral extensions
   ------------------ Morulaimurus Sauer, 1966
   4. Labial disc present, prominent
   --------- Carphodorus Colbran, 1965
   Labial disc indistinct or absent
   --------- 5

5. Spear well developed, lateral fields
   with 4 incisures
   ------------------- Telotylenchus Siddiqi, 1960
   Spear greatly attenuated, lateral fields
   with 3 incisures
   ------------------- Trichotylenchus Whitehead, 1959

Thorne and Malek (1968) considered the
genus Tetylenchus Filipjiev, 1936 under Tylen-
chorhynchinae. However, it appears to belong
to Tylenchidae because the protrudo r muscles
of the spear are oblique to body axis being
attached to the cuticular band at the base of
the lip region (see Thorne and Malek, 1968); the
labial-framework, spear and median
esophageal bulb are weakly developed and
the bursa is not terminal. The genus does not fit
any of the existing subfamilies of Tylenchi-
dae i.e. Tylenchinae, Psilenchinae Paramonov,
1967 or Anguininae Paramonov, 1962, and
therefore a new subfamily, Tetylenchinae, is
proposed to receive it.

Tetylenchinae subfam. n.

   DIAGNOSIS: Tylenchidae. Deirids and phas-
mids usually distinct. Amphids pore-like,
labial, close to oral opening. Four prominent
submedian papillae on the outer contour of lip
region. Spear elongate-slender, with or without
basal knobs. Median esophageal bulb oval;
cardia usually discoidal. Vulva median; ovaries paired, outstretched. Tail in both sexes elongate-conoid, not filiform; in male enveloped by a subterminal bursa.

**Type and Only Genus: Tetijlenchus Filipjev, 1936.**

Tetlenchinae differs from Psilenchinae in having pore-like amphids which are labial in position, conoid tail and large, subterminal bursa. From Tylenchinae it is differentiated in having conoid tail, paired ovaries and large, subterminal bursa.

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**Literature Cited**


