THE TYLENCHULIDAE OF THE WORLD

Identification of the Family Tylenchulidae

(Nematoda: Tylenchida)

by

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Preface

This is an attempt to assemble in one book all the species of the Tylenchulidae (Nematoda: Tylenchida), including all the subfamilies and genera treated in Decraemer & Hunt (2006; 2013). The first attempt being Solov'eva (1972) who listed 44 species of the genus *Paratylenchus*. Solov'eva's book was a great help in obtaining some of the Russian descriptions.

Many nematologists have been active in the study of the morphology and/or taxonomy of the Tylenchulidae, a.o. D.J. Raski (USA), E. Van den Berg (South Africa), M.W. Brzeski (Poland), R.N. Inserra (USA), M.R. Siddiqi (UK), L.Y. Wu (Canada), N. Vovlas (USA), P. Castillo (Spain), R.C. Colbran (Australia), L. Háněl (Poland), D. Sturhan (Germany), A.C. Tarjan (USA), G. Thorne (USA), A.M. Golden (USA), E. Cohn (Israel), D.Y. Chen (Taiwan), Z. Tanha Maafi (Iran), A.S. Eroshenko (Russia), R.P. Esser (USA), L.R. Tiedt (South Africa) and P. Quénéhervé (South Africa).

Several people helped in obtaining descriptions a.o. M. Pedram (Iran), Z. Tanha Maafi (Iran) and R.M. Souza (Brazil).

INTRODUCTION

Skarbilovich (1947) proposed the subfamily Tylenchulinae and Kirjanova (1955) raised it to family level, Tylenchulidae. Raski (1957) proposed the family Tylenchulidae to include the subfamilies Tylenchulinae Skarbilovich, 1947 (with the genera *Tylenchulus* Cobb, 1913 and *Trophotylenchulus* Raski, 1957) and the Sphaeronematinae Raski & Sher, 1952 (with the genera *Sphaeronema* Raski & Sher, 1952 and *Trophonema* Raski, 1957). Some other views on the systematic position of the family Tylenchulidae are those of Skarbilovich (1959) who placed the two subfamilies in the Heteroderidae; of Raski & Sher (1952) who placed *Sphaeronema* and the Sphaeronematinae in the Criconematidae and of Maggenti (1962) who synonymized *Trophotylenchulus* with *Tylenchulus*.

On the other hand Siddiqi & Goodey (1964) studying the family Criconematidae Thorne, 1949, concluded that this family contained three subfamilies:

1) The subfamily Paratylenchinae Thorne, 1949 (with the genera *Paratylenchus* Micoletzky, 1922 and *Cacopaurus* Thorne, 1943);

2) the subfamily Criconematinae Taylor, 1936 (with the genera *Criconema* Menzel, 1914, *Criconemoides* Taylor, 1936, *Hemicriconemoides* Chitwood & Birchfield, 1957 and *Macroposthonia* de Man, 1880);

3) The subfamily Hemicycliophorinae Skarbilovich, 1959 (with the genera *Hemicycliophora* de Man, 1921 and *Caloosia* Siddiqi & Goodey, 1964).

In Geraert (1966) the family Tylenchulidae has been transferred to the superfamily Criconematoidea (Taylor, 1936) Geraert, 1966, containing also the families Criconematidae Thorne, 1949, the Hemicycliophoridae (Skarbilovich, 1959) Geraert, 1966, the Paratylenchidae (Thorne, 1949) Raski, 1962 and the Sphaeronematidae (Raski & Sher, 1952) Geraert, 1966.

Raski & Siddiqui (1975) linked the Paratylenchidae more closely to the Tylenchulidae. Siddiqi (1980) raised the Criconematoidea to the suborder Criconematina with 4 superfamilies: Criconematoidea, Hemicycliophoroidea, Tylenchuloidea and Tylenchocriconematoidea. Later, Siddiqi (1986, 2000) considered only the three first cited superfamilies in Criconematina, reducing Tylenchocriconematoidea to subfamily level, Tylenchocriconematinae. Raski & Luc (1987) considered two families in the superfamily Criconematoidea: the Criconematidae and the Tylenchulidae. De Ley & Blaxter (2002, 2004) and Decraemer & Hunt (2006, 2013) accepted the Criconematoidea but with three families: Criconematidae, Hemicycliophoridae and Tylenchulidae.

In this book the family Tylenchulidae is reported at species level; the two other groups have been reported before: Geraert (2010) did it for the Criconematidae, Chitambar & Subbotin (2014) for the Hemicycliophoroidea.

Morphology

A detailed morphological study of the order Tylenchida can be found in Geraert (2006). Only some particularities of the Tylenchulidae will be given.

In the Paratylenchinae and the Tylenchulinae the body is always ventrally curved, though in females somewhat less curved than in the juvenile stages. The greatest width is in the middle of the body and the body tapers in the pharyngeal region (the width of the lip-region is no less than one third of the maximum body width) and tapers also, without interruption, from the vulva to the tail tip. Gravid females may become quite fat but, as they also elongate (Rhoades & Linford, 1961 showed that *Paratylenchus* females grow considerably after final molt), the a-value does not always give a very good indication of their girth. For some species of *Paratylenchus*, with longer stylets, Raski (1962) found that, when they fatten, they may more or less roll up, in other words, the dorsal side of the body grows the more or can be more easily stretched. The fattening is restricted to that part of the body anterior to the vulva, so that, in older females, a remarkable reduction of the body diameter occurs, posterior to the vulva. In the Sphaeronematinae and in the Meloidoderitinae the adult female is spheroidal or lemon-shaped.

Most Tylenchulidae have a lateral field without areolation; in obese females the lateral field may disappear. The two outer lines are most visible; between them are none, one or two incisures. When no inner incisures has been seen ('lateral field 2 lines'), this does not mean that an incisures might not occur (e.g. *Paratylenchus peperpotti* and *P. steineri*). The number of incisures has been accepted as a diagnostic feature at the species level; but some species have been described which only differ in that one species has three and the other four lines.

In the Paratylenchinae the excretory pore is in most cases difficult to see, because the lining of this duct leading to this pore is weakly sclerotized. The excretory pore lies at about 18 to 25 % of the body length; in species with longer stylets the excretory pore is more opposite the anterior parts of the pharynx than in species with small stylets. During the growth of the females, the pharynx hardly grows at all but the cuticle moves relative to the pharynx, so it can often been seen that smaller animals have the excretory pore opposite the first half of the isthmus, whereas larger ones have it opposite the second half. In larger species the pharynx is not much longer than in small ones, the excretory pore is then found opposite the posterior part of the pharynx or even opposite the intestine. All exceptions to Raski's use of the position of the excretory pore as a diagnostic feature for his genus *Gracilacus* occur in the largest species of his genus. In the Tylenchulinae the excretory pore is located near the nerve-ring or much more behind the pharyngeal base, sometimes about 90 % of body length from anterior end; the excretory system is enormously developed producing a gelatinous matrix.

The deirids are opposite the nerve ring. The hemizonid can be found just before, around or behind the excretory pore; such differences in position occur even in specimens of a same population.

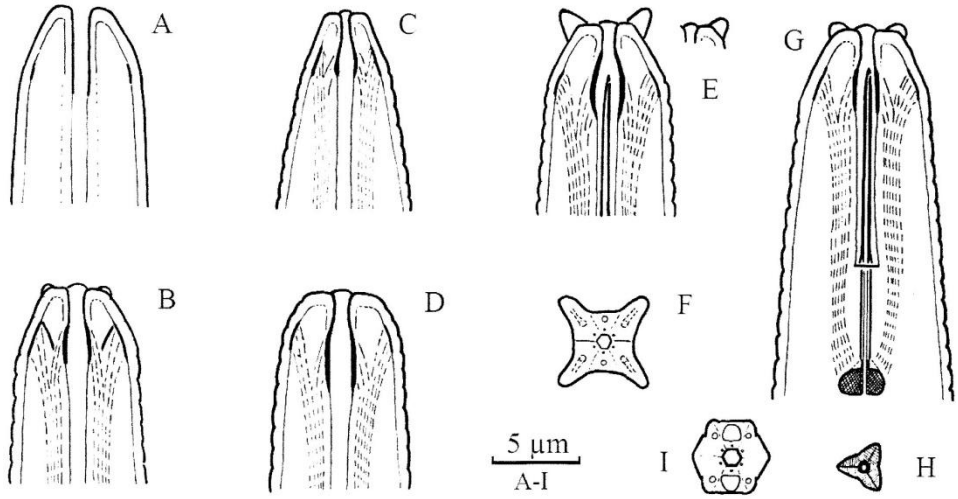

Fig. *Intro* 1. *Form of head in Tylenchulidae. A: juvenile; B: conical-truncate head; C: tapering head; D: rounded head; E: head with strongly developed submedian lobes; F: end-on view of E; G: head with well-developed submedian lobes; H: stylet knobs seen from above; I: end-on view of head with submedian lobes hardly developed (From Geraert, 1965 courtesy of* Nematologica).

The terms commonly used to describe the form of the head in the Paratylenchinae are: tapering (Fig. *Intro* 1C), conical-truncate (Fig. *Intro* 1B); rounded (Fig. *Intro* 1D). When the heads show as in Fig. *Intro* 1 E, the description reads as follows: 'lips set-off', 'head sharply offset'; with the aspect of Fig. *Intro* 1 G (or somewhat less pronounced): 'lip-region slightly depressed at the oral area. End-on views of the head (Fig. *Intro* 1 F & I) show that only some parts of the lip region are so much developed; these parts, four in number are called the submedian lobes. The four cephalic papillae end on these lobes. These lobes can be large (Fig. *Intro* 1 E, 2 C), small (Fig. *Intro* 1 B, 2 B) or not present (Fig. *Intro* 1 D, 2 A); sometimes strongly developed, so appear as disc (Fig. *Intro* 2 D) or cap-like structure (Fig. *Intro* 2 F). A specimen with slightly developed submedian lobes may have the appearance of a rounded or truncate head, depending on its position. The amphidial apertures lie in the middle of the lateral lips. The lateral lips too may be somewhat elevated. The striae on the head are less visible than on the body; three to four annuli can be found. The different parts of the head framework are only slightly

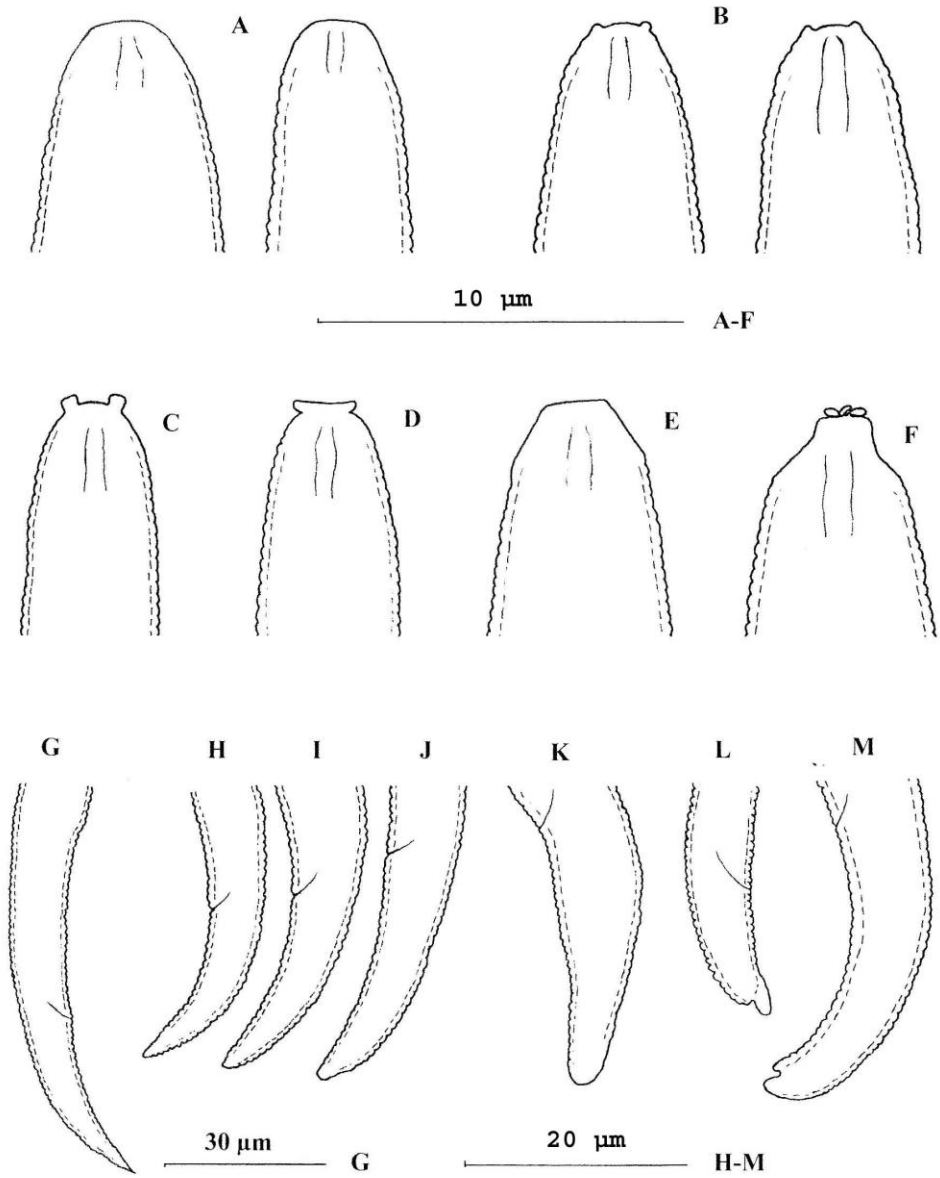

Fig. *Intro* 2. *Form of head (A-F) and tail terminus (G-M) in Tylenchulidae. A: without submedian lobes; B: with small submedian lobes; C: with strongly developed submedian lobes; D: disc-shaped; E: trapezoid; F: with cap-like structure; G: pointed or acute; H: subacute; I, J: finely rounded; K: bluntly (broadly) rounded; L: digitate; M: indented. (From Ghaderi et al., 2014 courtesy of* Zootaxa).

sclerotized; the most visible is that part of the stoma-wall where parts of the stylet-muscles are attached. The attachment places for the rest of the stylet-muscles are towards the outside of the head.

The general structure of the pharynx is referred to as 'criconematoid'. For animals with short stylets the length of the pharynx does not depend on the length of the stylet. When the stylet is larger than 50 µm the procorpus is stretched and so influences the pharyngeal length.

Rectum and anus are hardly visible; the anus is difficult to see because the cuticle at the anus is not inwardly folded; so there are no attachment places for anal muscles and the suggestion, already made by Thorne & Allen (1950), that the anus is not functional, remains. In fat, fully grown females, the anal region can be somewhat protruded.

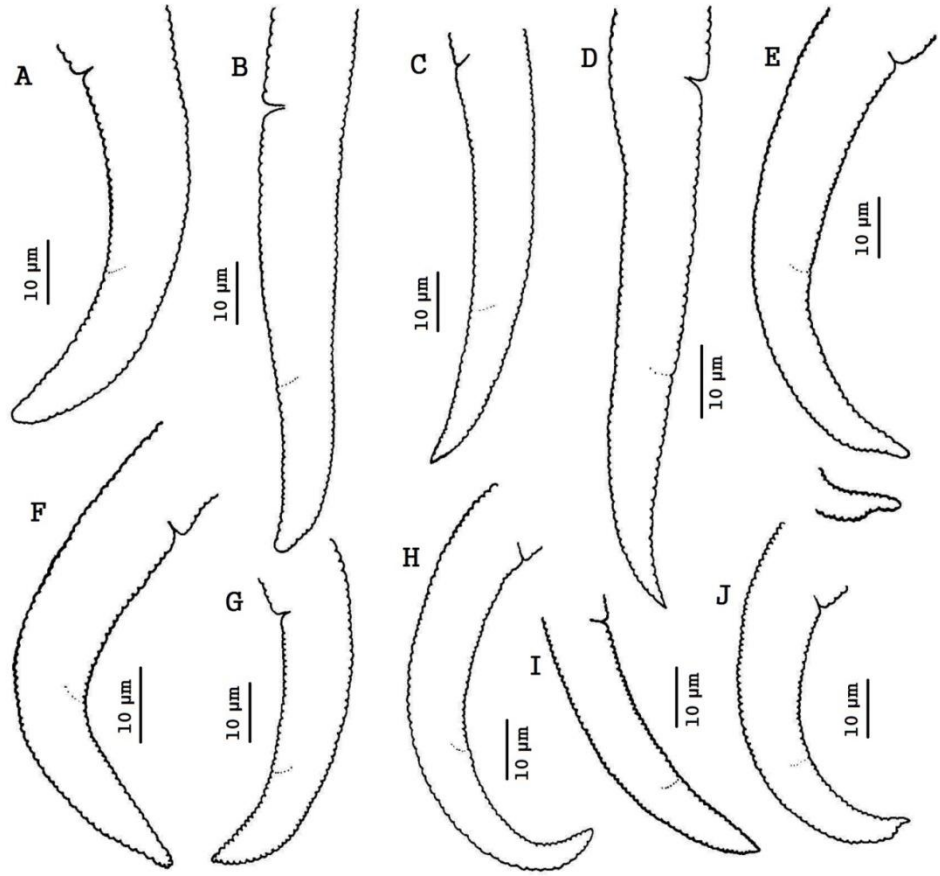

Fig. *Intro* 3. *Different tail forms in Tylenchulidae. (From Geraert, 1965 courtesy of* Nematologica).

Lateral vulval flaps are present in most species of the Paratylenchinae; they are more or less developed. In very young and small females the whole vagina is short and a short post-vulval uterine sac can be present; in older and larger females the vagina lengthens so that it reaches at least three quarters of the body diameter. During this growth the animal has grown in length but hardly flattened; so, the vagina has to bend forward and the post-vulval part of the uterine sac collapses and adheres to the vagina wall. This sac length varies within species. When the animal fattens, the vagina tends to straighten again and the post-vulval uterine sac can again appear for a short distance posterior to the vagina. The spermatheca lies latero-ventrally; it is sac-like, opening only into the uterus where the oviduct joins it. When spermatozoids are absent, the spermatheca is smaller and the walls are thicker. A spermagonium was postulated by Raski (1962) for some females recently molted and already full of spermatozoids.

The tail end can be broadly rounded in some populations, in others broadly to finely rounded, in still others, from finely rounded to pointed (Fig. *Intro* 2 & 3). The differences between a sharply pointed and a broadly rounded one is clear enough and very rarely are they found together in one population, so this feature can be used for differentiation.

But the following difficulties arise:

- The appearance 'sharply pointed' always depends on the magnification with which the tail is seen and can only be decided under the highest magnification
- in every population where sharply pointed tails occur finely rounded tails can also be found and, usually it is a question of interpretation
- The percentage of sharply pointed tails, in populations where such tails occur, varies, so the possibility that pointed tails may also occur in populations where only finely rounded tails have so far been found cannot be excluded.

Usually the annuli on the tail tip are less apparent, but in a few species the annuli on the tail end are as obvious as in the middle of the body (crenate tail end).

Light & SEM studies (Sturhan & Geraert, 2005) revealed that the phasmids can be observed in some genera of Tylenchulinae and Sphaeronematinae (Fig. *Intro* 4), but these structures are absent in Paratylenchinae.

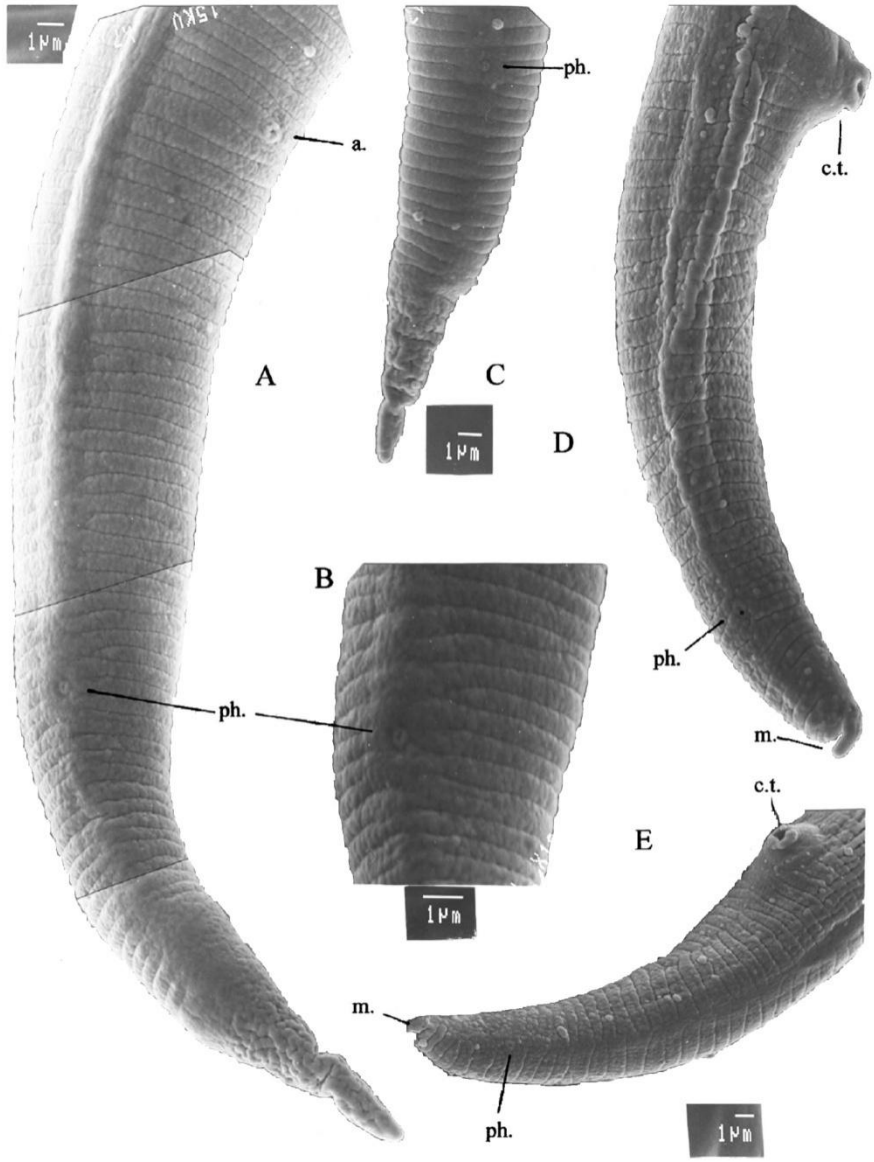

Fig. *Intro* 4. *SEM micrographs showing phasmid location in* Sphaeronema alni *juveniles (A, B) and of* Sphaeronema *sp. juveniles (C) and males (D, E). (From Sturhan & Geraert, 2005 courtesy of* Nematology).

Family Tylenchulidae Skarbilovich, 1947

Diagnosis (cf. Siddiqi, 2000)

Criconematoidea. Body small (rarely over 0.5 mm; up to 0.83 mm in *Tylenchocriconema*), becoming obese or swollen in females of several genera. Cuticle thin, finely annulated (secondarily thickened and without discernible annulation in obese females); occasionally ornamented with fine punctations (*Cacopaurus* and few *Paratylenchus* species) or minute spines or hexagonal beads (*Meloidoderita*). Lateral field with two to four incisures, may occasionally be obscure. Deirids and phasmids usually absent. Lip region lacking prominent annuli, continuous with body; submedian lobes may be absent, weakly to strongly developed. Lip region rarely with circumoral elevation in *Trophotylenchulus*. Cephalic framework lightly sclerotized. Stylet delicate, from short (below 10 µm) to long (120 µm); conus always longer than shaft. Stylet knobs well developed, rounded to sloping backwards. Orifice of dorsal gland at about 3 µm or more from base of stylet. Pharynx criconematoid; median bulb large, muscular, amalgamated with broad precorpus, which may be slender in short-stylet forms. Isthmus slender, not amalgamated with basal bulb which is usually small and rounded; containing three pharyngeal glands. Pharyngo-intestinal valve small, usually indistinct. Nerve ring circumpharyngeal. Excretory pore either pharyngeal or post-pharyngeal (e.g. in *Tylenchulus* and *Trophotylenchulus*); surrounded by papilla-like structures in *Tylenchulus*. Excretory cell may be abnormally enlarged to produce a gelatinous matrix in which eggs are deposited (e.g. *Tylenchulus, Trophotylenchulus*). Monodelphic-prodelphic. Vulva transversely oval or slit-like, located posteriorly, generally at more than 70 % of body from anterior end; in obese or swollen forms subterminal or terminal. Vagina anteriorly directed. Postvulval uterine sac absent or, if present, very short. Spermatheca small, rounded to oval, offset, ventral or ventro-lateral to the axis of the gonoduct. Uterus with a muscular part and a glandular crustaformeria, may be very thick-walled in swollen females, and may form a cystoid body in *Meloidoderita*. Intestine syncytial, lacking a definite lumen, often appears as a solid mass, which may extend into tail cavity; junction with rectum indistinct. Rectum obscure, short; anus a small round pore, sometimes non-functional. Tail conoid to subcylindrical, very short in obese or swollen forms; ending to a pointed to bluntly rounded terminus, occasionally digitate, indented or furcated.

Males. Vermiform. Pharynx usually degenerated. Stylet also degenerate, or lacking. Monorchic; gonoduct packed with minute sperm; testis in adult degenerates; the entire complement of sperm is probably produced just before the final moult. Bursa usually absent, if present, low, adanal to subterminal (enveloping entire tail in *Tylenchocriconema*). Spicules setose, arcuate, with pointed tip. Gubernaculum simple, linear or crescent-like in lateral view, fixed. Cloacal lips narrow, sometimes drawn out as

a penial tube. Hypoptygma single, rarely double (*Tylenchocriconema*), or absent (*Tylenchulus*). Tail usually conoid with pointed to rounded terminus.

Juveniles. Slender. Similar to female in most details. Stylet present and functional, except fourth stage of some *Paratylenchus* species.

Some morphological and molecular evidences cast doubt on the monophyly of Tylenchulidae. Sturhan & Geraert (2005) proposed reconsidering the Tylenchulidae classification because these authors observed minute phasmid-like structures in tylenchulids, *Sphaeronema* and *Meloidoderita* spp., which were absent in the species of the subfamily Paratylenchinae. They moreover added that the lack of phasmids in other taxa of Criconematoidea could be considered as an apomorphic character. However, these morphological observations of important taxonomical significance were supported by molecular studies; Subbotin *et al.* (2005, 2006) indicated that *Paratylenchus bukowinensis, P. nanus* and two other unspecified *Paratylenchus* populations (as representative of the subfamily Paratylenchinae) did not form a clade with the members of other subfamilies of Tylenchulidae (*Trophotylenchulus arenarius* and *Tylenchulus semipenetrans* from Tylenchulinae and *Sphaeronema alni* from Sphaeronematinae).

Ectoparasitic mostly on roots of higher plants, rarely secondarily obese females becoming endoparasites. In some cases under bark of perennial host roots (some species of *Gracilacus*); exceptionally (*Tylenchocriconema*) on leaves and in crowns (mostly below waterline) of bromeliads.

Type subfamily
Tylenchulinae Skarbilovich, 1947

Other subfamilies
Meloidoderitinae Kirjanova & Poghossian, 1973
Paratylenchinae Thorne, 1949
Sphaeronematinae Raski & Sher, 1952

KEY TO THE SUBFAMILIES

1. Uterine walls form a protective cystoid body ……..... Meloidoderitinae
- Uterine walls do not form a protective cystoid body ……... 2
2. Female usually vermiform, if saccate, then body elongate obese, enlarging on all sides; stylet long (usually over 15 μm and with conus abnormally elongated) ……..... Paratylenchinae

- Female subspherical to spherical, or elongate-obese with body enlarging mostly dorsally; stylet short (usually under 15 µm and with conus not abnormally elongated) ……..….. 3

3. Adult female lacking a post-vulval region; excretory pore in pharyngeal region …….. Sphaeronematinae
- Adult female with a distinct post-vulval region; excretory pore much behind pharyngeal region (except *Boomerangia*) ……... Tylenchulinae

KEY TO THE GENERA

1. Uterine walls form a protective cystoid body ……..... *Meloidoderita*
- Uterine walls do not form a protective cystoid body …….. 2
2. Female usually vermiform, if saccate, then body elongate obese, enlarging on all sides; stylet long (usually over 15 µm and with conus abnormally elongated) ... 3
- Female subspherical to spherical, or elongate-obese with body enlarging mostly dorsally; stylet short (usually under 15 µm and with conus not abnormally elongated) ……... 5
3. Female body long (average > 600 µm) and slender; head truncate (obliquely ventrad in males), squarish; males with long, leptoderan bursa …….. *Tylenchocriconema*
- Female body shorter (< 600 µm) and not so slender; head with different shapes, but usually not so truncate or squarish; males without bursa (rudimentary, if present) ……..... 4
4. Female body cylindroid-obese (a = 5-8), cuticle bearing minute tubercles, lateral field with rows of tubercles; vulva very posterior, post-vulval region short, bluntly conoid …….. *Cacopaurus*
- Female body slender or variously swollen mostly in prevulval region; tubercles in cuticle rare; post-vulval region more elongate-conoid rounded ….. *Paratylenchus*
5. Female body vermiform, only mature female slightly obese at prevulval region …… …….*Boomerangia*
- Female body considerably swollen ……..... 6
6. Adult female lacking a post-vulval region; excretory pore in pharyngeal region ….. …….*Sphaeronema*
- Adult female with a distinct post-vulval region; excretory pore behind pharyngeal region ……..... 7
7. Excretory pore in female at 68-85% of body length, surrounded by papilla-like outgrowths ……..... *Tylenchulus*
- Excretory pore in female at less than 61% of body length, not surrounded by outgrowths …….. *Trophotylenchulus*

Subfamily Meloidoderitinae Kirjanova & Poghossian, 1973

Diagnosis (cf. Siddiqi, 2000)

Tylenchulidae. Small-sized (under 0.5 mm). Marked sexual dimorphism. In mature females body fully swollen, without tail, pear-shaped or oval; neck region can be observed (see genus *Meloidoderita* for more discussions). Cuticle thick, may have spine-like outgrowths or hexagonal beads. Stylet about 15-19 µm long, knobs prominent. Orifice of dorsal gland 3-7 µm from stylet base. Excretory pore opposite median bulb; latter very muscular with large refractive thickenings. Vulva terminal, on a cone-like elevation of body. Longitudinal axis of body from head to vulva; anus shifted to dorsal side. Uterus spheroidal, with very thick walls, filling one-third to a half of body cavity in young and most of body in old females. In old females uterus becomes patchily sclerotized with a palmate branched surface pattern and transforms into a cystoid body, 0.18-0.48 mm long and 0.10-0.46 mm wide. Maternal body-wall withers off and the cystoid body serves as protecting case for the retained eggs. Several eggs are laid in gelatinous material which covers the females and, subsequently, the cystoid bodies. Eggs 60-112 µm long, 34-66 µm wide.

Males. Slender, vermiform, under 0.5 mm long. Cephalic region continuous. Stylet absent or degenerated. Pharynx degenerated. Vas deferens packed with minute sperm, testis atrophied in mature males. Tail elongate, subcylindrical or conoid. Bursa absent. Spicules and gubernaculum typical of the family.

Second stage juveniles vermiform, straight to arcuate upon relaxation. Cuticle finely annulated; lateral field with three or four incisures. Cephalic region conoid-rounded to truncate, continuous; labial disc indistinct; framework lightly sclerotized. Stylet well developed, 12-17 µm long; conus often a little longer than the shaft; knobs large, rounded. Median bulb oval, with prominent refractive thickenings. Isthmus long, slender. Pharyngeal glands enclosed in terminal bulb, offset from or with base slightly extending over intestine. Excretory pore opposite isthmus. Rectum and anus indistinct. Tail terminus spicate, or finely rounded.

Type and only genus
Meloidoderita Poghossian, 1966

Genus Meloidoderita Poghossian, 1966

Diagnosis
Same as for subfamily.

Siddiqi (2000) described the genus *Meloidoderita* as mature females with a swollen body, without neck or tail, and males without bursa. Andrássy (2007) also described the *Meloidoderita* adult female as without neck. Ashrafi *et al.* (2012) claimed that all *Meloidoderita* species have an irregularly shaped, well-defined neck region.

Type species
Meloidoderita kirjanovae Poghossian, 1966

Other species
Meloidoderita polygoni Golden & Handoo, 1984
M. safrica Van den Berg & Spaull, 1982
M. salina Ashrafi, Mugniéry, van Heese, van Aelst, Helder & Karssen, 2012

KEY TO THE SPECIES

1. Cuticle of cystoid body with hexagonal beaded pattern ……..... *M. salina*
- Cuticle of cystoid body with spine-like structures …….. 2
2. Female cystoid bodies average 388 µm long, 356 µm wide, excretory pore averages 112 µm from anterior end, spines on cystoid body average 22 µm long, width at base 5.3 µm …….. *M. polygoni*
- Female cystoid bodies average 256-268 µm long, 218-222 µm wide, excretory pore averages 62-75 µm from anterior end, spines on cystoid body average 8.5 µm long, width at base 2.3 µm or spines widely dispersed, swollen or knob-like ….. 3
3. Spines on female cystoid bodies fine, averaging 8.5 µm long, width at base 2.3 µm, more dense; juvenile stylet 12-14 µm …….. *M. kirjanovae*
- Spines on female cystoid bodies widely dispersed, coarse, swollen, knob-like; juvenile stylet 14-16 µm ……... *M. safrica*

DESCRIPTION OF SPECIES

Meloidoderita kirjanovae Poghossian, 1966
(Fig. *Meloidoderita* 1, 2, 3)

After Poghossian (1966)

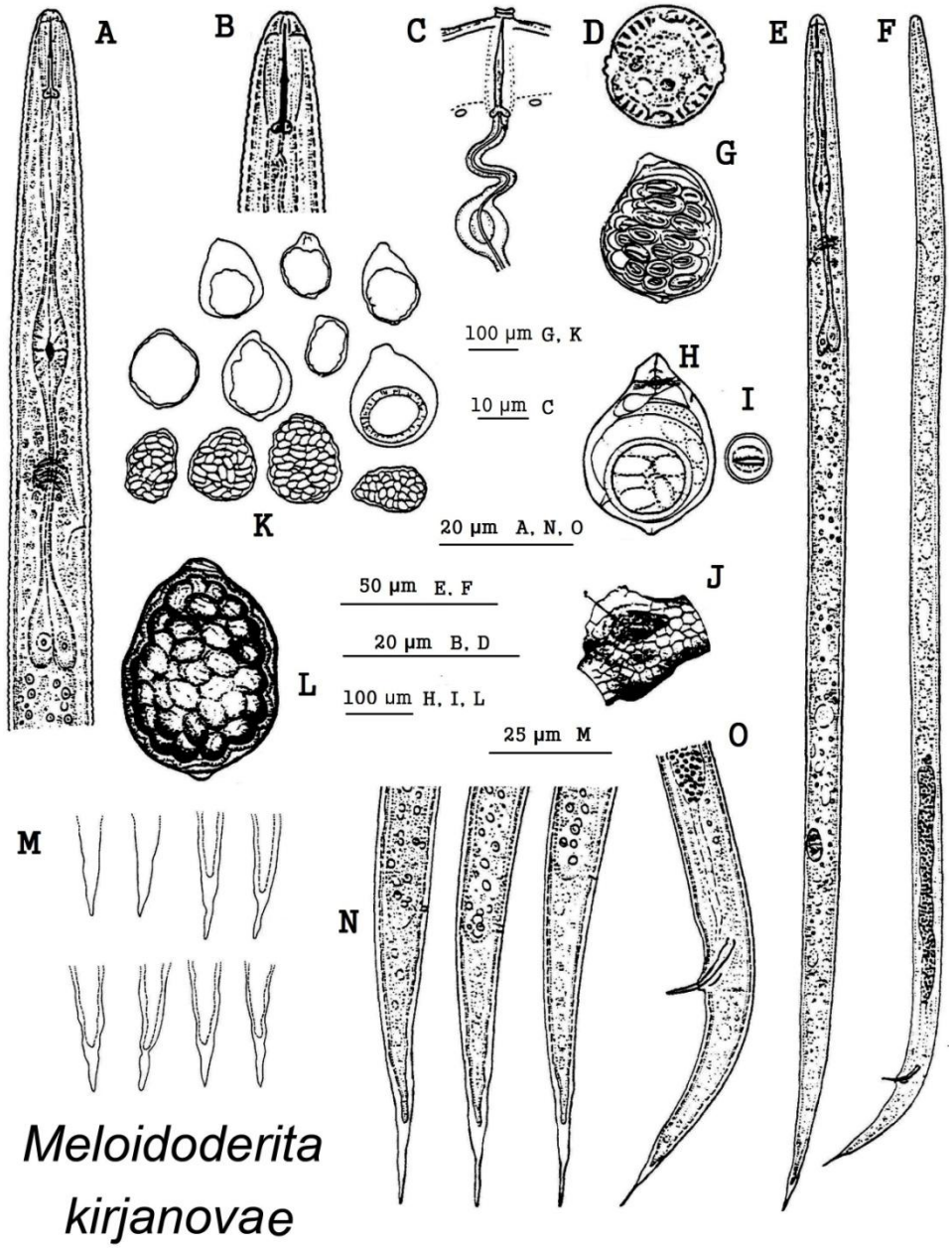

Fig. *Meloidoderita* 1. *Diagnostic drawings of* Meloidoderita kirjanovae *females (C, D, G-J), males (F, O), juveniles (A, B, E, M, N) and cystoid bodies (K, L). (A-L, N, O from Raski, 1991 courtesy of* Manual of Agricultural Nematology, Marcel Dekker, Inc.*; M from Golden & Handoo, 1984 courtesy of* Journal of Nematology*).*

Holotype: L = 0.35 mm; a = 1.2; body width = 0.29 mm; stylet = 15 µm.

127 paratype females: L = 0.22-0.45 mm; a = 1.1-1.7; b = ?; body width = 144-371 µm; excretory pore = 44-88 µm; stylet = 14-19 µm; V = subterminal.
33 juveniles: L = 0.32-0.44 mm; a = 22-34; b = 3.0-3.4; body width = 12-17 µm; stylet = 13-14 µm; c = 7-10.
22 cystoid bodies: L = 0.18-0.36 mm; body width = 0.15-0.35 mm.
150 eggs: L = 60-92 µm; width = 35-50 µm.

After Poghossian (1975)
1 paratype male: L = 0.42 mm; a = 32; c = (11); c' = (4.7); spicules = (13) µm.

After Golden & Handoo (1984)
45 females: L = 0.24-0.44 mm; a = 1.2-2.1; body width = 0.17-0.31 mm; stylet = 14-15 µm; excretory pore = 69-172 µm.
13 males: L = 0.35-0.40 mm; a = 30-38; stylet (anterior portion) = 6-7 µm; c = 9-13; spicules = 14-16 µm; gubernaculum = 3-5 µm.
25 second stage juveniles: L = 0.36-0.42 mm; a = 26-30; b = 2.4-3.1; stylet = 13-14 µm; c = 8-10.
10 cystoid bodies: L = 0.20-0.36 mm; a = 1.1-1.6; body width = 0.13-0.28 mm.
20 eggs: L = 75-83 µm; L/width = 1.8-2.1; width = 39-43 µm.

After Siddiqi (1985)
20 juveniles: L = 0.36-0.41 mm; a = 26-33; b = 3.1-4.3; stylet = 12-14 µm; c = 7.0-9.3; c' = 5.1-6.3.

After Raski (1991)
127 paratype females: L = 0.22-0.45 mm; body width = 0.14-0.37 mm; stylet = 15-19 µm; excretory pore = 44-88 µm.
33 second stage juveniles (type population): L = 0.32-0.44 mm; a = 22-34; b = 3.0-3.4; stylet = 13-14 µm; c = 7-10.
15 second stage juveniles (live material): L = 0.22-0.52 mm.
20 second stage juveniles (fixed material): L = 0.36-0.41 mm; a = 26-33; b = 3.1-4.3; stylet = 12-14 µm; c = 7-9; c' = 5.1-6.3.
22 cystoid bodies: L = 0.18-0.36 mm; body width = 0.15-0.35 mm.
150 eggs: L = 60-92 µm; width = 35-50 µm.

After Vovlas *et al.* (2006)
8 females: L = 0.24-0.28 mm; stylet = 14-16 µm; excretory pore = 53-80 µm.
10 males: L = 0.27-0.37 mm; a = 20-24; c = 6-7; spicules = 13-15 µm.
10 juveniles: L = 0.30-0.37 mm; a = 21-27; b = 2.7-3.9; stylet = 12-15 µm; c = 6-9.

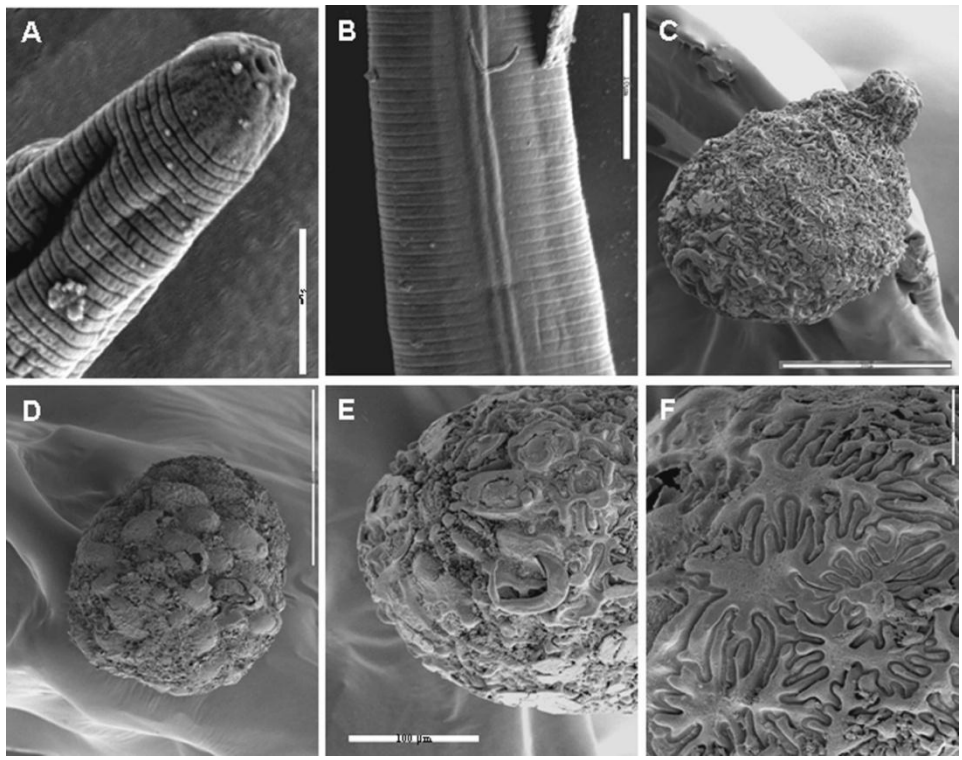

Fig. *Meloidoderita* 2. *SEM micrographs of* Meloidoderita kirjanovae *juveniles (A, B) and cystoid bodies (C-F) (Scale-bars: A = 5 µm; B = 10 µm; C = 200 µm; D, F = 20 µm; E = 100 µm). (From Vovlas et al., 2006 courtesy of* Journal of Nematology*).*

Mature females. Body swollen, pyriform, without neck or tail. Vulva at the tip of a small conical elevation of the posterior end of body; longitudinal axis of body from head to vulva with anus shifted dorsally, 44-180 µm from vulva. Cuticle about 4 µm thick near head and about 6 µm thick near middle, with numerous spine-like outgrowths about 3 µm long. Stylet conus longer than shaft; basal knobs 4.4-5.5 µm across and 2.2-3.3 µm high. DGO = 2.5-6.6 µm. Anterior and posterior cephalids opposite base of cephalic region and basal knobs of stylet, respectively. Excretory pore opposite median pharyngeal bulb. Procorpus cylindrical. Median bulb oval, variable in size with age, 15-40 µm in diameter, with large valve plates. Vulval region about 50 µm in diameter, lacking perineal pattern. Vulval slit 24-36 µm long. Uterus spherical, with very thick walls, occupying up to half the body cavity in young females. In old females it assumes a branched, palmate shape and fills most of the body cavity.

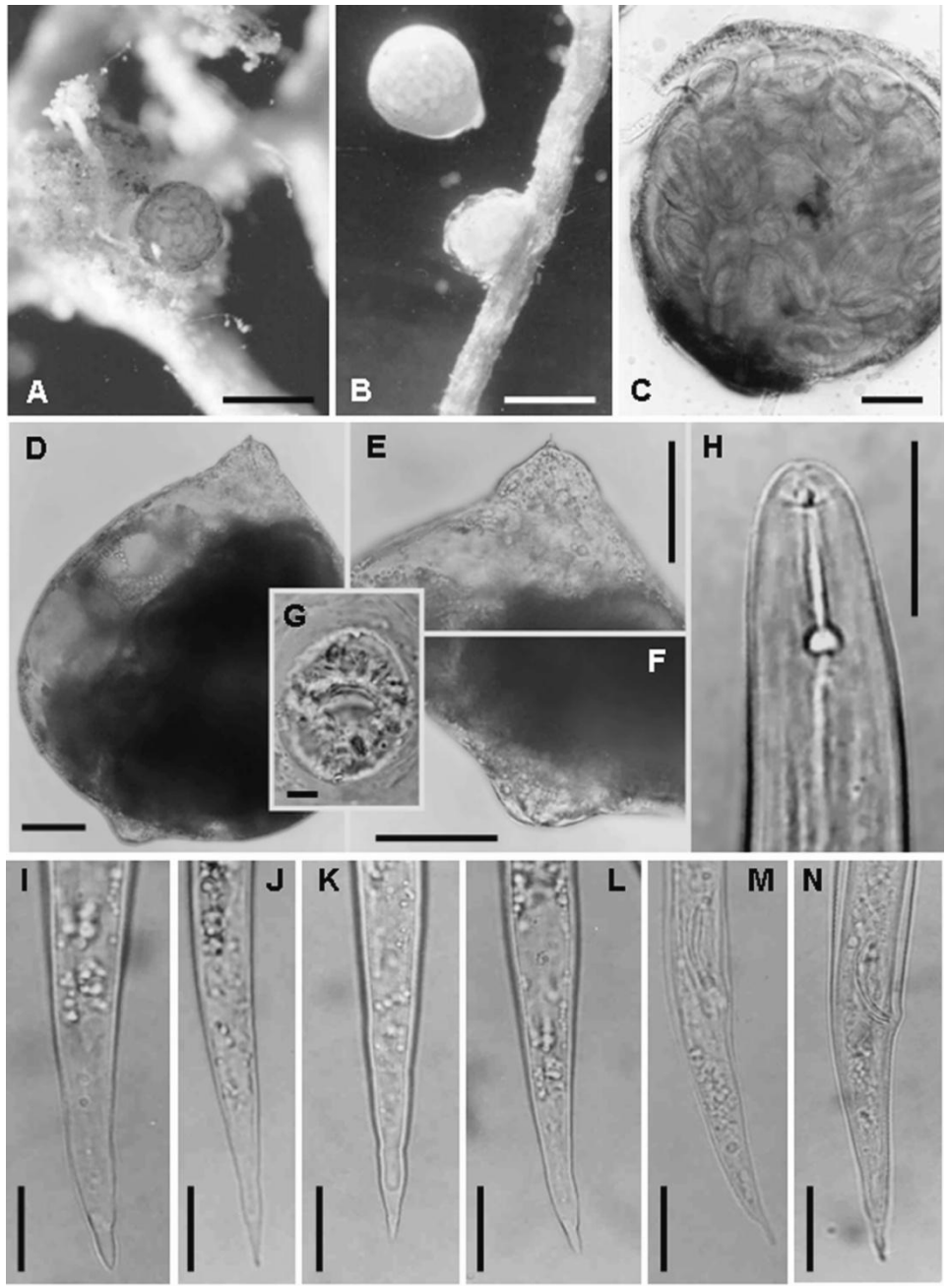

Fig. *Meloidoderita* 3. *Photomicrographs of* Meloidoderita kirjanovae *females (D-G), males (L, M), juveniles (H-K) and cystoid bodies (A-C) (Scale-bars: A, B = 250 µm; C-F = 50 µm; G-M = 15 µm). (From Vovlas et al., 2006 courtesy of* Journal of Nematology*).*