

Trichodorus altaicus sp. n. (Nematoda : Trichodoridae) and a key to the species of the genus *Trichodorus*

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Summary – A new species of the family Trichodoridae is described from the Asian part of the Russian Federation. *Trichodorus altaicus* sp. n. is characterized by the onchiostyle length (39-47 μm) and absence of pharyngeal gland or intestinal overlaps in males and females; presence of two ventromedian cervical papillae located posterior to the base of the onchiostyle but anterior to the excretory pore, posterior supplement situated at level of the proximal end of the retracted spicules, spicule length (38-47 μm) and shape of the spicules in the males; presence of two pairs of lateral body pores, pore-like vulva opening in ventral view and shape of the vaginal sclerotizations in the females. A key to the species of the genus *Trichodorus* is presented.

Résumé – *Trichodorus altaicus* sp. n. (Nematoda : Trichodoridae) et clé de détermination des espèces du genre *Trichodorus* – Une nouvelle espèce de Trichodoridae provenant de la partie asiatique de la Fédération Russe est décrite. *Trichodorus altaicus* sp. n. est caractérisé par la longueur du stylet (39-47 μm) et l'absence d'un recouvrement de l'intestin par les glandes pharyngiennes, chez les mâles et les femelles; la présence de deux papilles cervicales ventromédianes postérieures au stylet mais antérieures au pore excréteur, la position du troisième supplément ventromédian au niveau de l'extrémité antérieure des spicules, la longueur (38-47 μm) et la forme des spicules; la présence de deux pores latéraux de chaque côté du corps, la vulve en forme de pore et la forme des sclérotisations vaginales chez les femelles. Une clé de détermination des espèces du genre *Trichodorus* est proposée.

Key-words : Nematodes, *Trichodorus*, Russian Federation, key.

A soil sample collected in a forest on the bank of the Katun River, Altai Mountains, Asian part of the Russian Federation, yielded a new *Trichodorus* species. The specimens were extracted from the soil using the decantation and sieving method with final separation on extraction sieves with filters. The specimens were hand-picked and put into a very small amount of water, killed with hot 2 % formaldehyde, fixed in this solution for about a week, and then processed to dehydrated glycerin using a methanol-glycerin modification of Seinhorst's method. All measurements and drawings were made with glycerin-mounted specimens.

Trichodorus altaicus sp. n. (Figs 1 & 2)

MEASUREMENTS

See Table 1.

DESCRIPTION

Male: Body of heat-relaxed specimens straight, sometimes posterior end ventrally curved. Lip region with indistinct labial sensillae, not papilliform. Amphidial aperture sublabial, elliptical. Head separated from the rest of the body by a constriction. Body cuticle consisting of an outer layer, about 3-4 μm thick, subdivided

into a thin outer and a thicker inner layer, and an inner layer, finely striated, detached from the outer layer except near the head and body openings. Excretory pore at about 1.9-2.6 times the onchiostyle length from the anterior end of the body. Two conspicuous ventromedian cervical papillae present in all males, located posterior to the base of the onchiostyle region but anterior to the excretory pore. No lateral cervical pores were observed. Pharyngeal bulb occupying about one third of the neck length. Five pharyngeal gland nuclei present. No subventral pharyngeal overlaps of the intestine or dorsal intestinal overlap of the pharynx. Nerve ring at the level of the isthmus. Three precloacal ventromedian supplements present. The posterior one lies at about 68-88 % of the spiculum length anterior to the cloacal aperture, at level of the proximal end of the retracted spicules. Spicules curved ventrally in proximal and distal thirds, with the middle third twisted. The middle part of the spicules finely striated, slightly thickened, although this thickening is sometimes barely recognizable. No bristles on spicules were observed. Manubrium widened with a small hook-like projection directed ventrally. Gubernaculum expanded at both ends, the proximal part rounded to triangular thickened, the distal part keel-shaped. Tail 11-13 μm , with one pair of subventral pores. Outer

Table 1. Morphometric data of *Trichodorus altaicus* sp. n. (all measurements are in μm).

	Holotype (male)	Males	Females
n		6	14
L	742	610-742 (680 \pm 56)	571-727 (653 \pm 50)
Body width	43	41-47 (43 \pm 2)	34-46 (40 \pm 3)
Neck length	135	110-135 (122 \pm 10)	109-153 (127 \pm 12)
Onchiostyle length	43	39-47 (43 \pm 3)	39-47 (41 \pm 2)
Ant. end to excr. pore	106	90-108 (102 \pm 6)	90-116 (99 \pm 8)
Ant. end to CP1	83	76-84 (80 \pm 3)	
CP1 to CP2	12	11-15 (13 \pm 2)	
CP2 to excr. pore	11	5-11 (9 \pm 2)	
Spicule length	47	38-47 (43 \pm 3)	
Gubernaculum length	17	16-18 (17 \pm 1)	
Cloaca to SP1	34	26-37 (33 \pm 4)	
SP1 to SP2	42	28-44 (39 \pm 6)	
SP2 to SP3	40	29-47 (40 \pm 6)	
a	17.1	14.4-16.4 (15.7 \pm 1)	14-18.1 (16.2 \pm 1.2)
b	5.5	4.8-6.7 (5.6 \pm 0.7)	4.4-6 (5.2 \pm 0.6)
V			51-61 (54.6 \pm 2.7)
G ₁			17-28 (21.9 \pm 2.8)
G ₂			15-27 (20.7 \pm 3.6)
T	65	61-71 (67.3 \pm 4)	
Ant. end to excr. pore (% neck length)	80	74-92 (84 \pm 6)	64-91 (79 \pm 10)

cuticle may be swollen at the tip, inner striated cuticle with an indentation.

Female: Body of heat-relaxed specimens slightly arcuate dorsally. Excretory pore at about 2.1-2.7 times the onchiostyle length from the anterior end of the body. Two pairs of lateral body pores: one pair 81-158 (117) μm , i.e. 2.1-3.7 (2.8) vulvar body-widths, anterior to the vulva and the other pair 11-34 (22) μm , i.e. 0.3-0.8

(0.2) vulvar body-widths, posterior to the vulva. These pores usually do not opposite each other. These pores were not seen in five females and it remains unknown if they are absent or are visible only in females in dorso-ventral position. Female reproductive system didelphic - amphidelphic with reflexed ovaries. Spermatheca rounded to squared, mostly filled with oval-shaped sperm. Vulva opening minute, pore-like in ventral view. Vaginal sclerotizations forming a ring with a central opening of about 3 μm wide. In lateral view they appear as small, more or less triangular-shaped pieces with tips pointed towards the vulva. Tail rounded in outline, with subterminal anus and a pair of subterminal subventral pores. The inner striated cuticle forms two concavities when viewed laterally. These concavities were observed in all examined females and juveniles.

TYPE HABITAT AND LOCALITY

Soil rich in organic material in a mixed forest of *Picea* spp. and *Betula* spp., about 5 m from the bank of the Katun River, 2 to 3 km down the river from Tungur, Altai Mountains, Altaiskij Kraj, Asian part of the Russian Federation. Collected by Jan Brzeski during August 1990.

TYPE SPECIMENS

Holotype male, two paratype males and ten paratype females deposited at the Nematode Collection of the Instytut Zoologii PAN, Wilcza 64, 00-650 Warszawa, Poland.

DIAGNOSIS AND RELATIONSHIPS

Trichodorus altaicus sp. n. is characterized by the combination of the following characters: onchiostyle length (39-47 μm) and absence of pharyngeal gland or intestinal overlaps in males and females; presence of two ventromedian cervical papillae located posterior to the base of the onchiostyle but anterior to the excretory pore, posterior precloacal ventromedian supplement at level of the proximal end of the retracted spicules, spicule length (38-47 μm), shape of the spicules with the proximal and distal thirds curved ventrally and the middle, somewhat thickened third more or less straight in the males; presence of two pairs of lateral body pores, one prevulvar, the other one postadvular, pore-like vulva opening in ventral view and small, in lateral view more or less triangular-shaped vaginal sclerotizations with tips pointed towards the vulva in the females.

Trichodorus altaicus sp. n. resembles *Trichodorus aequalis* Allen, 1957 and *Trichodorus sparsus* Szczygiel, 1968 in the absence of overlaps in males and females; in having males with two ventromedian cervical papillae posterior to the base of the onchiostyle but anterior to the excretory pore and a similar position of the posterior precloacal ventromedian supplement, and in having females with two pairs of lateral body pores. Both sexes of *T. altaicus* sp. n. can be distinguished from these of *T. aequalis* and *T. sparsus* by the somewhat shorter body

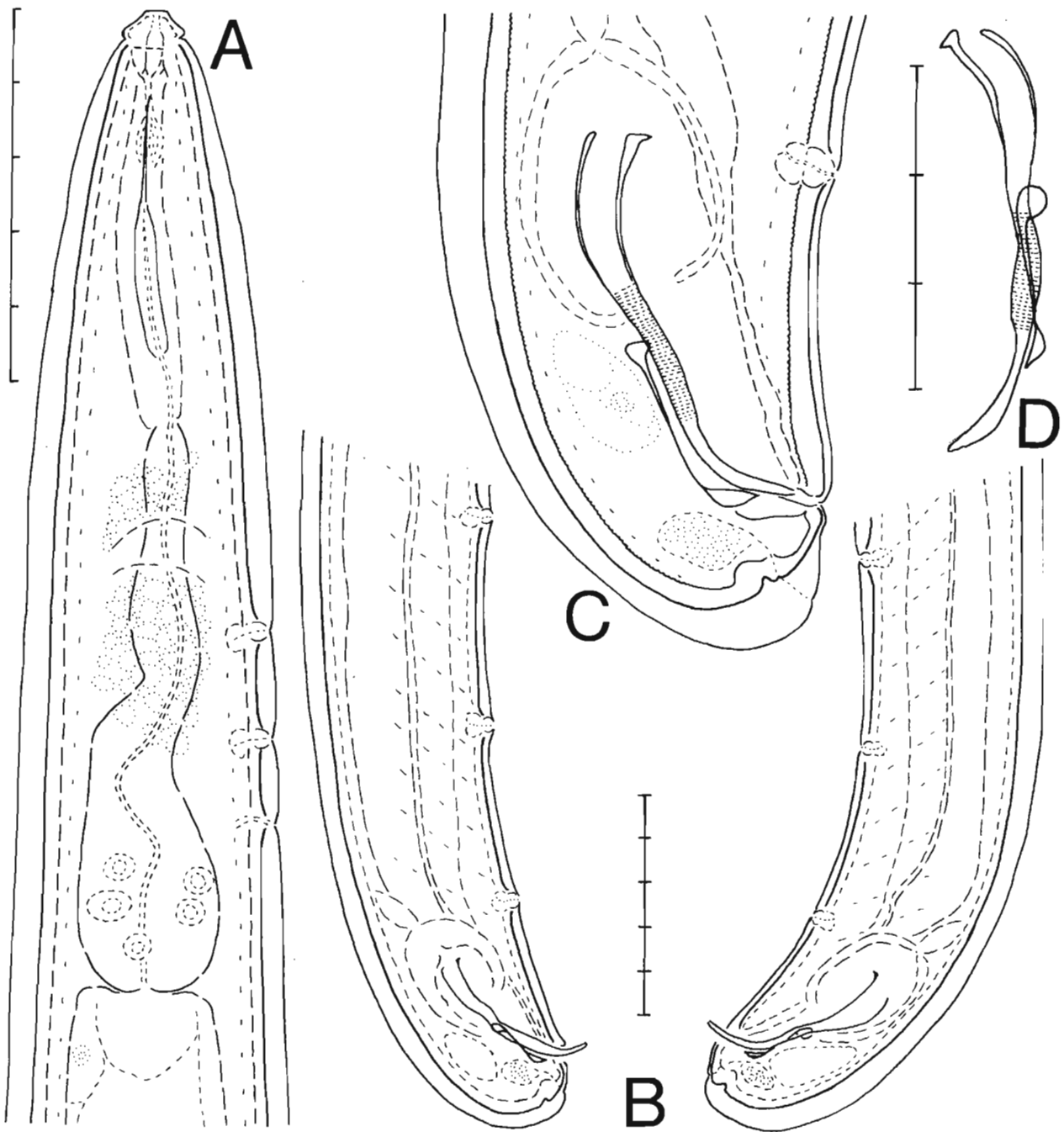


Fig. 1. *Trichodorus altaicus* sp. n. Male. A: Neck region; B-C: Tail region; D: Spicule and gubernaculum. (Smallest unit of scale bars = 10 μ m).

[571-742 vs 601-950 μ m (*T. aequalis*) and 530-1150 μ m (*T. sparsus*)] and onchiostyle [39-47 vs 42-74 μ m (*T. aequalis*) and 45-73 μ m (*T. sparsus*)]. The males of *T. altaicus* sp. n. also differ from the males of *T. aequalis* and *T. sparsus* by the shape of the spicules and

from the males of *T. sparsus* in the somewhat shorter spicule (38-47 vs 43-65 μ m in *T. sparsus*). The females of *T. altaicus* sp. n. also differ from the females of *T. aequalis* and *T. sparsus* by the shape of the vaginal sclerotizations in lateral view.

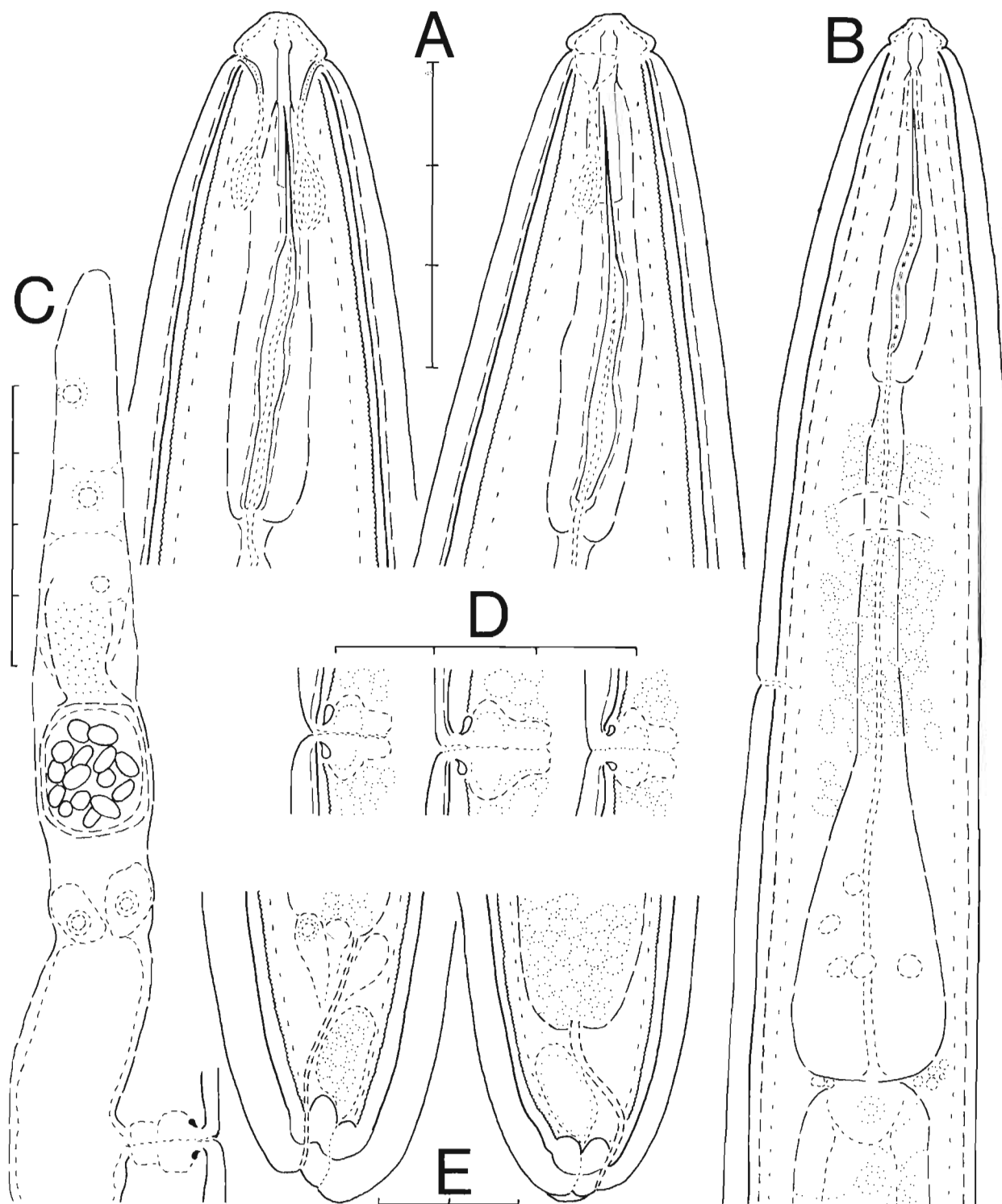


Fig. 2. *Trichodorus altaicus* sp. n. Female. A : Anterior region (left : ventral view; right : lateral view); B : Neck region, lateral view; C : Anterior branch of reproductive system; D : Vagina and vulval region, lateral view; E : Tail region. (Smallest unit of scale bars = 10 μ m).

Key to the species of the genus *Trichodorus* Cobb, 1913

Since both males and females have been described for all *Trichodorus* species found so far and since *Trichodorus* populations usually consist of mixtures of males and females, a single key for both males and females is presented. Also, morphological and morphometrical characters of the males or the females of some *Trichodorus* species are so similar (e.g. the males of *T. lusitanicus*, *T. beirensis*, *T. azorensis* and *T. viruliferus*; see Almeida *et al.*, 1989; and the females of *T. carlingi*, *T. aequalis* and *T. sparsus*; see Bernard, 1992) that data of both sexes are necessary to make a reliable species identification.

1. Number of ventromedian cervical papillae in males :
 - 0 2
 - 1 3
 - 2 11
 - 3 28
2. Shape of spicules :
 - strongly curved, distal part not widened
..... *T. obtusus* Cobb, 1913
 - slightly curved, distal part somewhat widened
..... *T. obscurus* Allen, 1957
3. Length of onchiostyle in females and males :
 - less than 35 μm
.. *T. philipi* De Waele, Meyer & Van Mieghem, 1990
 - more than 100 μm *T. elegans* Allen, 1957
 - between 35 and 100 μm 4
4. Position of ventromedian cervical papilla in males :
 - opposite posterior half of onchiostyle
..... *T. borae* Rahman, Jairajpuri & Ahmad, 1985
 - opposite pharyngo-intestinal junction
..... *T. sarniae* Vermeulen & Heyns, 1984
 - opposite isthmus or anterior half of pharyngeal bulb 5
5. Position of preloacal ventromedian supplements in males :
 - both SP1 ⁽¹⁾ and SP2 within range of retracted spicules, SP3 out of range of retracted spicules
..... *T. intermedius* Rodriguez-M. & Bell, 1978
 - SP1 just anterior to cloaca, SP2 opposite heads of retracted spicules, SP3 out of range of retracted spicules
..... *T. californicus* Allen, 1957
 - SP1 opposite middle of retracted spicules, SP2 and SP3 out of range of retracted spicules 6
 - SP1 opposite heads or just anterior to heads of retracted spicules, SP2 and SP3 out of range of retracted spicules 7
6. - Proximal part of spicules widened, then uniformly tapering towards distal end; vaginal sclerotizations reniform, longest axis parallel to vagina wall
..... *T. dilatatus* Rodriguez-M. & Bell, 1978
 - Proximal part of spicules slightly cephalated, then irregularly tapering towards distal end; vaginal sclerotizations peanut-like, longest axis parallel to body wall ..
..... *T. cottieri* Clark, 1963
7. Shape of proximal part of spicules :
 - not cephalated 8
 - cephalated 9
8. - Spicules with clear constriction in middle part; one pair of sublateral postvulvar body pores in females
..... *T. magnus* Decraemer & Marais, 1993
 - Spicules without constriction in middle part; one pair of lateral prevulvar and one pair of ventrosublateral postvulvar body pores in females *T. proximus* Allen, 1957
9. Shape of middle part of spicules :
 - without constriction
..... *T. eburneus* De Waele & Carbonell, 1983
 - with constriction 10
10. - Onchiostyle length less than 50 μm in females and males; vaginal sclerotizations small rounded triangular; one pair of sublateral postvulvar body pores in females
..... *T. kilianae* Decraemer & Marais, 1993
 - Onchiostyle length 50 μm or more in females and males; vaginal sclerotizations larger rounded or rounded triangular; one pair of lateral prevulvar and one pair of subventral postvulvar body pores in females
..... *T. vandenbergae* De Waele & Kilian, 1992
11. Position of ventromedian cervical papillae in males :
 - CP1 ⁽²⁾ opposite onchiostyle, CP2 opposite posterior half or basis of onchiostyle or posterior to basis of onchiostyle *T. lusitanicus* Siddiqi, 1974
 - CP1 and CP2 posterior to basis of onchiostyle 12
12. Position of excretory pore in males :
 - in between CP1 and CP2 13
 - posterior to CP2 15
13. - No dorsal overlap of pharyngeal bulb or ventral overlap of intestine in females and males; proximal part of spicules widened; vaginal sclerotizations small oblique drop-like to oval
..... *T. parorientalis* Decraemer & Kilian, 1992
 - Dorsal overlap of pharyngeal bulb in one-third to half of females and males; proximal part of spicules cephalated 14
14. Number and position of body pores in females :
 - one pair of lateral prevulvar and one pair of lateral postvulvar body pores
..... *T. coomansi* De Waele & Carbonell, 1983
 - one pair of lateral postvulvar body pores
..... *T. rinae* Vermeulen & Heyns, 1984
15. Position of preloacal ventromedian supplements in males :
 - SP1 opposite middle of retracted spicules, SP2 opposite heads of retracted spicules, SP3 out of range of retracted spicules *T. borneoensis* Hooper, 1962
 - SP1 35-75 % of spicule length from cloaca, SP2 and SP3 out of range of retracted spicules 16
 - SP1 opposite heads or just anterior to heads of retracted spicules, SP2 and SP3 out of range of retracted spicules 20
16. Body length :
 - between 500 and 750 μm
..... *T. elefjohnsoni* Bernard, 1992

(1) SP1 = posteriormost supplement.

(2) CP1 = anteriormost ventromedian cervical papilla.

- between 700 and 1100 μm 17
- 17. Shape and length of spicules :
 - proximal part widened, spicules almost straight, less than 55 μm *T. hooperi* Loof, 1973
 - proximal part cephalated, spicules curved ventrally, more than 60 μm 18
- 18. Shape of spicules :
 - slender, proximal end cephalated *T. petrusalberti* De Waele, 1988
 - heavily build, proximal third cephalated 19
- 19. - Onchiostyle length in females and males 53-64 μm ; spicule length 63-71 μm ; one pair of lateral prevulvar and one pair of lateral postvulvar body pores in females *T. minzi* De Waele & Cohn, 1992
- Onchiostyle length in females and males 64-72 μm ; spicule length 57-64 μm ; one pair of lateral postvulvar body pores in females *T. taylora* De Waele, Mancini, Roca & Lamberti, 1982
- 20. - Tips of spicules strongly recurved ventrally *T. carlingi* Bernard, 1992
- Tips of spicules not recurved ventrally 21
- 21. - Dorsal overlap of pharyngeal bulb present 22
- Overlap absent 23
- 22. - Onchiostyle length in females and males 63-72 μm ; spicule length 51-61 μm ; proximal part of spicule separated from middle part by a narrowing; one pair of lateral prevulvar and one pair of lateral postvulvar body pores in females; vaginal sclerotizations large rounded *T. persicus* De Waele & Sturhan, 1987
- Onchiostyle length in females and males 47-58 μm ; spicule length 34-39 μm ; spicule with clear constriction in middle part; one pair of lateral postvulvar body pores in females; vaginal sclerotizations small, triangular *T. orientalis* De Waele & Hashim, 1984
- 23. Shape of spicules :
 - proximal part not widened or cephalated *T. paucisetosus* Bernard, 1992
 - proximal part widened 24
 - proximal part cephalated 27
- 24. Number and position of body pores in females :
 - usually one pair of lateral postvulvar body pores *T. giennensis* Decraemer, Roca, Castillo, Peña-Santiago & Gomez-Barcina, 1993
 - usually one pair of lateral prevulvar and one pair of lateral postvulvar body pores 25
- 25. Shape of spicules :
 - middle third not curved ventrally but twisted *T. altaicus* sp. n.
 - middle third curved ventrally 26
- 26. - Tail in males evenly rounded, terminal cuticle not thickened; spicules without striae or setae *T. aequalis* Allen, 1957
- Tail in males not evenly rounded, terminal cuticle thickened; spicules with setae ... *T. sparsus* Szczygiel, 1968
- 27. - Body length 660-770 μm ; distal half of spicules straight, proximal half dorsally convex, spicules finely striated
 - *T. complexus* Rahman, Jairajpuri & Ahmad, 1985
 - Body length 785-1085 μm ; middle part of spicules straight, without constriction, spicules with striae and setae *T. nanjingensis* Ruijun & Hurui, 1990
- 28. Position of ventromedian cervical papillae in males :
 - CP1 posterior to basis of onchiostyle 29
 - CP1 opposite onchiostyle 31
- 29. Length of onchiostyle in females and males :
 - more than 60 μm *T. yokooi* Eroshenko & Teplyakov, 1975
 - less than 55 μm 30
- 30. - Body length 583-827 μm ; ventral overlap of intestine; spicule length 35-44 μm ; SP1 slightly anterior to heads of retracted spicules; one pair of lateral prevulvar and one pair of lateral postvulvar body pores in females *T. tricaulatus* Shishida, 1979
- Body length 820-1220 μm ; overlap absent; spicule length 49-58 μm ; SP1 within range of retracted spicules, SP2 and SP3 out of range of retracted spicules; one pair of lateral postvulvar body pores in females *T. pakistanensis* Siddiqi, 1962
- 31. Shape of vaginal sclerotisations :
 - very large quadrangular to rounded triangular 32
 - smaller 33
- 32. - One pair of lateral prevulvar and one pair of lateral postvulvar body pores in females; spicules narrow, proximal end distinctly cephalated with a smaller part between the cephalated end and the rest of the spicule *T. variopapillatus* Hooper, 1972
- Three pairs of lateral prevulvar body pores in females; proximal third of spicule widened then uniformly becoming smaller *T. aquitanensis* Baujard, 1980
- 33. - Length of onchiostyle in females and males :
 - more than 55 μm 34
 - less than 55 μm 35
- 34. - Proximal part of spicules cephalated, middle part without constriction; one pair of ventrosbmedian postvulvar body pores in females; vaginal sclerotizations drop-like, pointing towards each other *T. cedarus* Yokoo, 1964
- Proximal part of spicules widened, then gradually tapering towards middle where a constriction is present; one pair of lateral postvulvar body pores in females; vaginal sclerotizations square-shaped with rounded edges *T. azorensis* Almeida, De Waele, Santos & Sturhan, 1989
- 35. - Proximal part of spicules cephalated, narrowing to 2 μm about 5 μm from proximal end, then gradually widening to almost 4 μm in middle, narrowing again towards distal end; one pair of lateral postvulvar body pores in females; vaginal sclerotizations triangular *T. similis* Seinhorst, 1963
- Proximal part of spicules not cephalated 36
- 36. Shape of proximal part of spicules :
 - not widened 37
 - widened 38

37. – Distal half of spicules widening before tapering to distal end; SP1 opposite anterior half of retracted spicules; vaginal sclerotizations drop-like, pointing towards each other *T. cylindricus* Hooper, 1962
- Distal half of spicules thin; SP1 opposite heads of retracted spicules; vaginal sclerotizations rod-like, parallel to each other *T. primitivus* (de Man, 1880) Micoletzky, 1922
38. – Vaginal sclerotizations rounded triangular to almost oval, about $3 \times 5 \mu\text{m}$; lateral body pores absent in females; spicules with setae on middle part; SP1 usually well within range of retracted spicules *T. beirensis* Almeida, De Waele, Santos & Sturhan, 1989
- Vaginal sclerotizations smaller; spicules without setae; SP1 opposite heads or just anterior to heads of retracted spicules 39
39. – Spicules with distinct subventral flange (velum); vagina with large lobes distally; vulva opening transverse *T. velatus* Hooper, 1972

- Spicules without velum; vagina about as wide as long; vulva opening pore-like . *T. viruliferus* Hooper, 1963

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