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A Key and Diagnostic Compendium to the Species of the Genus *Tylenchorhynchus* Cobb, 1913 (Nematoda: Belonolaimidae)

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Abstract: An identification key to 111 species of *Tylenchorhynchus* is given. *Tylenchorhynchus* is defined as containing only those species with four incisures in the lateral field. A compendium providing the most important diagnostic characters for use in identification of species is included as a supplement to the key. Some species in a related but unnecessary genus were placed in the genus *Tylenchorhynchus,* based on morphological structures and logical groupings of the species. *Bitylenchus iphilus* is transferred to *Tylenchorhynchus.* The diagnosis of *Tylenchorhynchus* is emended, and a list of all the valid species of the genus is given. The characters most useful for separating species are the stylet length, shape of lip region, number of lip annules, shape of tail and tail terminus, number of tail annules, and position of vulva (V%). As defined in the paper, the genus currently is composed of 111 valid species.

Key words: Compendium, diagnosis, identification, key, morphology, nematode, stunt nematodes, taxonomy, *Tylenchorhynchus.*

The cosmopolitan genus *Tylenchorhynchus* was established by Cobb (1913) for *T. cylindricus* found in southern California. Currently this genus contains 111 species that parasitize a wide variety of plants. Allen (1955) enhanced taxonomic criteria for *Tylenchorhynchus.* Tarjan (1973) gave a synopsis, key, and diagnostic data of the genera and species in the Tylenchorhynchinae. The history of the genus was discussed by Hooper (1978), Golden et al. (1987), and Anderson and Potter (1991). Siddiqi (1986) regarded 71 total species as being in *Tylenchorhynchus.* Fortuner and Luc (1987), in their reappraisal of Tylenchina, included *Tylenchorhynchus* under the family Belonolaimidae, subfamily Telotylenchinae, and recognized 129 valid species, defining *Tylenchorhynchus* as having 2 to 5 lines in the lateral field, which was sometimes areolated. Mahajan (1988) gave a diagnostic compendium to species of *Tylenchorhynchus* and included 89 valid species in the genus. Esser (1991) listed 257 nominal species in his checklist of the genus. Brzeski and Dolinski (1998) compiled a compendium containing 177 species with 2 to 5 lines in the lateral field. The taxonomy of stunt nematodes has been advanced through scanning electron microscopy (Fortuner and Luc, 1987; Powers, 1983; Powers et al., 1983; Siddiqi, 1986).

As a result of the inevitable taxonomic changes, development of a dichotomous key to *Tylenchorhynchus* spp. has become increasingly difficult. Many species previously included in *Tylenchorhynchus* have been placed in newer genera, and numerous species within related genera have been either shifted to *Tylenchorhynchus* or synonymized with other species. The most important character used in distinguishing these genera is the number of lateral lines or incisures, which can range from three to six. In the present study, *Tylenchorhynchus* is defined as containing only those species with four lines in the lateral field.

The objectives of this study were to examine specimens and published data on *Tylenchorhynchus* spp., define the valid and most significant differentiating characters, and prepare a new key and a compendium containing morphometric and related details to facilitate easy identification of 111 valid *Tylenchorhynchus* spp.

Materials and Methods

Paratype specimens of 37 species and nontype specimens of 40 other species were examined from the USDA Nematode Col-

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lection at Beltsville, Maryland. These specimens were either already mounted in glycerin or were preserved in 3% formaldehyde + 2% glycerin solution in vials. Up to 25 specimens were examined for each species. Examinations were made with a compound light microscope, and morphometric data were obtained with an eyepiece micrometer. Original descriptions and any subsequent redescriptions or other related data also were used to assess species. The root source for the arrangement of compendium included in Table 1 contains updated morphometric data of the most important diagnostic characters of all 111 valid *Tylenchorhynchus* spp. and is organized according to Tarjan (1964, 1973) compendia format.

All measurements were made in micrometers (µm) unless otherwise stated.

Systematics

Genus *Tylenchorhynchus* Cobb, 1913
(Fig. 1)
(Diagnostic data on females in Table 1.)

Emended diagnosis: Females small- to medium-sized (0.36–1.6 mm long), cuticle fine to distinctly annulated, sometimes with longitudinal striae, lateral field marked by 4 incisures, generally not areolated behind esophageal region; outer bands sometimes aerolated. Stylet well developed (10–31 µm long), with prominent basal knobs, cone about as long as shaft. Head continuous, offset, or sunken from body, annulated or smooth; cephalic framework lightly to heavily sclerotized. Deirids usually inconspicuous. Phasmids near middle of tail. Median bulb round or oval, with distinct valve plates, usually demarcated by constrictions from precorpus and isthmus. Basal esophageal bulb present, offset from intestine, its base sometimes slightly extending over intestine. Cardia prominent. Vulva generally near middle of body V = 47–64%. Ovaries paired, outstretched. Tail cylindrical to subcylindrical, conoid with blunt tip, pointed-conoid, conical to almost funnel-shaped, clavate to subclavate, or bluntly rounded; tail terminus hemispherical to subhemispherical, acutely pointed or bluntly pointed to bluntly rounded, conoid, or rounded; tail tip smooth or annulated. Males generally present, similar to females but slightly smaller. Tail short. Bursa nearly always extending to tail tip; phasmids near middle of tail; spicule distally flanged with well-developed velum, terminus narrow, indented or pointed. Gubernaculum well developed, about half the length of spicule, generally rod-like or sometimes variously hooked at anterior end, protrusible.

Type species:

Tylenchorhynchus cylindricus Cobb, 1913

Other species:

T. aduncus de Guiran, 1967
T. aerolatus Tobar Jiménez, 1970
T. agri Ferris, 1963
T. allii Khurma & Mahajan, 1987
T. alami Shaw & Khan, 1996
T. amgi Kumar, 1981
T. ancorastyletus Ivanova, 1983
T. annulatus (Cassidy, 1930) Golden, 1971
T. antarcticus Wouts & Sher, 1981
T. aspericutis Knobloch, 1975
T. badliensis Saha & Khan, 1982
T. bicaudatus Khakimov, 1973
T. bohrrensis Gupta & Uma, 1980
T. brassicae Siddiqi, 1961
T. brevilineatus Williams, 1960
T. bryobius Sturhan, 1966
T. canalis Thorne & Malek, 1968
T. clarus Allen, 1955
T. clavicaudatus Seinhorst, 1963
T. clavus Khan, 1990
T. claytoni Steiner, 1937
T. coffeae Siddiqi & Basir, 1959
T. contractus Loof, 1964
T. crassicaudatus Williams, 1960
T. cristatus Ivanova, 1983
T. crotoni Pathak & Siddiqi, 1997
T. cuticaudatus Ray & Das, 1983
T. cynodoni Kumar, 1981
T. delhiensis Chawla, Bhamburkar, Khan & Prasad, 1968
T. depressus Jairajpuri, 1982
T. dewaeli Kleynhans, 1992
T. dubius (Butschli, 1873) Filipjev, 1936
T. ebriensis Seinhorst, 1963

T. elegans Siddiqi, 1961
T. eremicolus Allen, 1955
T. eroshenkoi Siddiqi, 1986
T. estherae Kleynhans, 1992
T. ewingi Hopper, 1959
T. georgiensis Eliashvili, 1971
T. goffarti Sturhan, 1966
T. goldeni Rashid & Singh, 1982
T. gossypii Nasira & Maqbool, 1996
T. graciliformis Siddiqi & Siddiqui, 1983
T. haki Fotedar & Mahajan, 1971
T. hordei Khan, 1972
T. huesingi Paetzold, 1958
T. ibericus Mahajan & Nombela, 1986
T. iphilus (Minagawa, 1995) n. comb. syn. *Bitylenchus iphilus* Minagawa, 1995
T. irregularis Wu, 1969
T. ismaili Azmi & Ahmad, 1989
T. kamlae Shaw & Khan, 1996
T. kashmirensis Mahajan, 1974
T. kegasawai Minagawa, 1995
T. kegenicus Litvinova, 1946
T. kidwaii Rashid & Heyns, 1990
T. lamilliferus (de Man, 1880) Filipjev, 1936
T. latus Allen, 1955
T. leucaenus Azmi, 1991
T. leviterminalis (Siddiqi, Mukherjee & Dasgupta, 1982) Siddiqi, 1986
T. malinus Lin, 1992
T. manubriatus Litvinova, 1946
T. mashhoodi Siddiqi & Basir, 1959
T. maximus Allen, 1955
T. mexicanus Knobloch & Laughlin, 1973
T. microcephalus Siddiqi & Patel, 1990
T. microconus Siddiqi, Mukherjee & Dasgupta, 1982
T. musae Kumar, 1981
T. namibiensis Rashid & Heyns, 1990
T. natalensis Kleynhans, 1984
T. neoclavicaudatus Mathur, Sanwal & Lal, 1979
T. nordiensis Khan & Nanjappa, 1974
T. novenus Nobbs, 1989
T. nudus Allen, 1955
T. olereaceae Gupta & Uma, 1981
T. pachys Thorne & Malek, 1968
T. paracanalis Khan, 1991
T. paranudus Phukan & Sanwal, 1982
T. paratriversus Brzeski, 1991
T. parvus Allen, 1955
T. paulettae Bloemers & Wanless, 1998
T. penniseti Gupta & Uma, 1980
T. projectus Khan, 1990
T. punensis Khan & Darekar, 1979
T. quaidi Golden, Maqbool & Handoo, 1987
T. queirozi Monteiro & Lordello, 1976
T. robustus Thorne & Malek, 1968
T. rosei Zarina & Maqbool, 1991
T. sacchari Sivakumar & Muthukrishnan, 1983
T. sanwali Kumar, 1982
T. siccus Nobbs, 1989
T. silvaticus Ferris, 1963
T. solani Gupta & Uma, 1982
T. spinaceae Singh, 1976
T. striatus Allen, 1955
T. swarupi Singh & Khera, 1978
T. tarjani Andrássy, 1969
T. teeni Hashim, 1984
T. tenuicaudatus Wouts & Sher, 1981
T. thermophilus Golden, Baldwin & Mundo-Ocampo, 1995
T. tobari Sauer & Annells, 1981
T. tritici Golden, Maqbool & Handoo, 1987
T. tuberosus Zarina & Maqbool, 1994
T. usmanensis Khurma & Mahajan, 1987
T. variacaudatus Singh, 1971
T. velatus Sauer & Annells, 1981
T. ventrosignatus Tobar Jiménez, 1969
T. vishwanathensis Pathak & Siddiqi, 1996
T. vulgaris Upadhyay, Swarup & Sethi, 1972
T. wilskii Kornobis, 1980
T. zambiensis Venditti & Noel, 1995

Tylenchorhynchus Species Key

1. Stylet 10–31 µm long; tail terminus smooth ---------- 2
1a. Stylet 13–30 µm long; tail terminus annulated ---------- 80
2(1). Stylet 10–15 µm long ---------- 3
2a. Stylet 15–23 µm long ---------- 13
2b. Stylet 23–31 µm long ---------- 74
3(2). Lip region 0–4 annules ------- 4
3a. Lip region 4–7 annules ------- 9
4(3). Lip region continuous with 0–4 annules ---------- 5
4a. Lip region set off or conoid with 1–4 annules ---------- 7
5(4). Lip region without any annules; tail clavate with hemispherical terminus bearing 20–26 annules -------- *T. cynodoni*

TABLE 1. Diagnostic data on species of *Tylenchorhynchus* females. See Figure 1 for shapes.

Species	Length (mm)	Lip region[a]	Lip annules	Stylet (µm)	Stylet knob inclination[b]	Tail annules	Tail shape[c]	Tail terminus[d]	Tail tip annulation[e]	c′
aduncus	0.68–0.75	OFF	4–5	18–20	POS	19–27	CON	BLP	SMO	2.5–3
aerolatus	0.54–0.70	OFF	5–6	15–17	POS	16–22	SCYL	BLP	SMO	2–3
agri	0.66–0.77	OFF	4	20–23	LAT	18–26	SCYL	HEM	SMO	2.6
alami	0.61–0.70	CNT	3	19–21	–	25	CNC	–	SMO	3–4
allii	0.54–0.68	OFF	6–7	15–17	–	34–47	SCYL	SHEM	SMO	2.7–3.6
amgi	0.67–0.75	CNT	0	19–20	ANT	16–20	SCYL	SHEM	SMO	3.7
ancorastyletus	0.65–0.91	OFF	3–4	18–20	ANT	9–19	CON	HEM	SMO	2.1–3
annulatus	0.61–0.86	OFF	2–3	17–21	LAT	17–27	SCYL	HEM	SMO	2.9–3.7
antarcticus	0.69–0.82	OFF	5–7	24–26	POS	39	SCYL	HEM	ANN	2.5–2.7
aspericutis	0.51–0.58	OFF	3	15–16	LAT	11–12	CON	BLP	SMO	2–3
badliensis	0.62–0.71	OFF	3	17–19	ANT	17–22	CON	BLP	SMO	3–4
bicaudatus	0.69	OFF	0	23	–	26–27	CYL	IND	SMO	4.2
bohrrensis	0.61–0.75	CNT	2–3	15–17	ANT	17–21	SCYL	HEM	SMO	2–3.2
brassicae	0.58–0.72	OFF	4	16–17	LAT	18–33	CON	BLP	SMO	1.9–3
brevilineatus	0.50–0.71	OFF	5–6	13–18	POS	32–49	SCYL	HEM	SMO	2.9
bryobius	0.76–0.86	CNT	5–6	21–24	POS	35–45	SCYL	BLP	ANN	2.5–3.5
canalis	1.00	OFF	5–6	20	ANT	66	SCYL	HEM	ANN	2.8
clarus	0.49–0.69	CNT	5	15–18	ANT	10–20	CON	BLP	SMO	2.6–3.1
clavicaudatus	0.54–0.72	CNT	3	18–19	POS	31	CLA	HEM	SMO	3.8–4
clavus	0.74–0.79	CNT	3	24–27	ANT	12–19	CLA	–	SMO	–
claytoni	0.51–0.75	OFF	3–4	17–21	LAT	9–20	CON	BLR	SMO	2–3
coffeae	0.57–0.63	CNT	2	17–20	POS	19	SCYL	BLP	SMO	3–3.3
contractus	0.42–0.63	CNT	5–6	16–18	LAT	20–23	CON	BLP	SMO	2.5
crassicaudatus	0.58–0.69	CNT	3	20	POS	17–19	CLA	HEM	ANN	3.5
cristatus	0.69–0.79	OFF	4–5	18–19	POS	23–25	CON	BLP	ANN	2.8–3.3
crotoni	0.53–0.58	OFF	4–5	13–18	–	21	CON	BLT	SMO	–
cuticaudatus	0.50–0.62	OFF	5–6	14–15	ANT	37	CYL	HEM	ANN	2.3–3.4
cylindricus	0.65–1.17	OFF	5	24–29	ANT	15–20	CON	BLP	SMO	1.6–2.5
cynodoni	0.63–0.68	CNT	0	13–15	ANT	20–26	CLA	HEM	SMO	4.3
delhiensis	0.60–0.70	CNT	2	14–16	LAT	29	SCYL	BLP	SMO	4
depressus	0.55–0.63	OFF	5–7	10–11	POS	30–50	CYL	BLP	SMO	2.2–3.2
dewaeli	1.15–1.60	OFF	7	19–21	–	41–65	CON or CYL	RND	ANN	2.6–4.5
dubius	0.54–0.92	OFF	7	18–19	POS	36–66	SCYL	RND	ANN	3.2
ebriensis	0.52–0.59	CNT	5	21–22	POS	25	CON	BLP	SMO	2.6
elegans	0.56–0.70	CNT	3–4	15–18	–	22–23	SCYL	BLR	SMO	3–4
eremicolus	0.70–0.76	CNT	4	19–20	ANT	27–29	CON	BLP	ANN	2.7
eroshenkoi	0.70–0.89	CNT	6–7	25–26	POS	18–35	CON	BLP	SMO	1.1–1.7
estherae	0.67–0.79	OFF	6–7	19–23	LAT	28–66	CON	SMO	SMO or ANN	2.3–4.3
ewingi	0.55–0.75	CNT	3	18–20	POS	15–19	SCYL	BLP	SMO	2.3–2.5
georgiensis	0.57–0.69	OFF	5–6	19–20	POS	8–10	CYL	HEM	SMO	2.4
goffarti	0.49–0.70	OFF	6–7	13–15	POS	23–46	SCYL	BLP	SMO	2.5–3.5
goldeni	0.57–0.82	CNT	2–3	16–19	POS	19–36	SCYL	HEM	SMO	3
gossypii	0.47–0.73	CNT	2–3	15–17	–	15–17	BLR	HEM	SMO	2.3–3
graciliformis	0.67–0.83	OFF	5–6	17–18	ANT	16–20	SCYL	HEM	SMO	2.3–3.7
haki	0.55–0.63	CNT	3	16–18	POS	14–20	CON	HEM	SMO	3
hordei	0.68	OFF	5	19	POS	42–46	–	–	SMO	–
huesingi	0.78–0.92	CNT	5	18–19	POS	32–36	CYL	HEM	ANN	2
ibericus	0.99–1.27	OFF	6	21–26	POS	32–36	CYL	HEM	ANN	2.3–3.3
iphilus	0.55–0.80	OFF	5–6	17–20	LAT	24–41	CLA	BLP	ANN	–
irregularis	0.69–0.83	OFF	4	19–21	POS	20–26	CON	BLP	ANN	2.0–2.5
ismaili	0.46–0.66	OFF	4–5	17–20	POS	14–17	SCYL	NAR	ANN	2.5–2.6
kamlae	0.55–0.63	NAR	4	19–21	–	21	–	CNC	SMO	3–5
kashmirensis	0.60–0.74	OFF	3	17–21	LAT	13–17	SCYL	BLP	ANN	1.6
kegasawai	0.52–0.63	CNT	2–3	19–22	LAT	15–21	CLA	RND	SMO	3–4
kegenicus	0.79–1.17	CNT	7–10	28–31	POS	51–58	SCYL	BLP	SMO	3.3–4.8
kidwaii	1.08–1.24	CNT	7–9	20–23	–	23–29	CYL	RND	ANN	1.4–1.9
lamilliferus	0.86–1.1	CON	6	24–28	–	43	CON	BLR	ANN	–
latus	0.58–0.7	OFF	6	16–17	ANT	14–15	CON	BLP	SMO	2.2
leucaenus	0.55–0.56	OFF	4–5	17–18	POS	18–21	SCYL	BLP	ANN	–
leviterminalis	0.54–0.75	CNT	0–1	17–19	POS	14–21	SCYL	HEM	SMO	3.3–4.5
malinus	0.60–0.77	CNT	6	19–21	POS	26–34	CYL–CLA	HEM	ANN	2.4–3.2
manubriatus	0.75	CNT	6	18	POS	35–38	SCYL	HEM	SMO	3.3
mashhoodi	0.49–0.76	CNT	3–4	16–20	POS	14–29	CYL	BLP	SMO	2.5–4
maximus	0.98–1.40	CNT	7	21–24	POS	38–41	CYL	HEM	ANN	2.6

TABLE 1. (Continued).

Species	Length (mm)	Lip region[a]	Lip annules	Stylet (µm)	Stylet knob inclination[b]	Tail annules	Tail shape[c]	Tail terminus[d]	Tail tip annulation[e]	c′
mexicanus	0.55–0.79	OFF	3–4	19–21	POS	18–22	CON	BLR	SMO	1.7–2.6
microcephalus	0.36–0.81	CNT	0–1	18–21	–	25–35	SCLA	RND	SMO	3.8–5.7
microconus	0.46–0.65	OFF	3–4	15–18	POS	10–15	CON	BLP	SMO	1.7–2.6
musae	0.58–0.65	CNT	1–2	18–19	ANT	16–28	SCYL	BLP	SMO	2.8
namibiensis	0.67–0.88	OFF	6–9	16–20	POS	27–51	SCYL	RND	SMO	3–4.1
natalensis	0.78–0.96	OFF	6–7	19–21	POS	52–66	CYL	HEM	ANN	3–4.1
neoclavicaudatus	0.59–0.72	CNT	2–3	20–23	POS	32–50	CLA	HEM	SMO	2.7–3.6
nordiensis	0.55–0.68	CNT	4	11–13	ANT	14–19	CON	BLP	SMO	2.4–2.7
novenus	0.67–0.92	OFF	7–8	17–23	–	39–51	NAR	RND	SMO	2.1–3.7
nudus	0.62–0.78	CNT	2	19–23	ANT	18–20	CON	HEM	SMO	2.8
oleraceae	0.48–0.68	OFF	4–5	12–15	POS	38	CON	BLP	SMO	2.2–3.2
pachys	0.63	CON	1–2	13–15	ANT	13	SCYL	BLR	SMO	–
paracanalis	0.50–0.60	OFF	4	15–17	POS	49	CON	SMO	SMO	–
paranudus	0.58–0.78	OFF	0	18–21	ANT	14–25	CLA	HEM	SMO	2.5–3.7
paratriversus	0.70–0.82	OFF	3–4	21–23	ANT	27–38	CNC–FUNL	RND	SMO	2.2–2.9
parvus	0.63–0.74	CNT	7	17–18	LAT	35–43	CYL	HEM	ANN	3
paulettae	0.48–0.64	OFF	5–6	21–22	ANT	27	PCON	FR	SMO	2–4
penniseti	0.59–0.62	CNT	3	16	ANT	15–17	SCYL	BLP	SMO	2–2.8
projectus	0.70–0.78	CNT	4	20–22	ANT	13	CON	CON	SMO	–
punensis	0.60–0.75	CNT	2–3	14–15	ANT	24–27	CYL	BLP	SMO	3.7–4.8
quaidi	0.45–0.66	SNK	5–6	14–15	–	31–41	CYL	CON	SMO	–
queirozi	0.49–0.60	OFF	4–5	16–17	ANT	22–30	SCYL	HEM	ANN	2.6–3.5
robustus	1.00	CNT	0	23	ANT	40–45	CYL	HEM	SMO	3.5
rosei	0.55–0.58	CNT	2	17–18	–	14–17	SCLA	CON	SMO	–
sacchari	0.65–0.73	CNT	3	16–18	POS	18–22	CLA	HEM	SMO	3.5–4.5
sanwali	0.45–0.71	OFF	2	20	ANT	30–31	CON	BLP	ANN	2.0
siccus	0.68–0.94	OFF	6–8	24–30	ANT	16–30	CYL	RND	ANN	1.6–3.6
silvaticus	0.80–1.00	CNT	4	23–26	LAT	17–23	CYL	HEM	SMO	2.5
solani	0.60–0.70	OFF	5–6	16–17	POS	34	CON	BLP	SMO	2.4–3.1
spinaceai	0.60–0.81	OFF	4	14–18	ANT	12–18	SCYL	BLP	SMO	2.5–2.8
striatus	0.58–0.72	CNT	5	16–17	ANT	20–27	SCYL	BLP	SMO	2.8
swarupi	0.42–0.54	OFF	5–6	13–15	POS	–	CYL	BLP	ANN	2.7
tarjani	0.50–0.62	OFF	4–5	24–25	POS	14–15	SCYL	BLP	SMO	2.7–2.8
teeni	0.63–0.73	OFF	6–7	17–18	POS	44–57	CYL	HEM	ANN	2.6–3.3
tenuicaudatus	0.62–0.80	OFF	8	23–26	ANT	38–65	CYL	ACP	SMO	3.3–4.2
thermophilus	0.70–0.85	CNT	3–4	19–20	ANT	21–34	CON	BLP	SMO	–
tobari	0.61–0.77	OFF	8–10	17–19	POS	50	SCYL	HEM	SMO	3.1–4.4
tritici	0.52–0.65	OFF	2–3	12–15	POS	15–23	CYL	BLR	SMO	–
tuberosus	0.62–0.72	CNT	0	20–22	ANT	12–19	SCYL	HEM	SMO	2.5–3.9
usmanensis	0.55–0.65	OFF	5–6	14–16	POS	34–40	CON	NAR	SMO	2.3–3
variacaudatus	0.50–0.56	CNT	2	17–18	ANT	14–15	CON	BLP	SMO	2.3–2.8
velatus	0.66–0.80	OFF	5–6	22–25	ANT	25	CYL	HEM	ANN	1.9–2.8
ventrosignatus	0.45–0.62	OFF	4	11–14	POS	28–32	SCYL	BLR	SMO	2.6–3.2
vishwanathensis	0.53–0.66	OFF	2	15–20	–	17	CON	BLR	SMO	–
vulgaris	0.56–0.67	OFF	6–7	14–16	POS	35–42	SCYL	BLP	SMO	3
wilskii	0.81–1.00	OFF	6	24–27	POS	29–34	CYL	HEM	ANN	2.1–2.5
zambiensis	0.51–0.65	OFF	4–5	13–15	–	21–32	SCYL	CON	SMO	2.2–3.1

[a] Shape of lip region: CNT = continuous; CON = conoid; OFF = offset; SNK = sunken.
[b] Stylet knob inclination: ANT = anterior; LAT = lateral; POS = posterior.
[c] Shape of tail: BLR = bluntly rounded; CLA = clavate; CNC = conical; CON = conoid; CYL = cylindrical; NAR = narrow; SCLA = subclavate; SCYL = subcylindrical; PCON = pointed concoid; FUNL = funnel.
[d] Shape of tail terminus: ACP = acutely pointed; BLP = bluntly pointed: BLR = bluntly rounded; BLT = blunt; CON = conoid; HEM = hemispherical; NAR = narrow; RND = round; SMO = smooth; SHEM = sub-hemispherical; IND = indented; FR = finely rounded.
[e] Tail tip annulation: ANN = annulated; SMO = smooth.

5a. Lip region with 2–4 annules; tail conoid to cylinidrical with a bluntly pointed terminus bearing 14–27 annules-- 6

6(5a). Stylet 11–13 µm long; tail conoid with a bluntly pointed terminus bearing 14–19 annules ---------- *T. nordiensis*

6a. Stylet 14–15 µm long; tail cylindrical with bluntly pointed terminus bearing 24–27 annules -------- *T. punensis*

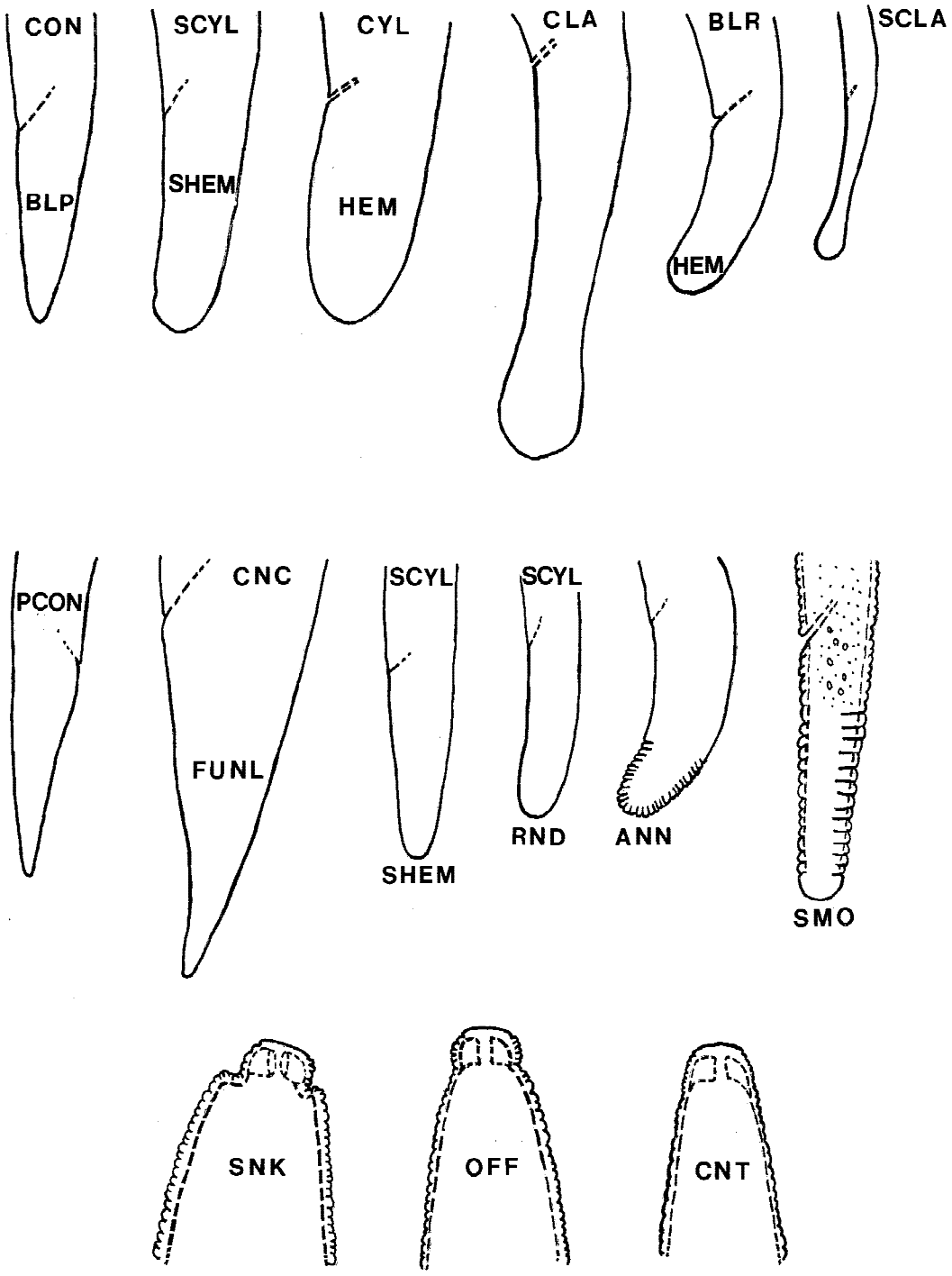

FIG. 1. *Tylenchorhynchus* tail and lip region shapes with code designations used in Table 1. For shape of tail: BLR = bluntly rounded; CLA = clavate; CNC = conical; CON = conoid; CYL = cylindrical; SCLA = subclavate; SCYL = subcylindrical; PCON = pointed conoid; FUNL = funnel. For shape of tail terminus: BLP = bluntly pointed; HEM = hemispherical; RND = round; SHEM = sub-hemispherical. For tail tip annulation: ANN = annulated; SMO = smooth. For shape of lip region: CNT = continuous; OFF = offset; SNK = sunken.

7(4a). Lip region set off with 2–4 annules; tail cylindrical to sub-cylindrical with a bluntly rounded to bluntly pointed terminus bearing 15–32 annules ---------- 8

7a. Lip region conoid with 1–2 annules; tail sub-cylindrical with a bluntly rounded terminus bearing 13 annules ---------- *T. pachys*

8(7). Lip region with 4 annules; stylet 11–14 µm long; tail sub-cylindrical with a bluntly pointed terminus bearing 28–32 annules; wave-like structures present near vulva on ventral side of body of mature females ---------- *T. ventrosignatus*

8a. Lip region with 2–3 annules; stylet 12–15 µm long; tail cylindrical with a bluntly pointed terminus bearing 15–23 annules; no such wave-like structures present ---------- *T. tritici*

9(3a). Stylet 10–11 µm long ---------- *T. depressus*

9a. Stylet 12–15 µm long ---------- 10

10(9a). Lip region 4–5 annules ---------- 11

10a. Lip region 5–7 annules ---------- 12

11(10). Tail conoid with a bluntly pointed terminus bearing 38 annules ---------- *T. oleraceae*

11a. Tail sub-cylindrical with a conoid terminus bearing 21–32 annules ---------- *T. zambiensis*

12(10a). Lip region sunken, dome-shaped with 5–6 annules; tail cylindrical with a conoid terminus; lateral field areolated ---------- *T. quaidi*

12a. Lip region set off, not sunken or dome-shaped, with 6–7 annules; tail sub-cylindrical with a bluntly pointed terminus; lateral field not areolated ---------- *T. goffarti*

13(2a). Lip region continuous ---------- 14

13a. Lip region set off (except *T. paratriversus* sometimes continuous with body) ---------- 44

14(13). Lip region 0–3 annules ---------- 15

14a. Lip region 3–6 annules ---------- 36

15(14). Stylet 15–18 µm long ---------- 16

15a. Stylet 18–23 µm long ---------- 24

16(15). Tail 14–20 annules ---------- 17

16a. Tail 20–36 annules ---------- 23

17(16). Tail clavate to sub-clavate with a hemispherical to conoid terminus ---------- 18

17a. Tail sub-cylindrical to conoid or bluntly rounded with a hemispherical to bluntly pointed or conoid terminus ---------- 19

18(17). Lip region with 3 annules; tail clavate with a hemispherical terminus bearing 18–22 annules ---------- *T. sacchari*

18a. Lip region with 2 annules; tail sub-clavate with a conoid terminus bearing 14–17 annules ---------- *T. rosei*

19(17a). Tail sub-cylindrical with a hemispherical to bluntly pointed terminus ---------- 20

19a. Tail conoid to bluntly-rounded with a hemispherical to bluntly pointed terminus ---------- 21

20(19). Tail sub-cylindrical with a hemispherical terminus bearing 17–21 annules; spicule and gubernaculum longer, measuring 23–27 µm and 12–14 µm, respectively ---------- *T. bohrrensis*

20a. Tail sub-cylindrical with a bluntly pointed terminus bearing 15–17 annules; spicule and gubernaculum shorter, measuring 22 µm and 10 µm, respectively ---------- *T. penniseti*

21(19a). Tail conoid with a bluntly pointed or hemispherical terminus; males absent ---------- 22

21a. Tail bluntly rounded with a hemispherical terminus; males present ---------- *T. gossypii*

22(21). Lip region with 2 annules; stylet 17–18 µm long with anteriorly directed knobs; tail conoid with a bluntly pointed terminus bearing 14–15 annules ---------- *T. variacaudatus*

22a. Lip region with 3 annules; stylet 16–18 µm long with posteriorly directed knobs; tail conoid with a hemispherical terminus bearing 14–20 annules ---------- *T. haki*

23(16a). Lip region with 2–3 annules; tail sub-cylindrical with a hemispherical terminus bearing 20–36 annules; vulva at 55–59%; males present ---------- *T. goldeni*

23a. Lip region with 2 annules; tail sub-cylindrical with a bluntly pointed terminus bearing 29 annules; vulva at 47–48%; males absent ---------- *T. delhiensis*

24(15a). Lip region 0–2 annules ------- 25

24a. Lip region 2–3 annules ------- 32

25(24). Body length less than 1.00 mm; stylet 18–23 µm long; tail with 16–35 annules ------- 26

25a. Body length about 1.00 mm or longer; stylet 23 µm long; tail with 40–45 annules ---------- *T. robustus*

26(25). Tail sub-cylindrical or conoid with hemispherical to sub-hemispherical or bluntly pointed terminus bearing 12–28 annules ---------- 27

26a. Tail sub-clavate with a rounded terminus bearing 25–35 annules ---------- *T. microcephalus*

27(26). Tail conoid with a hemispherical terminus bearing 18–20 annules ---------- *T. nudus*

27a. Tail sub-cylindrical with a hemispherical to sub-hemispherical or bluntly pointed terminus bearing 12–28 annules ---------- 28

28(27a). Lip region 0 annules (except *T. leviterminalis* sometimes with 1 annule) ---------- 29

28a. Lip region 1–2 annules ------- 31

29(28). Stylet 12–22 µm long with anteriorly directed knobs; males absent ---------- 30

29a. Stylet 17–19 µm long with posteriorly directed knobs; males present --- *T. leviterminalis*

30(29). Stylet 19–20 µm long; tail sub-cylindrical with a sub-hemispherical terminus bearing 16–20 annules -------- *T. amgi*

30a. Stylet 20–22 µm long; tail sub-cylindrical with a hemispherical terminus bearing 12–19 annules ------- *T. tuberosus*

31(28a). Lip region with 2 annules; stylet 17–20 µm long with posteriorly directed knobs; tail sub-cylindrical with a bluntly pointed terminus bearing 19 annules ---- *T. coffeae*

31a. Lip region with 1–2 annules; stylet 18–19 µm long with anteriorly directed knobs; tail sub-cylindrical with a bluntly pointed terminus bearing 16–28 annules ---------- *T. musae*

32(24a). Tail clavate with a hemispherical to rounded terminus bearing 15–50 annules -- 33

32a. Tail conical or sub-cylindrical with a bluntly pointed terminus bearing 15–25 annules ---------- 35

33(32). Tail 15–21 annules ---------- *T. kegasawai*

33a. Tail 31–50 annules ---------- 34

34(33a). Stylet 18–19 µm long; tail with 31 annules ---------- *T. clavicaudatus*

34a. Stylet 20–23 µm long; tail with 32–50 annules ---------- *T. neoclavicaudatus*

35(32a). Stylet 18–20 µm long; tail sub-cylindrical with a bluntly pointed terminus bearing 15–19 annules ---------- *T. ewingi*

35a. Stylet 19–21 µm long; tail

conical bearing 25 annules ---------- *T. alami*

36(14a). Stylet 15–20 µm long ---------- 37

36a. Stylet 20–22 µm long ---------- 43

37(36). Lip region 3–4 annules ---------- 38

37a. Lip region 5–6 annules ---------- 40

38(37). Tail conoid with a bluntly pointed terminus bearing 21–34 annules ---- *T. thermophilus*

38a. Tail cylindrical to sub-cylindrical with a bluntly pointed to bluntly rounded terminus bearing 14–29 annules ---------- 39

39(38a). Stylet 16–20 µm long; tail cylindrical with a bluntly pointed terminus bearing 14–29 annules ------ *T. mashhoodi*

39a. Stylet 15–18 µm long; tail sub-cylindrical with a bluntly rounded terminus bearing 22–23 annules ---------- *T. elegans*

40(37a). Tail conoid with a bluntly pointed terminus bearing 10–23 annules ---------- 41

40a. Tail sub-cylindrical with a bluntly pointed or hemispherical terminus bearing 20–38 annules ---------- 42

41(40). Lip region with 5 annules; stylet 15–18 µm long with anteriorly directed knobs; tail with 10–20 annules ----- *T. clarus*

41a. Lip region with 5–6 annules; stylet 16–18 µm long with laterally directed knobs; tail with 20–23 annules ---------- *T. contractus*

42(40a). Stylet 16–17 µm long with anteriorly directed knobs; tail sub-cylindrical with a bluntly pointed terminus bearing 20–27 annules ---------- *T. striatus*

42a. Stylet 18 µm long with posteriorly directed knobs; tail sub-cylindrical with a hemispherical terminus bearing 35–38 annules -- *T. manubriatus*

43(36a). Lip region with 5 annules; stylet 21–22 µm long with posteriorly directed knobs; tail conoid with a bluntly pointed terminus bearing 25 annules ---------- *T. ebriensis*

43a. Lip region with 4 annules; stylet 20–22 µm long with anteriorly directed knobs; tail conoid with a conoid terminus bearing 13 annules ---------- *T. projectus*

44(13a). Lip region 0–3 annules ---------- 45

44a. Lip region 3–6 annules ---------- 50

44b. Lip region 6–10 annules ---------- 69

45(44). Lip region smooth, 0 annules ---------- 46

45a. Lip region 2–3 annules ---------- 47

46(45). Stylet 18–21 µm long; tail clavate with a hemispherical terminus bearing 14–25 annules ---------- *T. paranudus*

46a. Stylet 23 µm long; tail cylindrical with a deeply indented terminus bearing 26–27 annules ------ *T. bicaudatus*

47(45a). Tail 11–17 annules ---------- 48

47a. Tail 17–24 annules ---------- 49

48(47). Lip region with 3 annules; tail conoid with a bluntly pointed terminus bearing 11–12 annules ------ *T. aspericutis*

48a. Lip region with 2 annules; tail conoid with a bluntly rounded terminus bearing 17 annules ---- *T. vishwanathensis*

49(47a). Stylet 17–21 µm long with laterally directed knobs; tail sub-cylindrical with a hemispherical terminus bearing 18–24 annules ------ *T. annulatus*

49a. Stylet 17–19 µm long with anteriorly directed knobs; tail conoid with a bluntly pointed terminus bearing 17–22 annules ------- *T. badliensis*

50(44a). Lip region 3–4 annules ---------- 51

50a. Lip region 4–6 annules (except *T. paratriversus* sometimes with 3 annules) ---------- 59

51(50). Stylet 15–18 µm long ---------- 52

51a. Stylet 18–23 µm long ---------- 55

52(51). Tail 10–18 annules ---------- 53

52a. Tail 18–49 annules ---------- 54
53(52). Tail conoid with a bluntly pointed terminus bearing 10–15 annules; males absent ---------- *T. microconus*
53a. Tail sub-cylindrical with a bluntly pointed terminus bearing 12–18 annules; males present -------- *T. spinaceae*
54(52a). Tail with 18–33 annules; sinuous canals present in the region of intestine, extending back to the tail terminus ---------- *T. paracanalis*
54a. Tail with 49 annules; no such sinuous canals present -------- ---------- *T. brassicae*
55(51a). Tail conoid with a bluntly rounded to hemispherical or bluntly pointed terminus- 56
55a. Tail sub-cylindrical to conical with a hemispherical terminus ---------- 58
56(55). Body with 29 longitudinal striae at mid-body; stylet 18–21 µm long; tail conoid with a bluntly rounded terminus bearing 9–20 annules---------- ---------- *T. claytoni*
56a. Body without longitudinal striae ---------- 57
57(56a). Stylet 19–21 µm long with posteriorly directed knobs; tail conoid with a bluntly rounded terminus bearing 18–22 annules ------ *T. mexicanus*
57a. Stylet 18–20 µm long with anteriorly directed knobs; tail conoid with a hemispherical terminus bearing 9–19 annules --- *T. ancorastyletus*
58(55a). Stylet 20–23 µm long; tail sub-cylindrical with a hemispherical terminus bearing 18–26 annules; c′ = 2.6; males present ---------- *T. agri*
58a. Stylet 19–21 µm; tail conical with 21 annules; c′ = 3–5; males absent ---------- *T. kamlae*
59(50a). Stylet 15–18 µm long---------- 60
59a. Stylet 18–23 µm long---------- 66
60(59). Tail conoid with a bluntly rounded to blunt or narrow terminus ---------- 61
60a. Tail sub-cylindrical with a hemispherical or bluntly pointed terminus---------- 64
61(60). Tail 14–21 annules; males absent---------- 62
61a. Tail 34–40 annules; males present ---------- 63
62(61). Lip region with 6 annules; stylet knobs with anterior margins directed forward; tail conoid with a bluntly rounded terminus bearing 14–15 annules ---------- *T. latus*
62a. Lip region with 4–5 annules; stylet knobs rounded; tail conoid with a blunt terminus bearing 21 annules --- *T. crotoni*
63(61a). Stylet 16–17 µm long; tail conoid with a bluntly pointed terminus bearing 34 annules- ---------- *T. solani*
63a. Stylet 15–16 µm long; tail conoid with a narrow terminus bearing 34–40 annules-------- ---------- *T. usmanensis*
64(60a). Tail 16–22 annules ---------- 65
64a. Tail 32–49 annules---------- ---------- *T. brevilineatus*
65(64). Stylet 15–17 µm long with posteriorly directed knobs; tail sub-cylindrical with a bluntly pointed terminus ---- ---------- *T. aerolatus*
65a. Stylet 17–18 µm long with anteriorly directed knobs; tail sub-cylindrical with a hemispherical terminus------- ---------- *T. graciliformis*
66(59a). Tail 8–38 annules---------- 67
66a. Tail 42–46 annules ----- *T. hordei*
67(66). Tail conoid or conical with a bluntly pointed to pointed or variously rounded terminus bearing 19–38 annules-- 68
67a. Tail cylindrical with a hemispherical terminus bearing 8–10 annules ------- *T. georgiensis*
68(67). Stylet 18–20 µm long with

posteriorly directed knobs; tail conoid with a bluntly pointed terminus bearing 19–27 annules; bursa reaching male tail end ---- *T. aduncus*

68a. Stylet 21–23 µm long with anteriorly directed more or less anchor-shaped knobs; tail conical to almost funnel-shaped with variously rounded terminus bearing 27–38 annules; bursa not reaching male tail end ---------- *T. paratriversus*

68b. Stylet 21–22 µm long with anteriorly directed knobs; tail conical to conoid with a pointed to finely rounded terminus bearing 27 annules; bursa reaching male tail end ---------- *T. paulettae*

69(44b). Stylet 15–17 µm long---------- 70

69a. Stylet 17–23 µm long---------- 71

70(69). Tail sub-cylindrical with a bluntly pointed terminus bearing 35–42 annules---------- *T. vulgaris*

70a. Tail sub-cylindrical with a hemispherical terminus bearing 34–47 annules -- *T. allii*

71(69a). Lip region with 8–10 annules; tail sub-cylindrical with a hemispherical terminus bearing 50 annules; males absent ---------- *T. tobari*

71a. Lip region with 6–9 annules; tail conoid, sub-cylindrical or narrow with a rounded to bluntly rounded terminus bearing 27–66 annules; males present---------- 72

72(71a). Lip region with 6–7 annules; stylet 19–23 µm long; tail conoid with a bluntly rounded terminus bearing 28–66 annules; gubernaculum peculiarly shaped like a hammer- ---------- *T. estherae*

72a. Lip region with 7–9 annules; stylet 11–23 µm long; tail sub-cylindrical or narrow with a rounded terminus bearing 27–51 annules-------- 73

73(72a). Lip region with 7–8 annules; stylet 17–23 µm long; tail narrow with a rounded terminus bearing 39–51 annules ---------- *T. novenus*

73a. Lip region with 6–9 annules; stylet 16–20 µm long; tail sub-cylindrical with a rounded terminus bearing 27–51 annules ---- *T. namibiensis*

74(2b). Lip region continuous-------- 75

74a. Lip region set off---------- 78

75(74). Lip region 3–4 annules-------- 76

75a. Lip region 6–10 annules----- 77

76(75). Body length longer (L = 0.80–1.00 mm); stylet 23–26 µm long; tail cylindrical with a hemispherical terminus bering 17–23 annules; spicule and gubernaculum longer, measuring 28–32 µm and 16–19 µm, respectively - ---------- *T. silvaticus*

76a. Body length shorter (L = 0.74–0.79 mm); stylet 24–27 µm long; tail elongate-clavate bearing 12–19 annules; spicule and gubernaculum shorter, measuring 21–25 µm and 11–14 µm, respectively ---------- *T. clavus*

77(75a). Lip region with 6–7 annules; stylet 25–26 µm long; tail conoid with a bluntly pointed terminus bearing 18–35 annules; males absent---------- ---------- *T. eroshenkoi*

77a. Lip region with 7–10 annules; stylet 28–31 µm long; tail sub-cylindrical with a bluntly pointed terminus bearing 51–58 annules; males present -------- *T. kegenicus*

78(74a). Lip region with 4–5 annules; stylet 24–29 µm long; tail conoid to sub-cylindrical with a bluntly pointed terminus bearing 14–20 annules-------- 79

78a. Lip region with 8 annules;

stylet 23–26 µm long; tail cylindrical with an acutely pointed terminus bearing 38–65 annules - *T. tenuicaudatus*

79(78). Body length longer (L = 0.65–1.17 mm); stylet 24–29 µm long with anteriorly directed knobs; vulva at 51–65%; tail conoid with a bluntly pointed terminus bearing 15–20 annules ---------- *T. cylindricus*

79a. Body length shorter (L = 0.50–0.62 mm); stylet 24–25 µm long with posteriorly directed knobs; vulva at 52–54%; tail sub-cylindrical with a bluntly pointed terminus bearing 14–15 annules ---------- *T. tarjani*

80(1a). Stylet 13–21 µm long ---------- 81

80a. Stylet 21–30 µm long ----------100

81(80). Stylet 13–15 µm long ---------- 82

81a. Stylet 16–21 µm long ---------- 83

82(81). Stylet knobs inclined posteriorly; vulva at 52–56%; tail cylindrical with a bluntly pointed terminus ---- *T. swarupi*

82a. Stylet knobs inclined anteriorly; vulva at 53–60%; tail cylindrical with a hemispherical terminus ----- *T. cuticaudatus*

83(81a). Tail with 13–21 annules ------ 84

83a. Tail with 23–66 annules ------ 87

84(83). Lip region continuous with 3 annules; stylet 20 µm long; tail clavate with a hemispherical terminus ----- *T. crassicaudatus*

84a. Lip region set off with 3–5 annules; stylet 17–21 µm long; tail sub-cylindrical with a narrow to bluntly pointed terminus ---------- 85

85(84a). Stylet 17–18 µm long; vulva at 55–56%; tail with 18–21 annules ---------- *T. leucaenus*

85a. Stylet 17–21 µm long; vulva at 54–64%; tail with 13–17 annules ---------- 86

86(85a). Lip region set off with 3 annules; tail sub-cylindrical with a bluntly pointed terminus; vulva at 62–64%; males present ---------- *T. kashmirensis*

86a. Lip region set off with 4–5 annules; tail sub-cylindrical with a narrow terminus; vulva at 54–61%; males absent ---------- *T. ismailii*

87(83a). Lip region continuous with 4–7 annules ---------- 88

87a. Lip region set off with 2–8 annules ---------- 91

88(87). Lip region continuous with 4–5 annules ---------- 89

88a. Lip region continuous with 6–7 annules ---------- 90

89(88). Stylet 18–19 µm long with posteriorly directed knobs; tail cylindrical with a hemispherical terminus bearing 32–36 annules -------- *T. huesingi*

89a. Stylet 19–20 µm long with anteriorly directed knobs; tail conoid with a bluntly pointed terminus bearing 27–29 annules ------ *T. eremicolus*

90(88a). Stylet 17–18 µm long with rounded laterally directed knobs; tail cylindrical with a hemispherical terminus bearing 35–43 annules ---------- *T. parvus*

90a. Stylet 19–21 µm long with posteriorly directed knobs; tail cylindrical to slightly clavate with a hemispherical terminus bearing 26–34 annules ---------- *T. malinus*

91(87a). Lip region set off with 2–4 annules ---------- 92

91a. Lip region set off with 5–8 annules ---------- 93

92(91). Stylet 20 µm long with anteriorly directed knobs; tail conoid with a bluntly pointed terminus bearing 30–31 annules ---------- *T. sanwali*

92a. Stylet 19–21 µm long with posteriorly directed knobs; tail conoid with a bluntly pointed terminus bearing

20–26 annules ------ *T. irregularis*

93(91a). Stylet 16–20 µm long; tail sub-cylindrical with a bluntly pointed or hemispherical terminus ---------- 94

93a. Stylet 17–21 µm long; tail clavate with bluntly pointed terminus or cylindrical to conoid with a hemispherical to rounded terminus ---------- 96

94(93). Body length 1 mm or longer; stylet 20 µm long; tail with 66 annules ---------- *T. canalis*

94a. Body length less than 1 mm long; stylet 16–19 µm long; tail with 22–66 annules ------- 95

95(94a). Lip region with 6–8 annules; stylet 18–19 µm long; tail sub-cylindrical with a bluntly pointed terminus bearing 36–66 annules ---------- *T. dubius*

95a. Lip region with 4–5 annules; stylet 16–17 µm long; tail sub-cylindrical with a hemispherical terminus bearing 22–30 annules --------- *T. queirozi*

96(93a). Stylet 17–20 µm long; tail clavate with a bluntly pointed terminus ------ *T. iphilus*

96a. Stylet 17–21 µm long; tail conoid to cylindrical with a bluntly pointed or rounded to hemispherical terminus -- 97

97(96a). Tail 23–25 annules -- *T. cristatus*

97a. Tail 41–66 annules ---------- 98

98(97a). Body length more than 1 mm; vulva at 49–50%; tail conoid with a rounded terminus ---------- *T. dewaeli*

98a. Body length less than 1 mm; vulva at 51–57%; tail cylindrical with a hemispherical terminus ---------- 99

99(98a). Stylet 19–21 µm long; males absent; tail with 52–66 annules ---------- *T. natalensis*

99a. Stylet 17–18 µm long; males present; tail with 44–57 annules ---------- *T. teeni*

100(80a). Body length greater than 1 mm----------101

100a. Body length less than 1 mm-105

101(100). Stylet 21–24 µm long (except *T. ibericus* with a range of 21–26 µm) ----------102

101a. Stylet 24–28 µm long ----------104

102(101). Lip region continuous with 6–9 annules; males present -103

102a. Lip region set off with 6 annules; males absent -- *T. ibericus*

103(102). Lip region continuous with 7 annules; tail cylindrical with a hemispherical terminus bearing 38–41 annules-- ---------- *T. maximus*

103a. Lip region continuous with 7–9 annules; tail cylindrical with a rounded terminus bearing 23–29 annules-------- ---------- *T. kidwaii*

104(101a). Lip region continuous with 6 annules; tail conoid with a bluntly rounded terminus bearing 43 annules---------- ---------- *T. lamilliferus*

104a. Lip region set off with 6 annules; tail cylindrical with a hemispherical terminus bearing 29–34 annules-------- ---------- *T. wilskii*

105(100a). Stylet 21–24 µm long (except *T. velatus* with a range of 22–25 µm) ----------106

105a. Stylet 24–30 µm long ----------107

106(105). Lip region conoid, set off with 5–6 annules; tail sub-cylindrical with a bluntly pointed terminus bearing 35–45 annules --------- *T. bryobius*

106a. Lip region set off with 5–6 annules; tail cylindrical with a hemispherical terminus bearing 25 annules --- *T. velatus*

107(105a). Lip region set off with 5–7 annules; stylet 24–26 µm long with posteriorly directed knobs; tail sub-cylindrical with a hemispherical terminus bearing 39 annules ---------- *T. antarcticus*

107a. Lip region set off with 6–8 annules; stylet 24–30 µm

long with anteriorly directed knobs; tail cylindrical with a rounded terminus bearing 16–30 annules ---------- *T. siccus*

Results and Discussion

The key is based on the overall morphology of females, as males are not known in several species. In some cases, differences in male morphology of reproductive organs, such as length and shape of spicule and gubernaculum, were used in the diagnoses. The measurements of most of the examined specimens closely fit the original description and any subsequent redescriptions of species. Some of the variation noted in certain populations of species were incorporated into the morphometric compendium (Table 1). If one cannot trust the species name found with the key or compendium, the original description and any subsequent redescriptions of the species should be checked. This key is significant because it provides the only accurate all-inclusive guide to identifications and works well with all the valid 111 *Tylenchorhynchus* spp., including the specimens of this genus deposited in the USDA Nematode Collection (Handoo et al., 1998).

Bitylenchus was proposed by Filipjev (1934) as a subgenus under *Tylenchus* Bastian (1965); Jairajpuri (1982) published its study as a subgenus under *Tylenchorhynchus,* and later Golden et al. (1987) synonymized it with *Tylenchorhynchus.* In recent revision of the suborder Tylenchina, *Bitylenchus* is considered as a junior synonym of *Tylenchorhynchus* (Fortuner and Luc, 1987) or referred to as a valid genus (Siddiqi, 1986). Gomez-Barcina et al. (1992) concluded that the two genera *Bitylenchus* and *Tylenchorhynchus* can be separated from each other by several characters, particularly the structure of the gubernaculum and the presence/absence of post-anal intestinal sac. All these characters are common in several species of *Tylenchorhynchus* and are discussed in recent revisional studies of the suborder Tylenchina (Fortuner and Luc, 1987). For example, the outer bands of the lateral fields of *T. antarcticus* are areolated, *T. agri* has a large post-anal sac, *T. cylindricus* has intestinal fasculi, the female tail tip of *T. contractus* has a thicker cuticle, *T. claytoni* has a gubernaculum that does not protrude from the cloaca, etc. These characters do not clearly differentiate *Bitylenchus* from *Tylenchorhynchus,* and I agree with Golden et al. (1987) and Fortuner and Luc (1987) to consider again *Bitylenchus* as a junior synonym of *Tylenchorhynchus* and accordingly transfer *Bitylenchus iphilus* to *Tylenchorhynchus* as *Tylenchorhynchus iphilus* (Minagawa, 1995) n. comb.

In many *Tylenchorhynchus* species, the known range of variation is limited to observation of specimens in single populations from the type locality. Further morphological studies, including scanning electron microscopy of specimens in a broader spectrum of habitats is needed to further clarify the relationships and identities of many species. We do not really know if we are dealing with an artificial group. For example, the separation of *Tylenchorhynchus* from other closely related groups on the basis of number of lateral lines may not be a reliable character.

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