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Five Species of Tylenchidae and Dolichodoridae (Nematoda: Tylenchoidea) from Iran

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ABSTRACT

During a survey, five known species of plant-parasitic nematodes of the families Tylenchidae and Dolichodoridae (Tylenchomorpha: Tylenchoidea) were collected and identified from several locations in Golestan, Guilan, Kurdistan, and Fars provinces. *Paratrophurus kenanae, Tylenchus elegans* and *T. ritae*, as new records for Iranian nematode fauna, with the two previously reported species *Filenchus butteus* and *Tylenchorhynchus leviterminalis* are illustrated and described. The similarity of several species of *Paratrophurus* with those of the closely related genus, *Tylenchorhynchus*, is also discussed.

Keywords: *Filenchus*, Identification, *Paratrophurus*, *Tylenchorhynchus*, *Tylenchus*.

INTRODUCTION

Genus *Paratrophurus* Arias, 1970, with 18 described species, is an uncommon plant-parasitic nematode in the family Dolichodoridae (Tylenchomorpha: Tylenchoidea) (Geraert, 2011). *Paratrophurus costaricensis* López, 1986, is the only species reported from rapeseed fields of northern Khorasan, Iran, without description (Baadl *et al*., 2010). Genus *Tylenchorhynchus* Cobb, 1913 with 133 valid species, is a common genus of the family Dolichodoridae (Tylenchomorpha: Tylenchoidea) in the world (Geraert, 2011). So far, About 30 species of this genus have been reported from different regions of Iran. Eleven of these species have been illustrated and described from Iran (Tanha Maafi and Kheiri, 1993; Niknam and Kheiri, 1997; Jamali *et al*., 2005; Niknam *et al*., 2008; Naseri *et al*., 2008; Erfanipour Ghasemi *et al*., 2011; Pourjam *et al*., 2011a; b).

Genus *Filenchus* Andrássy, 1954, is one of the most common genera in the family Tylenchidae (Tylenchomorpha: Tylenchoidea). It is very close to the genus *Tylenchus* Bastian, 1865, but it differs by having shorter stylet conus (about 1/3 *vs.* 1/2 stylet length). To date, 26 species of *Filenchus* and four species of *Tylenchus* have been reported from Iran. Among those, 19 species were described from Iran (Kheiri, 1970; Karegar *et al*., 1995; Karegar and Geraert, 1995; Karegar and Geraert, 1998a; 1998b; Pedramfar *et al*., 2001; Jahanshahi Afshar *et al*., 2006; Karimi Pourfard *et al*., 2011; Atighi *et al*., 2011).

The present study described and illustrated five other species of these families from Iran and, furthermore, gives more new details and discussions

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on the identification of the above species.

MATERIALS AND METHODS

Several hundred samples were collected from different crops, orchards, forests, and grasslands in Iran that their related nematodes are under identification. The samples were taken from Kabudval forest at Golestan province (36º54'N, 54º52'E), olive trees at Roudbar, Guilan province (36º48'N, 49º24'E), a tea plantation from Tea Research Center in Lahijan, Guilan province (37º12'N, 50º00'E), grasslands in Saqqez, Kurdistan province (36º14'N, 46º15'E), and Badjgah, Shiraz, Fars province (29º52'N, 52º48'E) had five new, or poorly known, species of Tylenchidae and Dolichodoridae in Iran. Nematodes were extracted by the tray method (Whitehead and Hemming, 1965). The specimens were killed and fixed by hot solution of FGA (4:1:1; formaldehyde: glycerin: acetic acid), then processed to anhydrous glycerin (De Grisse, 1969). The nematodes were mounted on permanent slides, using paraffin ring and examined by a Zeiss III light microscope at up to ×1000 magnification. Species identification was done, using the most updated keys on the nematodes included in Tylenchidae and Dolichodoridae families (Geraert, 2008; 2011).

RESULTS

In this study, five known species of the families Tylenchidae and Dolichodoridae were collected and identified. *Paratrophurus kenanae*, *Tylenchus elegans* and *T. ritae*, as new records for Iran nematode fauna, and two previously reported species, namely, *Filenchus butteus* and *Tylenchorhynchus leviterminalis* are described.

Paratrophurus kenanae Decker and El Amin, 1978

(Figure 1; Table 1)

Females

Body ventrally curved after fixation (Figure 1-I). Cuticle annuli 1.9-2.3 µm wide at mid-body. Lateral field with four longitudinal incisures, the outer ones crenate (Figure 1-E). Labial region conical-rounded, slightly offset from body contour, 7.2-7.7 µm wide and 3.0-3.8 µm high, without annulation (Figure 1-D). Cephalic framework moderately sclerotized. Stylet strong with rounded to slightly posteriorly directed knobs, 3.9-4.8 µm wide. Dorsal pharyngeal gland orifice located at 2.8-3.6 µm behind stylet knobs. Median bulb ovate, 15.0-15.4 µm long and 11-13 µm wide, with distinct central valvular apparatus, 3.3-3.7 µm long. Secretory-excretory pore at level of anterior end of basal bulb; hemizonid one or two annuli anterior to it. Basal bulb pyriform, occasionally saccate, 24-29 µm long and 11-17 µm wide (Figure 1-B). Ovaries outstretched, equally developed. Vagina 7.8-10.5 µm long and occupies 30-50% of the body width at vulval level. Spermatheca rounded and filled with small rounded sperm. Tail cylindrical, with 15-20 annuli on the ventral side, slightly clavate with hyaline, non-annulated terminus. Hyaline portion 11.5-13.5 µm long and about 20-28% tail length. Phasmids located at 15.6-17.5 µm from anus, and in the anterior half of tail (29.1-32.2%) [Figure 1, (G and H)].

Males

Similar to female in general view [Figure 1, (A and C)]. Tail conoid and pointed. Spicules arcuate and protruding from cloaca. Gubernaculum simple, crest-shaped. Bursa enveloping tail tip (Figure 1-F).

This species was collected in the rhizosphere of acacia plants from Sudan (Decker and El Amin, 1978). In the present study, it was collected from turf grass, near the Kabodval forest, Ali Abad-e-Katul, Golestan province. It is reported for the first time from Iran.

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Table 1. Morphometric characters of the Iranian populations of *Paratrophurus kenanae* and *Tylenchorhynchus leviterminalis* and their comparison with the type population.[a]

Character/Population	*Paratrophurus kenanae*				*Tylenchorhynchus leviterminalis*			
	Present study		Decker and El Amin, 1978		Present study		Siddiqi *et al*., 1982	
	Females	Males	Females	Males	Females	Males	Females	Males
n	5	3	11	11	8	5	15	7
L	727 ± 21 (702-759)	714 ± 60 (662-780)	785 (722-887)	687 (630-736)	722 ± 48 (660-794)	692 ± 5 (684-697)	650 (540-750)	620 (580-700)
a	28.8 ± 4.0 (24.4-33.7)	33.7 ± 6.4 (26.5-38.8)	31.3 (26.0-36.6)	26.3 (22.7-29.2)	34.1 ± 1.4 (32.2-36.9)	33.2 ± 1.8 (31.4-35.2)	31 (28-38)	36 (33-38)
b	4.9 ± 0.2 (4.7-5.1)	5.8 ± 0.9 (5.0-6.8)	5.8 (4.8-7.9)	5.6 (4.8-6.4)	5.2 ± 0.5 (4.7-6.2)	5.0 ± 0.7 (4.3-6.2)	5.4 (5-6)	5.3 (4.9-6.0)
c	13.7 ± 0.7 (12.7-14.5)	13.7 ± 0.1 (13.7-13.8)	17.2 (14.3-19.7)	15.5 (14.1-17.4)	14.3 ± 1.5 (12.5-16.5)	14.4 ± 0.3 (14.0-14.9)	14 (12-16)	15 (12-17)
c'	3.4 ± 0.4 (3.0-4.1)	3.2 ± 0.5 (2.8-3.8)	2.8 (2.4-3.2)	-	3.5 ± 0.6 (2.5-4.5)	3.5 ± 0.4 (3.1-3.9)	3.8 (3.3-4.5)	2.8 (2.4-3.2)
V	54.9 ± 2.2 (53.7-58.9)	-	55.5 (53.3-56.9)	-	52.9 ± 1.6 (50.3-54.7)	-	54 (52-58)	-
Stylet	21.3 ± 0.6 (20.7-22.3)	20.4 ± 0.8 (19.8-21.2)	19.5 (18.5-21.6)	17.2 (15.8-19.0)	21.0 ± 0.8 (19.4-22.0)	19.9 ± 0.5 (19.4-20.4)	18 (17-19)	18 (17-19)
Conus	10.8 ± 0.3 (10.3-11.3)	9.9 ± 0.5 (9.5-10.5)	-	-	10.5 ± 0.6 (9.4-11.2)	9.4 ± 0.6 (8.3-9.7)	-	-
m	-	-	-	-	50.0 ± 1.9 (47.9-53.7)	46.9 ± 2.6 (42.8-49.8)	-	-
Oesophagus	148 ± 3.2 (144-151)	125 ± 19.6 (103-141)	-	-	140 ± 8.7 (128-156)	139 ± 18 (112-160)	-	-
Median bulb	73.4 ± 4.5 (66.4-77.6)	65.0 ± 6.1 (61.2-72.0)	-	-	71.0 ± 2.9 (65.7-75.0)	72.4 ± 6.9 (67.2-80.2)	-	-
MB	49.5 ± 2.3 (45.8-51.0)	52.3 ± 6.2 (46.8-59.1)	-	-	50.6 ± 2.4 (47.1-55.0)	49.4 ± 3.5 (45.1-53.6)	53 (51-55)	53 (51-55)
S. E. pore	107 ± 1.3 (106-110)	96.5 ± 15.8 (79.6-111)	-	-	109 ± 11.1 (96.8-128)	101 ± 6.0 (93.3-108)	100 (90-104)	-
Head-vulva	400 ± 27.5 (377-447)	-	-	-	382 ± 28 (350-428)	-	-	-
Head-anus	673 ± 20 (653-706)	662 ± 56 (614-723)	-	-	671 ± 44.9 (620-745)	643 ± 5.3 (637-650)	-	-
Vulva-anus	274 ± 8.9 (258-281)	-	-	-	289 ± 21.7 (264-324)	-	-	-
Tail	53.3 ± 3.2 (48.5-56.9)	51.9 ± 4.7 (47.8-57.0)	-	-	50.8 ± 6.2 (40.0-62.1)	48.0 ± 1.1 (46.8-49.4)	-	-
Vulva-anus/Tail	5.1 ± 0.4 (4.8-5.7)	-	-	-	5.7 ± 0.6 (5.2-6.8)	-	-	-
Body width (BW)	25.7 ± 4.0 (20.8-29.9)	21.6 ± 3.5 (18.0-25.0)	-	-	21.2 ± 1.4 (19.6-23.3)	20.8 ± 1.0 (19.6-21.8)	-	-
VBW	25.0 ± 4.0 (20.8-29.5)	-	-	-	19.1 ± 1.7 (17.5-21.2)	-	-	-
ABW	15.8 ± 2.2 (13.4-18.7)	16.2 ± 0.9 (15.2-17.0)	-	-	14.6 ± 1.9 (11.3-17.0)	13.9 ± 1.1 (12.6-15.0)	-	-
BW at Phasmid	12.6 ± 2.0 (10.4-15.2)	-	-	-				
Spicules	-	21.3 ± 0.6 (20.8-22.0)	-	23.9 (22.1-26.2)	-	23.2 ± 1.0 (22.0-24.4)	-	23 (22-24)
Gubernaculum	-	11.5-11.6	-	12.2 (10.6-13.4)	-	11.6 ± 0.7 (11.0-12.5)	-	12 (11-13)

[a] All measurements are in µm and in the form: Mean±Standard deviation (range).

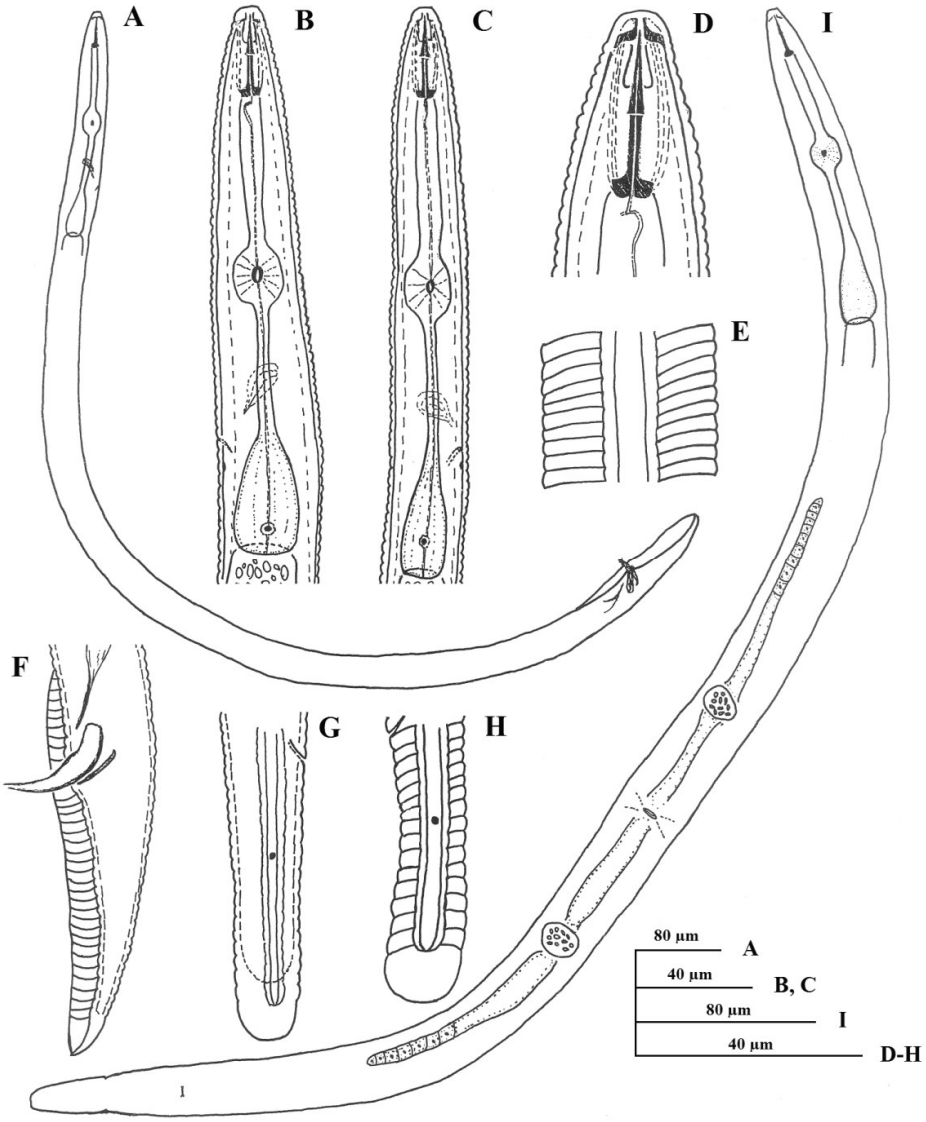

Figure 1. *Paratrophurus kenanae*: Female (B, D, E, G-I), Male (A, C, F). (A and I) Entire body; (B and C) Pharyngeal region; (D) Anterior end; (E) Lateral field, and (F-H) Tail.

Tylenchorhynchus leviterminalis Siddiqi, Mukherjee and Dasgupta, 1982
(Figure 2; Table 1)

Females

Body ventrally curved to open C-shaped after fixation (Figure 2-A). Cuticle annuli 1.8-2.4 µm wide at mid-body. Lateral field with four longitudinal incisures; the outer ones distinctly crenated (Figure 2-G). Labial region hemispherical, continuous with body contour, 6.5-8.0 µm wide and 3.1-4.2 µm high. Often one transverse striae, forming two annuli on labial region (Figure 2-C), occasionally smooth (Figure 2-D). Cephalic framework slightly sclerotized. Stylet with rounded knobs, 4.1-4.5 µm wide; its anterior

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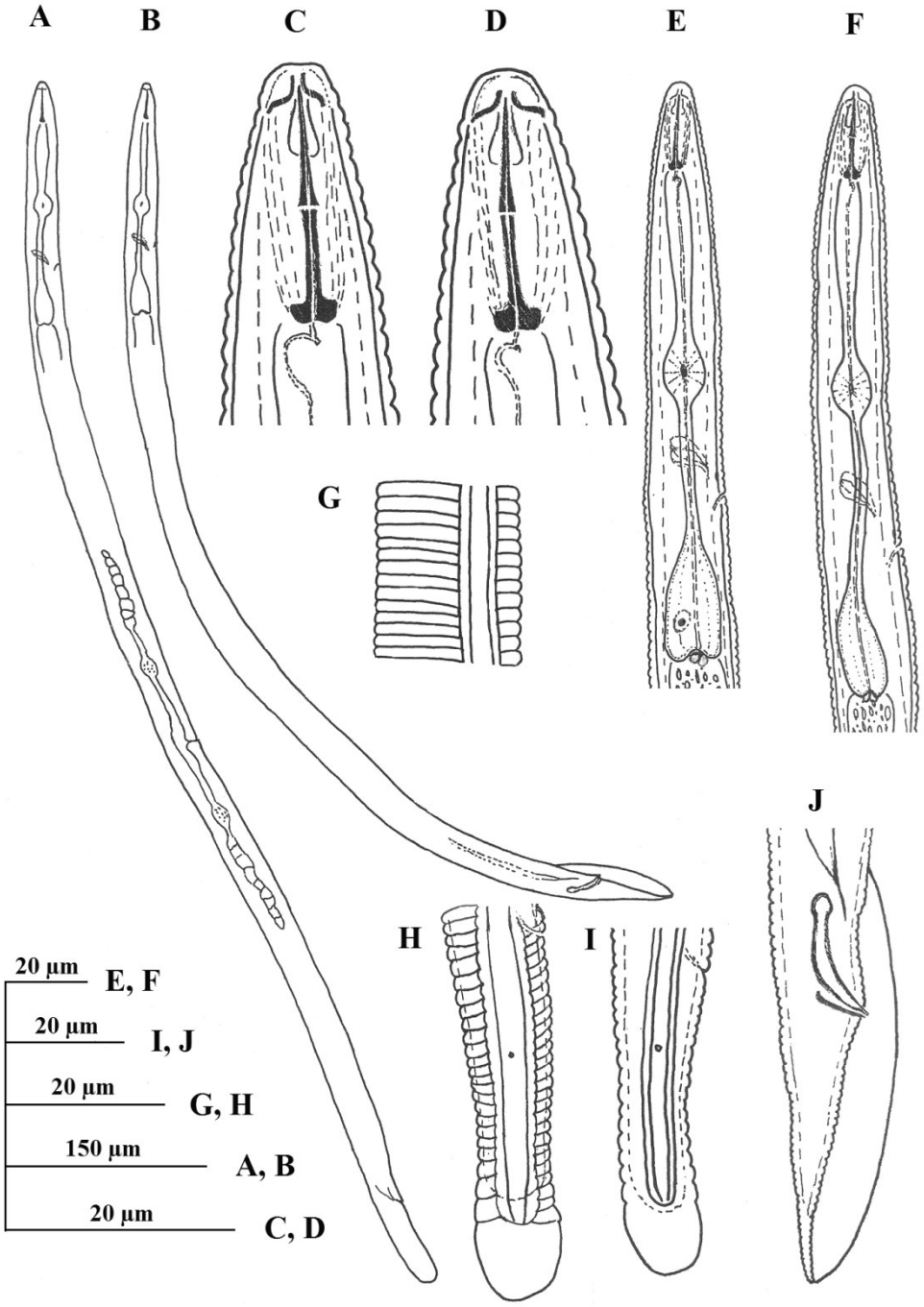

Figure 2. *Tylenchorhynchus leviterminalis*: Female (A, C-E, G-I), Male (B, F, J). (A and B) Entire body; (C and D) Anterior region; (E and F) Pharyngeal region; (G) Lateral field, and (H-J) Tail.

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surface sloping posteriorly. DGO opens at 2.6-3.7 µm behind stylet knobs. Median bulb rounded to slightly ovate, 12.0-13.8 µm long and 9.1-10.6 µm wide. Secretory-excretory pore at level of anterior end of basal bulb; hemizonid one or two annuli anterior to it. Basal bulb saccate, 24-30 µm long and 9.4-12.5 µm wide (Figure 2-E). Ovaries outstretched. Vagina straight or somewhat directed anteriorly; occupies about 1/3 of vulval body width. Spermatheca rounded, axial, filled with small and globular sperm. Tail often sub-clavate to clavate, or sometimes sub-cylindrical; bearing 20-26 annuli on ventral side. Tail terminus smooth with hyaline portion 10.8-15.3 µm long, about 21.6-27.5% of tail length. Phasmids are located in the anterior half of tail (21.5-36.2%) [Figure 2, (H and I)].

Males

Similar to female in general [Figure 2, (B and F)]. Tail conoid and pointed, enveloped by bursa. Spicules slightly curved ventrally and flanged distally. Gubernaculum protrusible, with proximal end directed anteriorly (Figure 2-J).

T. leviterminalis was first described from banana, mango, and jackfruit in India (Siddiqi *et al*., 1982). It was reported from banana in Sistan and Baluchestan province, southeastern Iran (Tanha Maafi *et al*., 2006). In this study, this species was collected from grasses in College of Agriculture (Badjgah Region), Shiraz University, Fars Province, South of Iran.

Filenchus butteus (Thorne & Malek, 1968) Raski and Geraert, 1987

(Figure 3; Table 2)

Females

Body assuming an open C-shaped, after fixation (Figure 3-A). Cuticle annuli 1.2-1.4 µm wide at mid body. Lateral field with four longitudinal incisures; central band distinctly wider than two outer ones (Figure 3-F). Labial region continuous, 6-7 µm wide and 2.8-3.1 µm high, with five fine annuli. Amphidial apertures begin at cephalic plate, continue as simple, oblique slits posteriorly. Dorsal gland opening near stylet knobs. Stylet delicate, with small and rounded basal knobs (Figure 3-D). Median bulb more or less ovate, 6.8-8.7 µm wide. Isthmus slender and long; nerve ring is located posterior to its middle. Basal bulb elongated with 21.5-27.3 µm long and 8.3-11.2 µm wide. Secretory-excretory pore located at second half of isthmus (Figure 3-B). Gonad outstretched; spermatheca empty. Vagina straight, about 1/3 of vulval body width. Posterior uterine sac shorter than vulval body width (Figure 3-C). Tail slightly curved ventrally, with rounded terminus (Figure 3-E).

Males

Not found.

This species was described from native sod in North and South Dakota, Montana and Nebraska, USA in the original description (Thorne and Malek, 1968). It was recorded from turnip rhizosphere in Kohgiluyeh and Boyer Ahmad province, south of Iran (Mirehki *et al*., 2010) and also from orchards in East Azarbaijan (Solouki *et al*., 2012), but not described. In this study, it was collected from an unknown grass at Zarineh Obatu, Saqqez, Kurdistan province, west of Iran.

Tylenchus elegans De Man, 1876

(Figure 4; Table 2)

Females

Body as open or close C-shaped after fixation (Figure 4-G). Cuticle coarsely annulated; annuli 2.0-2.4 µm wide at mid body. Lateral field with four longitudinal incisures, central band wider than the outer bands (Figure 4-F). In some specimens, outer bands crossed by transverse striae,

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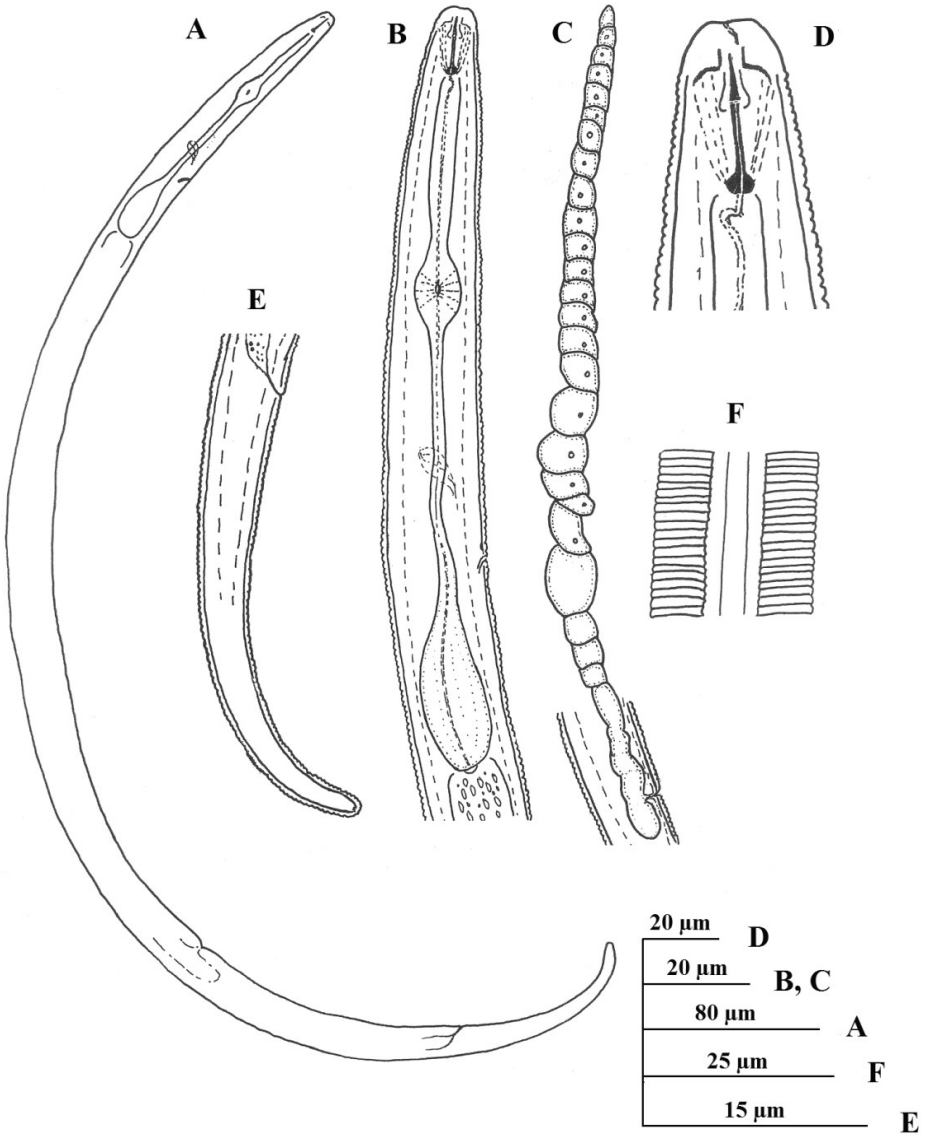

Figure 3. *Filenchus butteus*: Female. (A) Entire body; (B) Pharyngeal region; (C) Reproductive system; (D) Anterior region; (E) Tail, and (F) Lateral field.

margins of lateral field crenate. Labial region with 4-5 fine annuli, slightly narrower than the rest of body; continuous with body contour, 6.9-8.3 µm wide at base and 3.1-3.8 µm high. Dorsal gland orifice near the stylet knobs. Stylet delicate, with small and rounded knobs [Figure 4, (D and E)]. Median bulb more or less ovate, 8.3-10.2 µm wide. Isthmus slender and long; nerve ring is located posterior to its middle. Basal bulb often pyriform, occasionally elongated; with 17.1-26.6 µm length and 8-11 µm wide. Secretory-excretory pore level with basal bulb or a little posterior to it (Figure 4-B). Gonad outstretched. Spermatheca ovate, with globular relatively large sperm. Vulval lips flat; vagina straight, 7.0-11.1 µm long and 0.2-0.4 times as body width at the same level. Post vulval uterine sac rounded, often shorter than or

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Table 2. Morphometric characters of the Iranian populations of *Filenchus butteus*, *Tylenchus elegans* and *T. ritae*.[a]

Character/Population	*Filenchus butteus*	*Tylenchus elegans*		*Tylenchus ritae*			
				Forest population		Tea population	
	Females	Females	Males	Females	Males	Females	Males
n	4	12	9	4	2	5	3
L	714 ± 19 (693-738)	775 ± 43 (707-840)	754 ± 73 (617-860)	758 ± 32 (733-803)	747-794	785 (725-860)	759 ± 17 (745-780)
a	35.6 ± 1.6 (34.0-37.2)	27.8 ± 1.9 (25.1-31.9)	30.1 ± 2.4 (26.9-34.6)	29.2 ± 0.3 (29.0-29.7)	33.8-35.2	33 ± 2 (29.2-35.1)	39.2 ± 0.7 (38.5-40.2)
b	5.5 ± 0.2 (5.3-5.7)	5.9 ± 0.4 (4.9-6.4)	5.6 ± 0.4 (5.0-6.2)	6.1 ± 0.6 (5.2-6.7)	4.9-6.1	6.9 ± 0.9 (6.0-8.2)	6.3 ± 0.4 (5.9-6.9)
c	8.2 ± 0.8 (7.3-9.1)	7.6 ± 0.7 (6.6-8.6)	7.3 ± 0.5 (6.7-8.1)	5.9 ± 0.4 (5.3-6.1)	5.4-5.6	6.6 ± 0.6 (5.6-7.5)	5.1 ± 0.3 (4.8-5.4)
c'	6.4 ± 1.0 (5.0-7.2)	6.2 ± 0.7 (5.4-7.5)	6.2 ± 0.6 (4.9-6.8)	8.9 ± 0.6 (8.3-9.6)	9.0-9.3	8.2 ± 1.2 (6.6-10.1)	10.5 ± 0.9 (9.8-11.7)
V	68.7 ± 0.9 (67.8-69.7)	68.9 ± 2.4 (64.1-74.1)	-	62.2 ± 0.5 (61.7-62.6)	-	65.7 ± 3 (62.9-71.3)	-
V'	78.3 ± 0.5 (77.7-78.8)	79.5 ± 2.3 (75.6-85.6)	-	75.1 ± 1.1 (73.7-76.5)	-	77.9 ± 2.6 (74.7-82.7)	-
St	10.5 ± 0.3 (10.1-10.8)	15.3 ± 0.9 (14.2-17.0)	15.0 ± 1.0 (12.7-16.3)	15.1 ± 0.2 (14.8-15.3)	15.0-15.3	14.5 ± 0.6 (13.5-15.0)	13.5-14.0
Conus	3.7 ± 0.2 (3.5-3.8)	7.8 ± 0.7 (6.3-9.5)	7.5 ± 0.5 (6.9-8.6)	6.7 ± 0.2 (6.6-6.9)	6.6-6.8	-	-
m	35.1 ± 2.5 (32.7-37.6)	50.7 ± 5.1 (43.9-60.2)	49.7 ± 3.5 (45.7-56.4)	44.1 ± 0.9 (43.1-45.3)	43.1-45.2	-	-
Oesophagus	129 ± 7.1 (122-139)	132 ± 8.1 (115-143)	134 ± 7.7 (124-150)	125 ± 10 (119-140)	123-164	114.5 ± 14.2 (88-126)	120 ± 5.7 (113-127)
Median bulb	49.8 ± 0.8 (48.7-50.6)	58.5 ± 2.9 (53.5-62.4)	61.7 ± 3.7 (56.5-67.5)	57.1 ± 3 (55.0-61.4)	55.6-61.7	54.2 ± 1.3 (52-56)	-
MB	38.6 ± 1.5 (36.5-39.8)	44.5 ± 2.5 (39.5-50.1)	46.1 ± 1.1 (44.7-48.1)	45.7 ± 1.3 (43.8-46.7)	37.7-45.1	48.1 ± 6.9 (42.6-62.4)	43.5 ± 0.5 (43.0-44.2)
S. E. pore	97.2 ± 3.4 (92.5-100)	118 ± 7.6 (104-129)	119 ± 7.9 (105-130)	101 ± 8.1 (90-110)	-	110 ± 2.9 (105-113)	-
Head-vulva	490 ± 17 (470-510)	534 ± 31 (455-569)	-	471 ± 18 (454-496)	-	-	-
Head-anus	626 ± 20 (605-650)	672 ± 38 (602-715)	651 ± 59 (541-733)	628 ± 33 (594-673)	609-652	-	-
Vulva-anus	136 ± 4.1 (130-140)	138 ± 17.8 (88-153)	-	157 ± 15.5 (140-177)	-	147 ± 17.8 (113-165)	-
Tail	87.7 ± 9.8 (78.0-97.5)	103 ± 11.6 (89-124)	105 ± 15.8 (76-127)	129 ± 7.6 (123-140)	138-142	120.5 ± 15.7 (100-138)	148 ± 6.5 (142-157)
BW	20.1 ± 1.2 (19.2-21.7)	28.0 ± 2.7 (23.8-32.1)	25.1 ± 2.3 (20.6-27.6)	25.9 ± 1.2 (25.1-27.7)	22.1-22.6	-	-
VBW	18.7 ± 0.6 (18.0-19.3)	25.5 ± 2.1 (22.4-29.1)	-	23.1 ± 0.9 (21.8-23.9)	-	-	-
ABW	13.8 ± 1.3 (12.7-15.6)	16.8 ± 1.3 (14.4-18.8)	16.7 ± 1.5 (14.7-19.3)	14.6 ± 0.1 (14.5-14.8)	15.2	-	-
Spicule	-	-	23.2 ± 1.9 (20.4-27.5)	-	20.3-21.4	-	17.5-18.5
Gubernaculum	-	-	6.7 ± 1.5 (4.9-9.0)	-	6.9-7.2	-	5.3 ± 0.8 (4.7-6.4)

[a] All measurements are in µm and in the form: Mean±Standard deviation (range).

sometimes equals to vulval body diameter. Tail slightly arcuate to strongly curved ventrally, with finely rounded to acute terminus [Figure 4, (H and I)].

Males

Similar to female in general [Figure 4, (A and C)]. Tail with pointed terminus. Spicules slightly ventrally curved. Gubernaculum crescent shaped. Bursa confined to the cloacal region, about one to two times as long as spicules.

Several populations of this species have been reported from Poland, USA, Hungary, France, Switzerland, Belgium, Italy, and Mexico (Geraert, 2008). In the present study, three populations of this species were collected from forest trees in Ali Abad-e-Katul (Golestan province) and Saravan (Guilan province) and also from the rhizosphere of olive trees in Roudbar (Guilan province). This is the first report of *T. elegans* from Iran.

Tylenchus ritae Siddiqi, 1963

(Figure 5; Table 2)

Females

Body slightly ventrally curved, after fixation (Figure 5-G). Lateral field with four longitudinal lines, the outer ones are crenate (Figure 5-H). Labial region rounded, with 4-5 fine annuli; continuous with body contour, 7-7.5 µm wide and 3.5-4 µm high. Stylet moderately developed, with rounded knobs. DGO 2-3 µm posterior to the stylet base. Pharyngeal median bulb oval and well developed. Secretory-excretory pore situated in the first half of the basal bulb [Figure 5, (A and C)]. Isthmus sometimes with flextures (Figure 5-J). Reproductive system anteriorly developed; spermatheca spherical and without sperm. Vagina short, about one third of vulval body diameter, at right angle to body axis. Vulva a depressed transverse slit. Post vulval uterine sac about 60% of vulval body diameter, broadly rounded (Figure 5-F). Tail elongate-conoid, regularly tapering to a finely rounded terminus. Tail end in both sexes is ventrally hooked [Figure 5, (D, E and L)].

Males

Similar to female in general, but the tail is slightly longer (Figure 5-I). Spicules slightly ventrally curved. Gubernaculum crescent shaped. Bursa about two times as long as spicules (Figure 5-K).

This species was described around grass roots in India (Siddiqi, 1963). In the present study, two populations of this species were found from soil around tea from Tea Research Centre, Lahijan (Guilan province) and forest trees from Ali Abad-e-Katul (Golestan province). This is the first report of *T. ritae* from Iran.

DISCUSSION

Genera *Paratrophurus* and *Tylenchorhynchus*

The genus *Paratrophurus* Arias, 1970 is very close to some other genera in the family Dolichodoridae, including *Tylenchorhynchus*, *Trophurus* and *Histotylenchus*. Castillo *et al*. (1989) discussed that it differs from *Tylenchorhynchus* in the having smooth labial region and abnormally thickened terminal cuticle of the tail, from *Trophurus* in having two ovaries (*vs.* one ovary), and from *Histotylenchus* in having abutting pharyngeal bulb (*vs.* pharyngeal lobe overlapping).

However, with description of *P. striatus,* (a species with striated labial region), and with identification of some *Tylenchorhynchus* species with more or less thickened terminal cuticle and smooth labial region, as well as introduction of some *Paratrophurus* species with overlapping pharyngeal bulb (e.g. *P. bhutanensis* and *P. lobatus*), discrimination of the genus *Paratrophurus* becomes more difficult. The main problems arise from the *Tylenchorhynchus* species with non-striated labial region and distinct terminal hyaline

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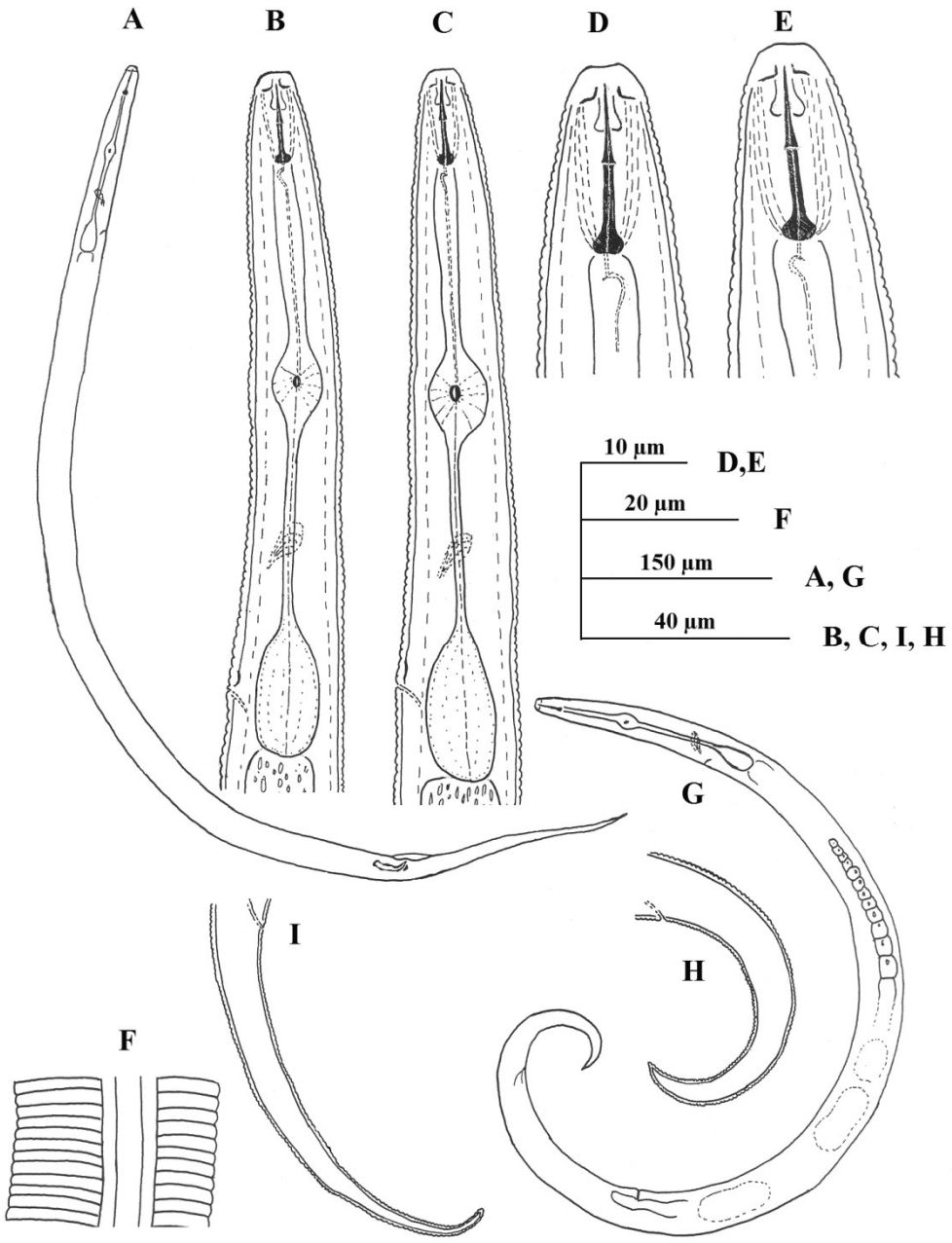

Figure 4. *Tylenchus elegans*: Female (C-I), Male (A and B). (A and G) Entire body; (B and C) Pharyngeal region; (D and E) Anterior region; (F) Lateral field, and (H and I) Tail.

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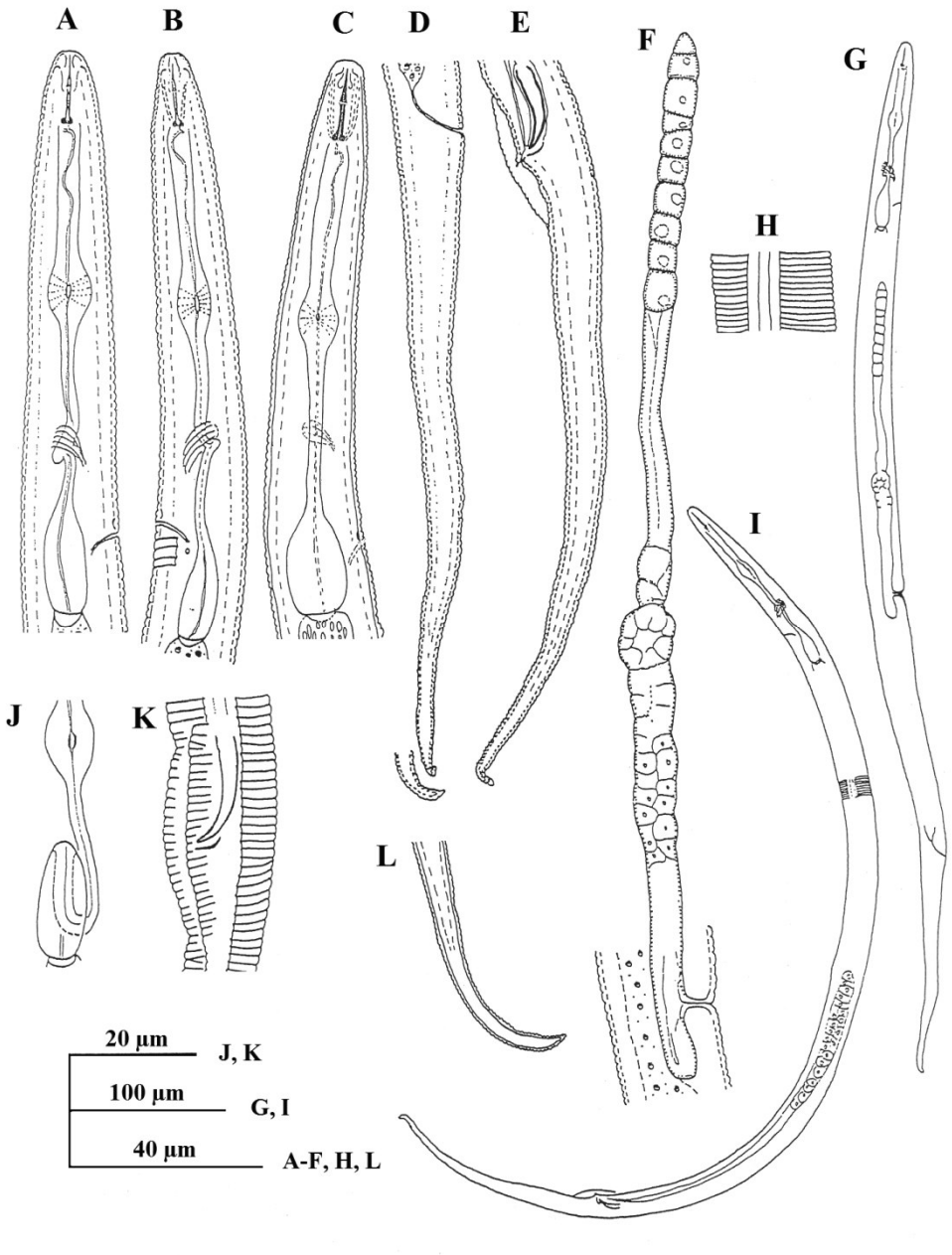

Figure 5. *Tylenchus ritae*: Female (A, C, D, F-H, J, L), Male (B, E, I, K). (A-C) Pharyngeal region; (D, E and L) Tail; (F) Reproductive system; (G andI) Entire body; (H) Lateral field; (J) Turning of isthmus, and (K) Spicules and bursa.

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(e.g. *T. tarjani, T. tuberosus, T. parasudanensis* and *T. leviterminalis*).

Our population from Kabodval forest agree with *P. kenanae*. This species comes close to certain species of *Paratrophurus* and *Tylenchorhynchus* including *P. sacchari*, *P. loofi*, *P. anomalus*, *T. parasudanensis*, *T. tuberosus* and *T. leviterminalis*. It differs from *P. sacchari* in having distinct spermatheca, full of sperm and in abundance of males. In *P. loofi,* the stylet knobs are 2.5-3.5 µm wide, but in the studied population, the width of stylet knobs was 3.9-4.8 µm. Stylet knobs width has been used as a diagnostic character by some authors (Castillo *et al*., 1989; Geraert, 2011). In addition, in our population, tail had fewer annuli (15-20 *vs.* 24-40 annuli). In *P. anomalus*, the cephalic region is offset and conoid-truncate, with strongly sclerotized framework, while in *P. kenanae*, the cephalic region is continuous and conoid-rounded, with slightly sclerotized framework. In *T. parasudanensis,* cuticular annuli are 0.7-1 µm wide and spermatheca is empty, while in *P. kenanae*, the cuticular annuli are 1.9-2.3 µm wide and spermatheca is full of sperm. In *T. tuberosus*, the stylet knobs directed anteriorly; while in *P. kenanae*, the stylet knobs are rounded to slightly directed posteriorly. *P. kenanae* and *T. leviterminalis* are very similar, therefore, Geraert (2011) did not differentiate them in his key. However, in the present study, some differences were observed in labial region, pharynx, tail, and spicules position between Golestan (*P. kenanae*) and Fars (*T. leviterminalis*) populations. In Golestan population, labial region is smooth and pharyngeal basal bulb is often pyriform, but in Fars population, labial region often with one transverse striae forming two annuli and basal bulb usually is saccate. Furthermore, in *P. kenanae*, tail is almost cylindrical and with 15-20 annuli, but in *T. leviterminalis*, tail is sub-clavate, clavate or sub-cylindrical with 20-26 annuli. However, all these differences may have a little taxonomic value.

Comparison of the Iranian population of *P. kenanae* with the original description (Decker and El Amin, 1978) shows some differences. In our population, c and c' ratios are 12.7-14.5 and 3.0-4.1, respectively, (*vs.* 14.3-19.7 and 2.4-3.2 in original description), and males stylet slightly longer (19.8-21.2 *vs.* 15.8-19.0 µm). Morphometrics of *T. leviterminalis* in the present study agree with the original description (Siddiqi *et al*., 1982), but stylet is slightly longer (19.4-22.0 and 19.4-20.4 in females and males, respectively, *vs.* 17-19 µm in both sexes).

Genera *Filenchus* and *Tylenchus*

Brzeski (1997) restudied the type materials of *F. butteus*, *F. cylindricollis* and *F. plattensis* and then synonymized these three species. *F. butteus* comes close to *F. sandneri*, *F. nakasonoi* and *F. hamatus*. Vulva in *F. butteus* is slightly more anterior to *F. sandneri* (V= 67.8-69.7 and V'= 77.7-78.8 in the present population *vs.* V= 72-78.5 and V'= 82-85 in *F. sandneri*), body is longer (693-738 *vs.* 370-420 µm) and c ratio is smaller (7.3-9.1 *vs.* 10-11). Our population differs from *F. nakasonoi* in having longer body and longer tail (respectively 250-280 and 41-54 µm in *F. nakasonoi*). In *F. hamatus*, stylet is slightly shorter (7-10 µm), c ratio is somewhat smaller (5.3-6.9), and tail is distinctly curved as C-shaped. In comparison with populations redescribed by Brzeski (1997), two differences are visible. Our population has longer body length (693-738 *vs.* 423-575 µm) and longer pharynx (122-139 *vs.* 82-103 µm).

T. elegans comes close to *T. davainei*, *T. capitatus* and *T. ritae*. It differs from *T. davianei* by having a slightly shorter body (707-840 *vs.* 810-1300 µm), continuous labial region (distinctly offset in *T. davainei*), shorter stylet (14.2-17.0 *vs.* 16.0-19.5 µm), shorter spicules (20.4-27.5 *vs.* 23-28 µm) and rounded tail terminus (*vs.* sharply pointed in *T. davainei*). Brzeski synonymized *T. capitatus* with *T. elegans* (Brzeski, 1996), but this synonymization was not accepted by others (Siddiqi, 2000; Geraert, 2008). *T. capitatus* can be differentiated from *T. elegans* by wide labial region, narrower central band on lateral field, weaker median bulb, and tail almost cylindrical with well-rounded terminus. In *T. elegans*, the central band of lateral field is wider than the marginal bands,

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but in *T. ritae*, the central band is smaller than or as wide as outer bands. Morphometrics of our populations of these two species completely agree with the original descriptions.

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معرفی گونه‌هایی از نماتدهای خانواده‌های Tylenchidae و Dolichodoridae (Nematoda: Tylenchoidea) از ایران

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چکیده

پنج گونه از نماتدهای انگل گیاهی (Tylenchomorpha: Tylenchoidea) از استان‌های گلستان، گیلان، کردستان و فارس جمع‌آوری و شناسایی شدند. گونه‌های *Paratrophurus kenanae* Decker & El Amin, 1978، *Tylenchus elegans* de Man, 1876 و *T. ritae* Siddiqi, 1963 گزارش‌های جدیدی برای فون نماتدهای ایران بوده و دو گونه *Filenchus butteus* (Thorne & Malek, 1968) Raski & Geraert, 1987 و *Tylenchorhynchus leviterminalis* Siddiqi, Mukherjee & Dasgupta, 1982 در گزارش‌های قبلی توصیف نشده‌اند. در این مطالعه، شرح، اندازه‌ها و تصاویر ترسیم شده این پنج گونه ارائه شده است. همچنین در مورد شناسایی جنس *Paratrophurus* و شباهت تعدادی از گونه‌های آن به گونه‌های برخی جنس‌های دیگر، به‌ویژه *Tylenchorhynchus*، بحث شده است.

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