J. Crop Prot. 2017, 6 (1): 125-143

Research Article

Description of some known species of the genus *Aphelenchoides* Fisher, 1984 (Nematoda: Aphelenchoididae) from Iran

Yaser Adeldoost, Ramin Heydari*, Mehrab Esmaeili and Esmaeil Miraeiz

Department of Plant Protection, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran.

Abstract: Twelve species of the genus *Aphelenchoides* were collected and identified based on morphological and morphometric characters from different regions in North, South and Western Iran. Among collected species *i. e. A. centralis, A. cibolensis, A. cyrtus, A. hamatus, A. helicus, A. huntensis, A. limberi, A. obtusicaudatus, A. sprophilus, A. sacchari, A. spicomucronatus* and *A.tuzeti,* three species namely *A. cibolensis, A. hamatus* and *A. saprophilus* are new records from Iran. Description, measurements, line drawings and microscopic photographs for Iranian population of these species are provided. *Aphelenchoides helicus* that was previously reported without description, is described and illustrated as well.

Keywords: morphology, morphometric, new record

Archive of SID

Introduction

The genus *Aphelenchoides* Fisher, 1984 belongs to the family Aphelenchoididae Skarbilovich, 1947. It comprises over 150 nominal species that inhabit soil and decaying plant material and are also associated with the fungi colonizing bark (Hunt, 1993, 2008). Most species of *Aphelenchoides* are fungivorous (Kanzaki and Giblin-Davis 2012), thirteen species have been reported as plant-parasitic in a wide variety of plants (Sánchez-Monge *et al*., 2015). Three species of the genus namely *A. besseyi* Christie, 1942, *A. fragariae* (Ritzema Bos, 1890) Christie, 1932 and *A. ritzemabosi* (Schwartz, 1911) Steiner and Buhrer, 1932, that are economically important, causing losses in a range of agricultural and horticultural crops have been extensively studied (Duncan and Moens, 2013).

To date, 37 species of the genus have been reported from different hosts and localities in Iran (Ghaderi *et al*., 2012; Esmaeili *et al*., 2016a,b, 2017a,b; Golhasan *et al*., 2016a,b; Miraeiz *et al*., 2017), for some of them there is no morphological data. Recently, *A. huntensis* Esmaeili, Fang, Li and Heydari, 2016, *A. fuchsi* Esmaeili Heydari, Ziaei and Gu, 2016, *A. eldaricus* Esmaeili, Heydari, Golhasan and Kanzaki, 2017 collected in association with pine trees, and *A. iranicus* Golhasan, Heydari, Alvarez-Ortega, Esmaeili, Castillo and Palomares-Rius, 2016 and *A. paraxui* Esmaeili, Heydari, Fang and Li, 2017 in association with oak trees, were described from Iran. In the present paper, we have provided morphometrics, illustrations and microscopic photographs for four species of *Aphelenchoides* including three new records from Iran and a previously reported species.

Materials and Methods

More than 100 soil, root and bark samples were randomly collected from different fields,

Handling Editor: Zahra Tanhamaafi

* **Corresponding author**, e-mail: rheydari@ut.ac.ir
Received: 24 April 2016, Accepted: 1 April 2017
Published online: 11 June 2017

www.SID.ir

orchards, forests, and grasslands in Fars, Golestan and Kermanshah provinces during 2013-2014. The Whitehead tray (Whitehead and Hemming, 1965) was used to extract nematodes. Specimens were heat-killed by adding hot 4% formaldehyde solution, processed to dehydrated glycerin according to De Grisse (1969) and observed under light microscope (LM). Measurements and drawings were made with a Nikon-E200 light microscope equipped with a drawing tube and were redrawn using CorelDraw® software version 17. Species were identified based on the valid key (Shahina, 1996) and related original descriptions.

Results

Twelve species belonging to the genus *Aphelenchoides* (see Table 1) were collected and identified. *Aphelenchoides cibolensis, A. hamatus* and *A. saprophilus,* as new records for Iran nematode fauna, and one previously reported species; *A. helicus* are described and illustrated.

Aphelenchoides cibolensis Riffle, 1970

(Figs 1 and 2; Table 2)

Female. Body slender and slightly curved ventrally upon fixation. Cuticle with distinct annuli, 1.0-1.2 µm in mid-body. Lateral field with three lines, 20-23% of corresponding body width. Lip region rounded, offset, *ca* 3.0-4.0 µm high and 5.0-5.5 µm wide. Stylet with small basal swellings, procorpus cylindrical. Median bulb strongly developed, almost spherical, with conspicuous valve situated more or less centrally. Pharyngo-intestinal junction immediately posterior to metacorpus. Excretory pore with slight variation in position, at level of base of median bulb to nerve ring. Hemizonid not observed. Nerve ring situated at *ca* one-half metacarpus length posterior to it. Ovary outstretched anteriorly, developing oocytes in single row. Spermatheca oval, sperm present in some individuals. Vagina obliquely transverse one-third body width. Vulva transverse, with slightly raised lips. Post-uterine sac well developed, extending for about one-sixth of vulva to anus distance. Rectum and anus visible. Tail truncated, dorsally almost angular as it forms a single sharply pointed ventral mucro.

Male: Not found.

Table 1 *Aphelenchoides* species recovered from rhizosphere soil, root and bark samples of plants in the present study.

Species	Locality (provinces)	Associated plants
A. centralis	Fars, Golestan & Kermanshah	Apple & Grapevine
A. cibolensis[*]	Fars & Kermanshah	Apricot & Palm
A. cyrtus	Kermanshah	Grapevine
A. hamatus[*]	Kermanshah	Grapevine
A. helicus	Golestan	Tomato
A. huntensis	Kermanshah	Pine tree
A. limberi	Fars & Kermanshah	Clover, Ficus & Olive
A. obtusicaudatus	Fars	Apple
A. saprophilus[*]	Fars & Golestan	Alfalfa, Forest tree & Olive
A. sacchari	Fars & Golestan	Apple
A. spicomucronatus	Fars, Golestan & Kermanshah	Apple, Cherry & Oak
A. tuzeti	Fars & Kermanshah	Grapevine

[*] New records for Iranian nematode fauna.

Archive of SID

www.SID.ir

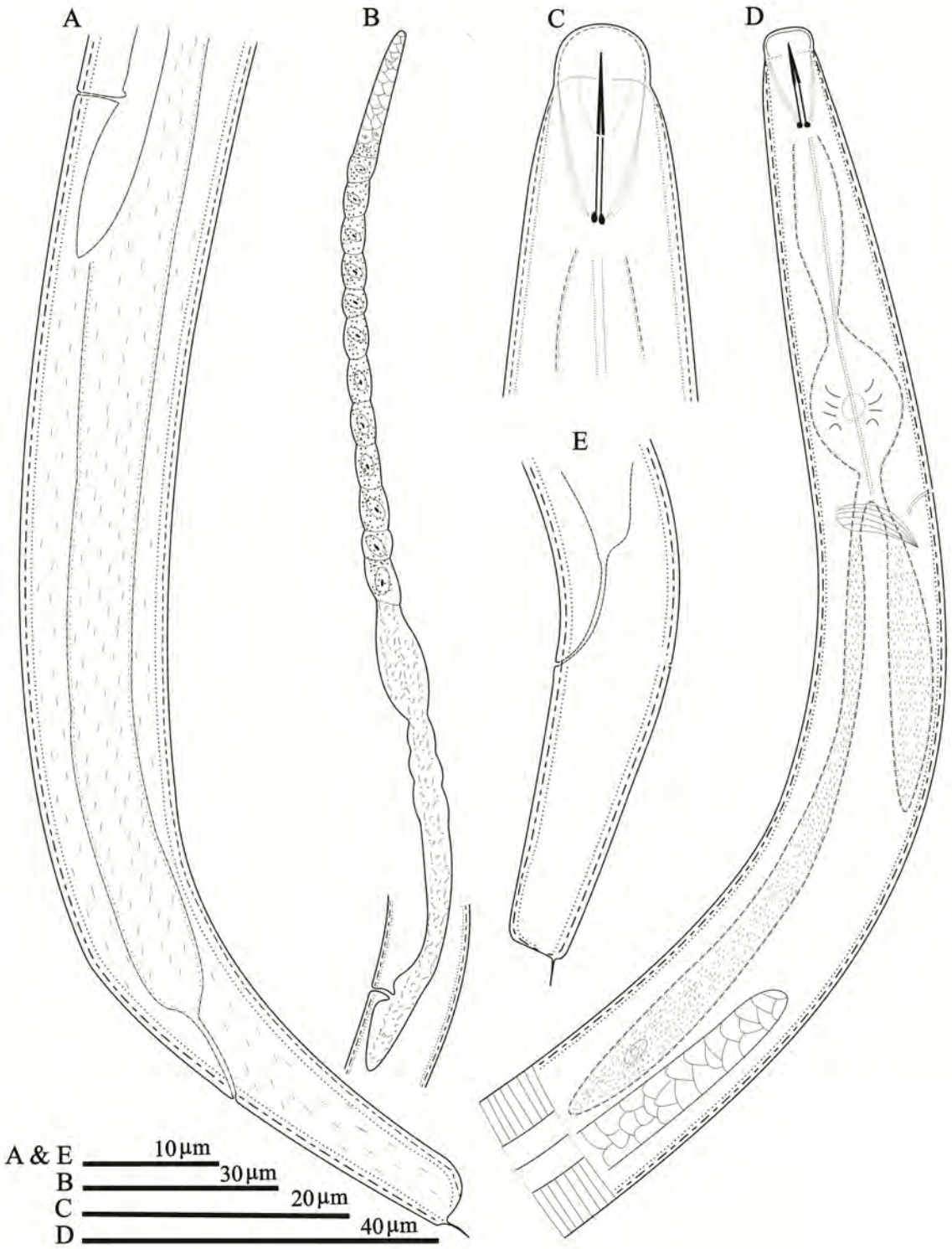

Figure 1 *Aphelenchoides cibolensis*. A: Vulva-body end; B: Female reproductive system; C: Anterior end of female; D: Female pharyngeal region.

www.SID.ir

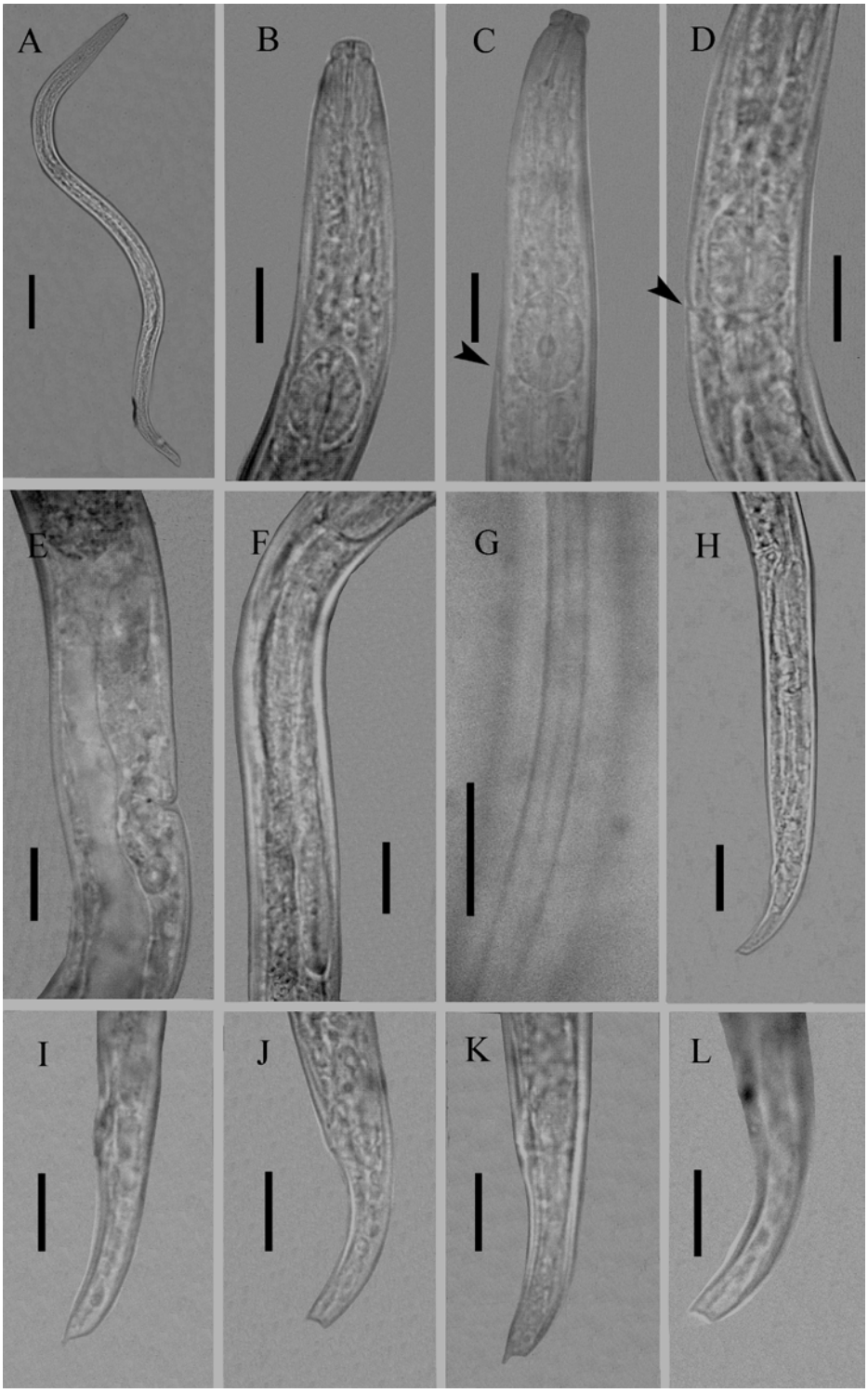

Figure 2 *Aphelenchoides cibolensis*. A: Entire body; B: Anterior end; C: Anterior end showing excretory pore (arrowhead); D: Metacorpus region showing excretory pore (arrowhead); E: Vulva region; F: Pharyngeal gland region; G: Lateral field at mid body; H: Vulva-body end; I-L: Various shapes of tail. (Scale - bars 10 µm, except A 40 µm & H 20 µm).

www.SID.ir

Table 2 Morphometric data of females of *Aphelenchoides cibolensis* compared with type population.

Characters[1]	Fars province population	Riffle (1970)
	Female	Female
n	10	10
L	374 ± 4.9 (364-382)	410 (360-460)
a	24.2 ± 0.9 (22.7-25.7)	26 (23-29)
b	6.5 ± 0.3 (6.2-7.1)	8 (7.3-8.9)
b'	3 ± 0.1 (2.9-3.2)	-
c	17.3 ± 1.4 (15.5-19.2)	15 (13-16)
c'	3 ± 0.3 (2.5-3.4)	-
V or T (%)	70.3 ± 1 (68.6-72.1)	70 (69-71)
Stylet	9.6 ± 0.4 (9-10)	10 (9-11)
m	42.8 ± 3.1 (40-50)	-
End of glands	125 ± 2.5 (120-130)	-
Overlapping	67 ± 2.5 (63-72)	-
Median bulb	45.8 ± 1.1 (44-48)	-
Pharynx	58± 2.2 (53-60)	-
Anterior end to Nerve ring	54.9 ± 1.5 (53-57)	-
Anterior end to Excretory pore	49.9 ± 1.6 (48-53)	-
Body width (BW)	15.5 ± 0.6 (14.5-16.5)	-
Post-uterine sac (PUS) length	11.9 ± 1.9 (10-15)	-
PUS/BW	0.8 ± 0.1 (0.6-1)	-
PUS/ Vulva-anus (%)	13.6 ± 2.4 (11-17.1)	-
Vulva–anus distance	87.9 ± 2.8 (82.5-91)	-
Anal BW	7.4 ± 0.3 (7-8)	-
Tail length	21.8 ± 1.8 (19-24)	-

[1] All measurements are given in micrometer, except V, T and PUS which are in percent.

Remarks

Female of *Aphelenchoides cibolensis* was originally described from New Mexico in the rootlets of juniper tree (*Juniperus deppeana* L.) by Riffle (1970). Later, the male of this species was described by Hooper and Myers (1971). Morphological and morphometric characters of the Iranian population of *A. cibolensis* fit well with the original description. This population was collected from the rhizosphere of an apricot tree in Nurabad (Fars province) also from the rhizosphere of palm tree in Ghasr-e Shirin (Kermanshah province), and is reported for the first time. This species is morphologically close to *A. dactylocercus* Hooper, 1958, *A. parabicaudatus* Shavrov, 1967, *A. sacchari* Hooper, 1958 and *A. trivialis* Franklin & Siddiqi, 1963. It differs from *A. dactylocerus* by shorter tail length (19-24 *vs* 38-40 µm) and shape of tail terminus (flattened *vs* rounded). *Aphelenchoides cibolensis* is distinguished from *A. parabicaudatus* by having three lines in lateral field *vs* four, position of excretory pore (at level of base of median bulb to nerve ring *vs* posterior to nerve ring) and higher V ratio (68.6-72.1 *vs* 61-64). Rashid *et al*. (1986)

www.SID.ir

described a population of *A. parabicaudatus* from Brazil which the lateral field of specimens was not so clear and the authors mentioned the number of incisures with probability as three. It differs from *A. sacchari* by shorter body length (360-380 *vs* 654-810 µm), shorter post-uterine sac (10-15 *vs* 77-120 µm) and shape of tail terminus (flattened *vs* rounded). It differs from *A. trivialis* by position of excretory pore (anterior to nerve ring *vs* posterior) and shape of tail terminus (flattened *vs* rounded).

The two populations of *A. cibolensis* collected from Kermanshah and Fars provinces showed variations in some indices *i.e.* Kermanshah population has lower c ratio (10-13.7 *vs* 15.5-19.2), higher c' ratio (4.5-7.1 *vs* 2.5-3.4) and anterior vulva (V = 66-68 *vs* 68.6-72.1).

***Aphelenchoides hamatus* Thorne & Malek, 1968**
(Figs 3 and 4; Table 3)

Female. Body cylindrical, straight, somewhat ventrally arcuate when heat-relaxed. Cuticle with distinct annuli, 1.0-1.4 µm in mid-body. Lateral field with four lines, 22-25% of corresponding body width. Lip region rounded, offset, *ca* 3.0-3.5 µm high and 5.5-7.0 µm wide. Stylet with small basal swellings, procorpus cylindrical. Median bulb strongly developed, almost rectangular, with conspicuous valve situated more or less centrally. Nerve ring situated at *ca* one-half metacarpus length posterior to it. Pharyngo-intestinal junction immediately posterior to metacorpus. Excretory pore located at posterior to level of the nerve ring. Hemizonid faint, situated *ca* one body diam. posterior to excretory pore. Ovary outstretched anteriorly, extending forward to pharyngeal region and then reflexed back *ca.* 5-7 body widths. Oocytes arranged in single row. Spermatheca oval, sperm present in some individuals. Vagina directed anteriad. Vulva transverse, with slightly raised lips. Post-uterine sac well developed, extending for about one-half of vulva to anus distance. Rectum and anus visible. Tail conical, tapering to a rounded point bearing a small and simple mucro.

Males. Body slender, cylindrical, J-shaped when heat-relaxed. Anterior region and cuticle similar to female. Testis single, anteriorly outstretched. Spicules arcuate, relatively long, apex and rostrum rounded and well developed, the end of the dorsal limb is clearly curved ventrally like a hook. Gubernaculum absent. Tail conical, bearing a short sharp mucro *ca* 1.6-2.2 µm long. Three pairs of subventral caudal papillae present: first pair located just posterior to cloacal aperture, second pair at mid-tail region, and third pair just anterior to tail end.

Remarks

Aphelenchoides hamatus was originally described from horticultural gardens of South Dakota State in soil around the rhizosphere of Iris by Thorne and Malek (1968). Later, this species was reported from Bristol, England (Wrigh and Perr, 1991). Morphological and morphometric characters of the Iranian population of *A. hamatus* fit well with the original description but differ by a shorter body length, which may be because of geographical intraspecific variability. This population was collected from the rhizosphere of grapevine in Gilan-e Gharb, Kermanshah province, and is reported from Iran for the first time. It is distinguished from three closely related species namely *A. blastophthorus* Franklin, 1952, *A. saprophilus* Franklin, 1957 and *A. xui* Wang, Wang, Gu, Wang and Li, 2013 by having long ovary, extending up to the gland lobes with long reflexed tip. Moreover, it differs from *A. blastophthorus* by having shorter stylet (9-11 *vs* 14-19 µm) and lower "a" index (23-25*vs* 40-41). It differs from *A. saprophilus* by male spicule length in dorsal limb (29-32 *vs* 23 µm). Also, it differs from *A. xui* by having the shorter post-uterine sac (53-65 *vs* 68-132 µm) and by the female tail terminus (tapering to a simple mucro *vs* ending a step-like projection/or offset mucro with many tiny nodular protuberances).

Archive of SID

www.SID.ir

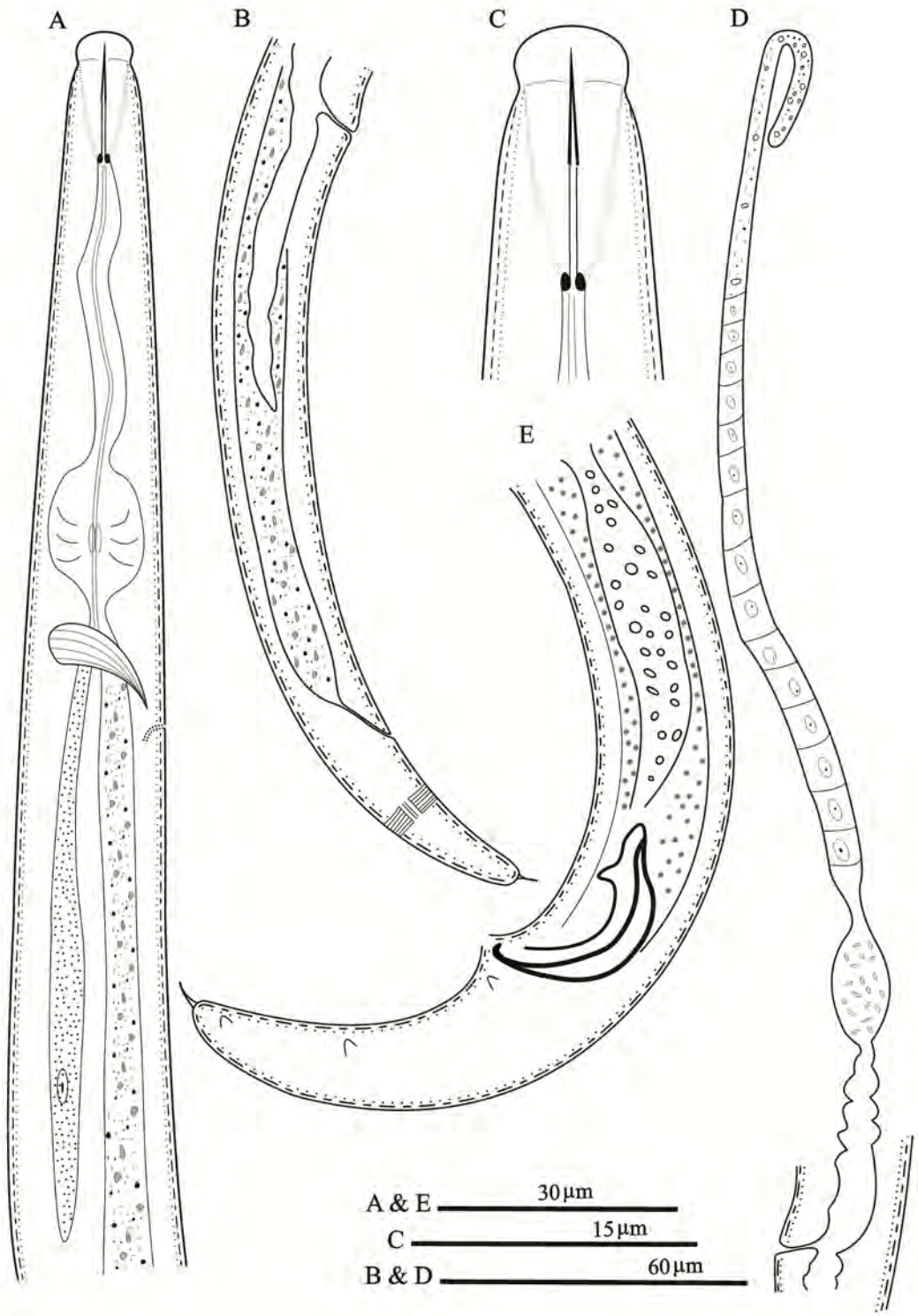

Figure 3 *Aphelenchoides hamatus*. A: Pharyngeal region; B: Anterior end; C: Vulva-body end; D: Female reproductive system; E: Posterior end of male.

www.SID.ir

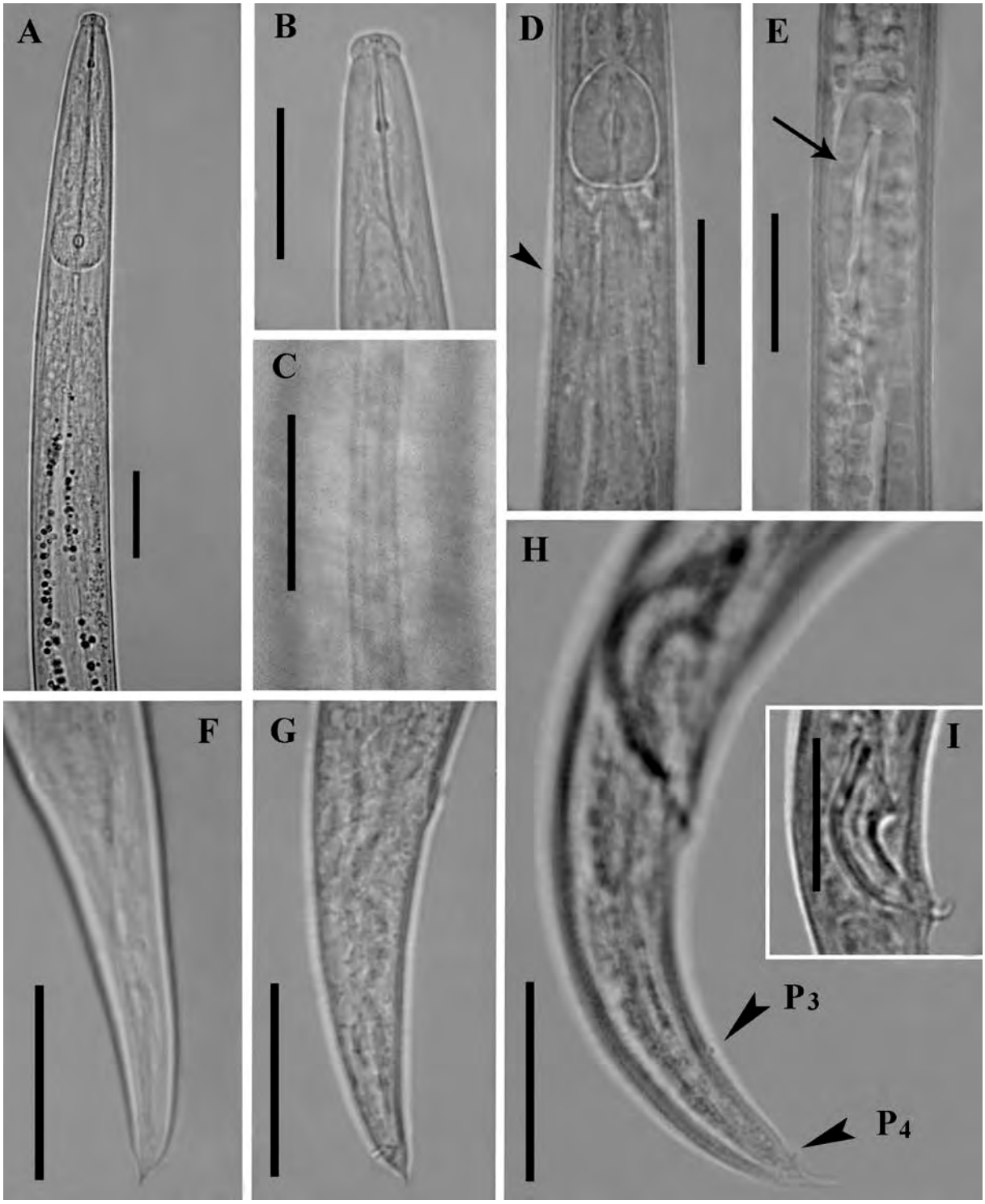

Figure 4 *Aphelenchoides hamatus*. A: Pharyngeal region; B: Anterior end; C: Lateral field at mid body; D: Metacorpus region showing excretory pore (arrowhead); E: Part of female reproductive system showing reflexed tip (arrowhead); F, G: Various shapes of tail; H, I: Posterior end of male showing spicules and P2 and P3 papillae arrangement (arrowheads). (Scale bars 20 µm).

www.SID.ir

Table 3 Morphometric data of *Aphelenchoides hamatus* and its comparison with type population.

Characters[1]	Kermanshah province population		Thorne and Malek (1968)	
	Female	Male	Female	Male
n	10	2	?	?
L	577 ± 47.5 (508-660)	636, 640	1000	700
a	27.2 ± 2.9 (23.1-25.7)	27.8, 30.0	22	30
b	10 ± 1.0 (8.3-11.6)	8.8, 9.2	9.5	8.8
b'	3.7 ± 0.5 (3.0-4.6)	3.7, 4.0	-	-
c	14.3 ± 1.3 (12.6-16.6)	13.9, 14.5	18	19
c'	3.9 ± 0.4 (3.0-4.5)	3.1	3.4	-
V or T (%)	69.1 ± 2.3 (65.3-73.4)	50, 62	70	78
Stylet	9.8 ± 0.8 (9-11)	10, 11	11-13	-
m	41.4 ± 2.6 (36.4-44.4)	44, 45	-	-
End of glands	160 ± 24.5 (125-185)	160, 174	-	-
Overlapping	82.8 ± 13 (65-100)	61, 65	-	-
Median bulb	58 ± 2.7 (55-64)	63, 66	-	-
Pharynx	57.8± 1.9 (56-62)	69, 73	-	-
Anterior end to Nerve ring	74.5 ± 6.4 (70-79)	71, 74	-	-
Anterior end to Excretory pore	79.9 ± 3.8 (75-85)	80, 84	-	-
BW	21.3 ± 0.8 (20-22)	22, 23	-	-
PUS length	60 ± 4.2 (53-65)	-	-	-
PUS/BW	1.0 ± 0.9 (0.5-2.7)	-	-	-
PUS/ Vulva-anus (%)	44 ± 5.14 (40-53)	-	-	-
Vulva –anus distance	137 ± 10 (122- 154)	-	-	-
Anal BW	10.6 ± 0.8 (10-12)	-	-	-
Tail length	40.7 ± 4.2 (35 -46)	44, 46	-	-
Spicule	-	29, 32	-	-

[1] All measurements are given in micrometer, except V, T and PUS which are in percent.

***Aphelenchoides helicus* Heyns, 1964**
(Figs 5 and 6; Table 4)

Female. The body is slender and mostly spiral in shape when heat-relaxed. Cuticle *ca* 0.8 µm thick with fine transverse striae. Lateral field with three lines, 25-28% of corresponding body width. Lip region rounded, offset, *ca* 2.5-3.4 µm high and 5.0-6.5 µm broad. Stylet with small basal swellings, procorpus cylindrical. Median bulb strongly developed, almost oval with conspicuous valve situated more or less centrally. Excretory pore variable in position from the level of metacorpus base to the level of nerve ring. Nerve ring surrounds the beginning of the intestine. Hemizonid not observed. Ovary outstretched anteriorly, developing oocytes in single row. The vulva is a transverse slit and is not prominent. Post-uterine sac collapsed reaching about one quarter of the distance to the anus. Rectum and anus visible. Tail elongate-conoid, ventrally arcuate, the terminus rounded or somewhat truncate without any mucro. ***Male.*** Not found.

www.SID.ir

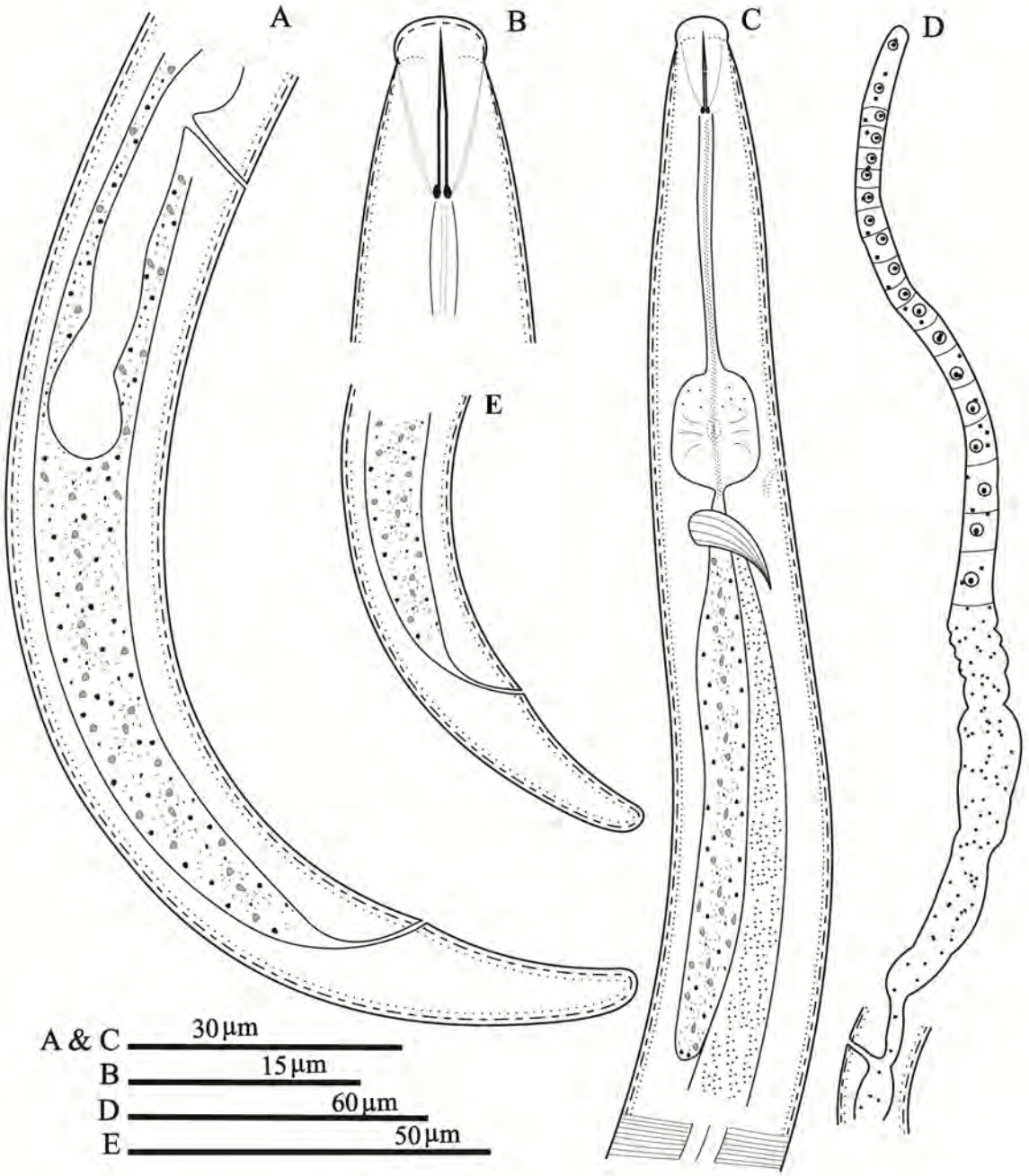

Figure 5 *Aphelenchoides helicus.* A: Vulva-body end; B: Anterior end; C: Female reproductive system; D: Pharyngeal region; E: Female tail.

www.SID.ir

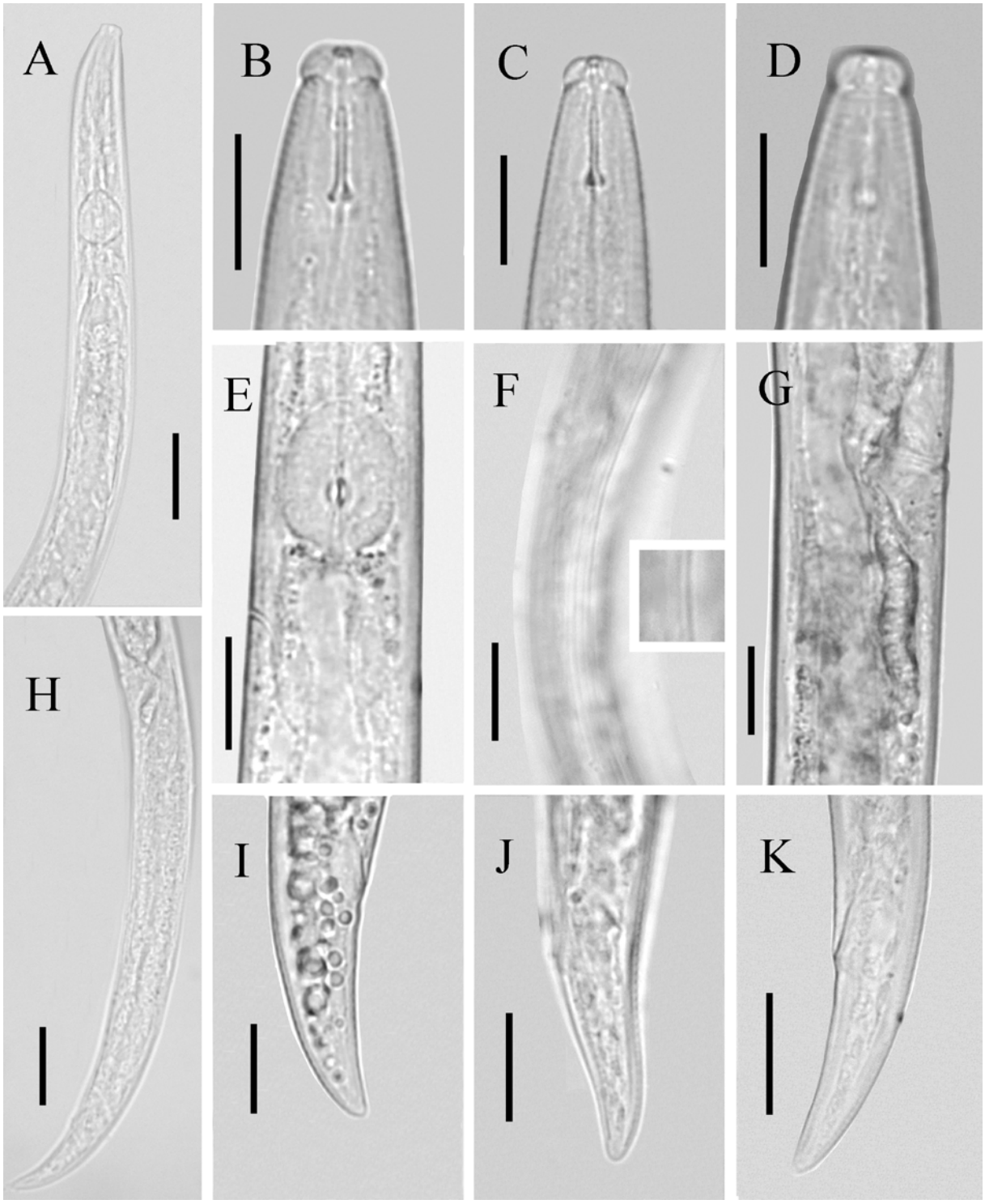

Figure 6 *Aphelenchoides helicus*. A: Pharyngeal region; B-D: Anterior end; E: Metacorpus region; F: Lateral field at mid body; G: Vulva region; H: Vulva-body end; I-K: Various shapes of tail. (Scale bars 20 µm, except A & H 10 µm).

www.SID.ir

Table 4 Morphometric data of females of *Aphelenchoides helicus* and its comparison with type population.

Characters[1]	Golestan province population	Heyns (1964)	Rashid *et al.* (1986)
	Female	Female	Female
n	18	3	3
L	505 ± 52.2 (408-572)	480-500	400 (340-510)
a	30.4 ± 2.8 (25.5-34.7)	24-31	27.5 (26.2-29.7)
b	10.8 ± 1.2 (9-12.6)	6.8-7.6	6.4 (5.7-7.2)
b'	5.3 ± 0.8 (4-6.7)	-	-
c	24.7 ± 2.6 (21.5-28)	11.6-15	16.5 (13.5-18)
c'	2.2 ± 0.2 (1.9-2.5)	-	3.3 (2.8-4)
V or T (%)	69.5 ± 1.5 (67.3-71.3)	67-71	71 (70-74)
Stylet	9.4 ± 0.3 (9-10)	10	9 (8.5-10)
m	35.3 ± 3.4 (30.9-39.8)	-	-
End of glands	96 ± 11.8 (83-115)	-	-
Overlapping	49 ± 9.5 (38-65)	-	-
Median bulb	40.9 ± 3.2 (37.5-48)	-	-
Pharynx	47 ± 2.9 (43-51)	-	61.5 (54-71)
Anterior end to Nerve ring	48.2 ± 4.3 (44-58)	-	-
Anterior end to Excretory pore	46.1 ± 5.5 (38-56)	-	51 (47-59)
Body width	16.6 ± 0.6 (16-17.5)	-	14 (13-17)
PUS length	30.3 ± 5.5 (20-38)	-	25 (13-44)
PUS/BW	1.8 ± 0.3 (1.2-2.4)	-	-
PUS/ Vulva –anus (%)	32.2 ± 6.4 (23-44.7)	-	-
Vulva –anus distance	94.6 ± 9.3 (84-114)	-	-
Anal BW	9.4 ± 0.8 (8.1-10.6)	-	-
Tail length	20.5 ± 1.2 (18-22)	-	24.5 (19.5-29.5)

[1] All measurements are given in micrometer, except V, T and PUS which are in percent.

Remarks

Aphelenchoides helicus was originally described from South Africa in cultivated fields of the Tobacco Research Institute by Heyns (1964). Later, this species was reported from different locations in Brazil (Rashid *et al.,* 1986). The latter authors developed the morphometric ranges and provided a more detailed line drawing. Morphology and morphometrics of the Iranian population of *A. helicus* in the present study correspond with the various

www.SID.ir

descriptions of the species (Heyens, 1964; Rashid *et al.,* 1986) with slight variations *i. e*. greater b and c indices (9.0-12.6 *vs* 5.7-7.2 and 21.5-28.0 *vs* 13.5-18.0, respectively). However, due to high similarity in other strong characters such as tail and body shape, lateral lines, length of stylet and post-uterine sac, authors considered these little differences as intraspecific variation. Because of the shape of tail terminus *A. helicus* is comparable with *A. limberi* Steiner, 1936 and *A. jacobi* Husain and Khan, 1967. It differs from the former species by number of incisures in lateral fields (three *vs* four) and from *A. jacobi* by having a shorter stylet (9-10 *vs* 12-14 µm). This species has previously been reported from Iran, recovered from the rhizosphere of beet in Fars province (Ebrahimi *et al*., 2002), with no morphological and morphometrics data. This population was collected from the rhizosphere of tomato in Gorgan, Golestan province.

***Aphelenchoides saprophilus* Franklin, 1957 (Figs 7 and 8; Table 5)**

Female. Body cylindrical, straight, somewhat ventrally arcuate when heat-relaxed. Cuticle with distinct annuli, 0.7-0.9 µm in mid-body. Lateral field with four lines, 23-27% of corresponding body width. Lip region rounded, offset, *ca* 2.0-3.0 µm high and 5.0-6.0 µm broad. Stylet with small basal swellings, procorpus cylindrical, median bulb strongly developed, almost rectangular, with conspicuous valve situated more or less centrally. Nerve ring situated at *ca* one-half metacarpus length posterior to it. Excretory pore located at or posterior to level of the nerve ring. Ovary outstretched anteriorly, developing oocytes in single row. Spermatheca oval, sperm present in some individuals. Vagina directed anteriad. Vulva transverse with slightly raised lips. Post-uterine sac well developed, extending for about one-half of vulva to anus distance. Rectum and anus visible. The tail tapers to a rounded point bearing a terminal mucro.

Males. Body slender, cylindrical, J-shaped when heat-relaxed. Anterior region and cuticle similar to female. Spicules arcuate, relatively short, apex and rostrum rounded and well developed, the end of the dorsal limb is curved ventrally like a hook. Gubernaculum absent. Tail conical, bearing a short sharp mucro *ca* 1.2-2.0 µm long. Three pairs of subventral caudal papillae present: first pair located just posterior to cloacal aperture, second pair in mid-tail region, and third pair just anterior to tail end.

Remarks

Aphelenchoides saprophilus was originally described from Docking village, Norfolk city of England in a soil sample by Franklin (1957). Morphological and morphometric characters of the Iranian population of *A. saprophilus* are in agreement with those of the original description. This population was collected from the rhizosphere of raspberry shrubs in Nurabad, Fars province, and is reported from Iran for the first time. This species is close to *A. blastophthorus* Franklin 1952, *A. composticola* Franklin, 1957 and *A. parietinus* (Bastian, 1865) Steiner, 1932. It differs from *A. blastophthorus* by shorter length of spicule dorsal limb (22-24*vs* 24-31 µm), shorter length of stylet (11-12 *vs* 15-19 µm) and lower V ratio (64-68 *vs* 68-75). It differs from *A. composticola* by number of incisures in lateral fields (three *vs* four). It differs from *A. parietinus* by having finer body annulation (0.7-0.9 *vs* 1.0-1.3 µm) and male presence *vs* absence.

Archive of SID

www.SID.ir

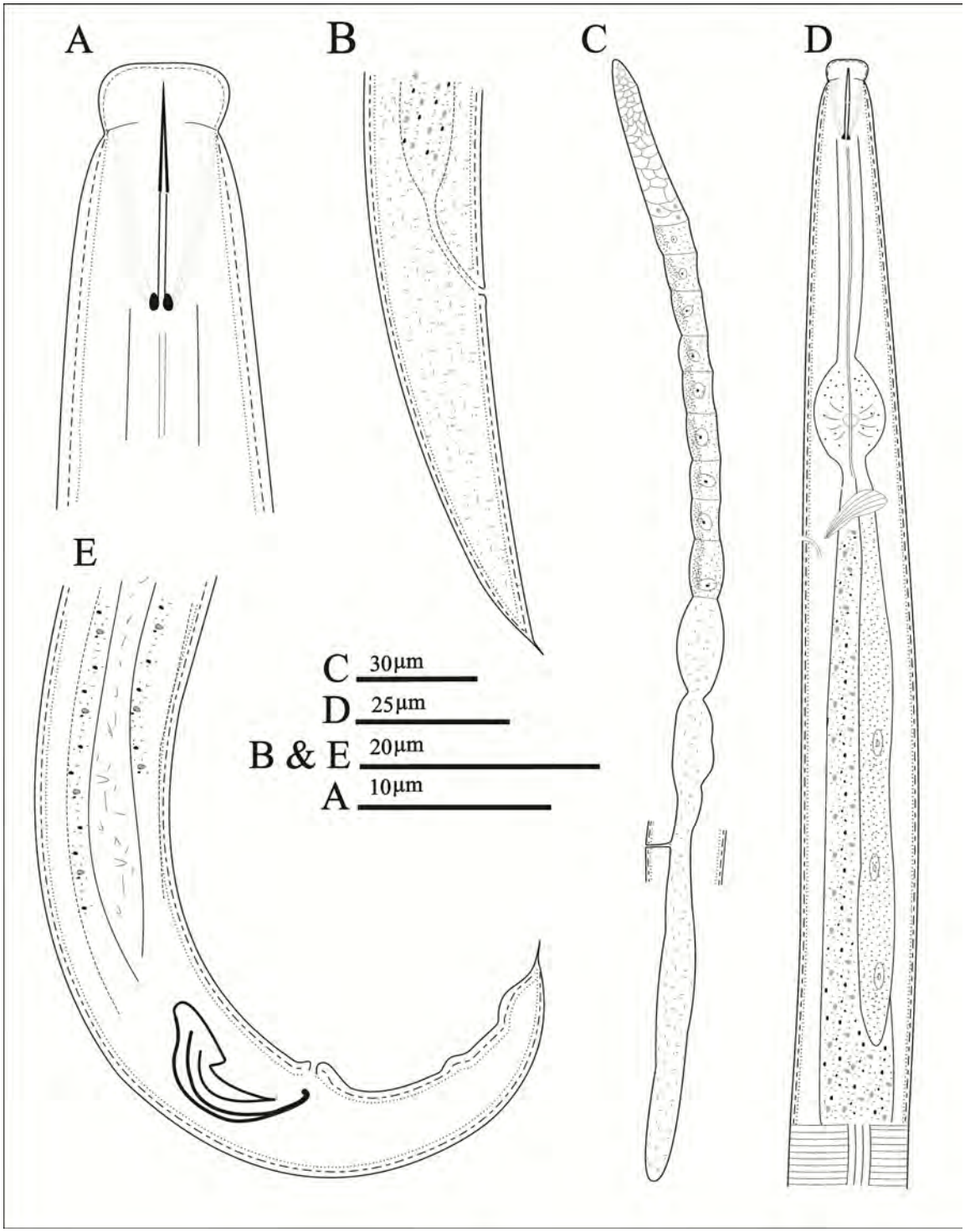

Figure 7 *Aphelenchoides saprophilus*. A: Anterior end; B: Female tail; C: Female reproductive system; D: Female pharyngeal region; E: Posterior end of male.

www.SID.ir

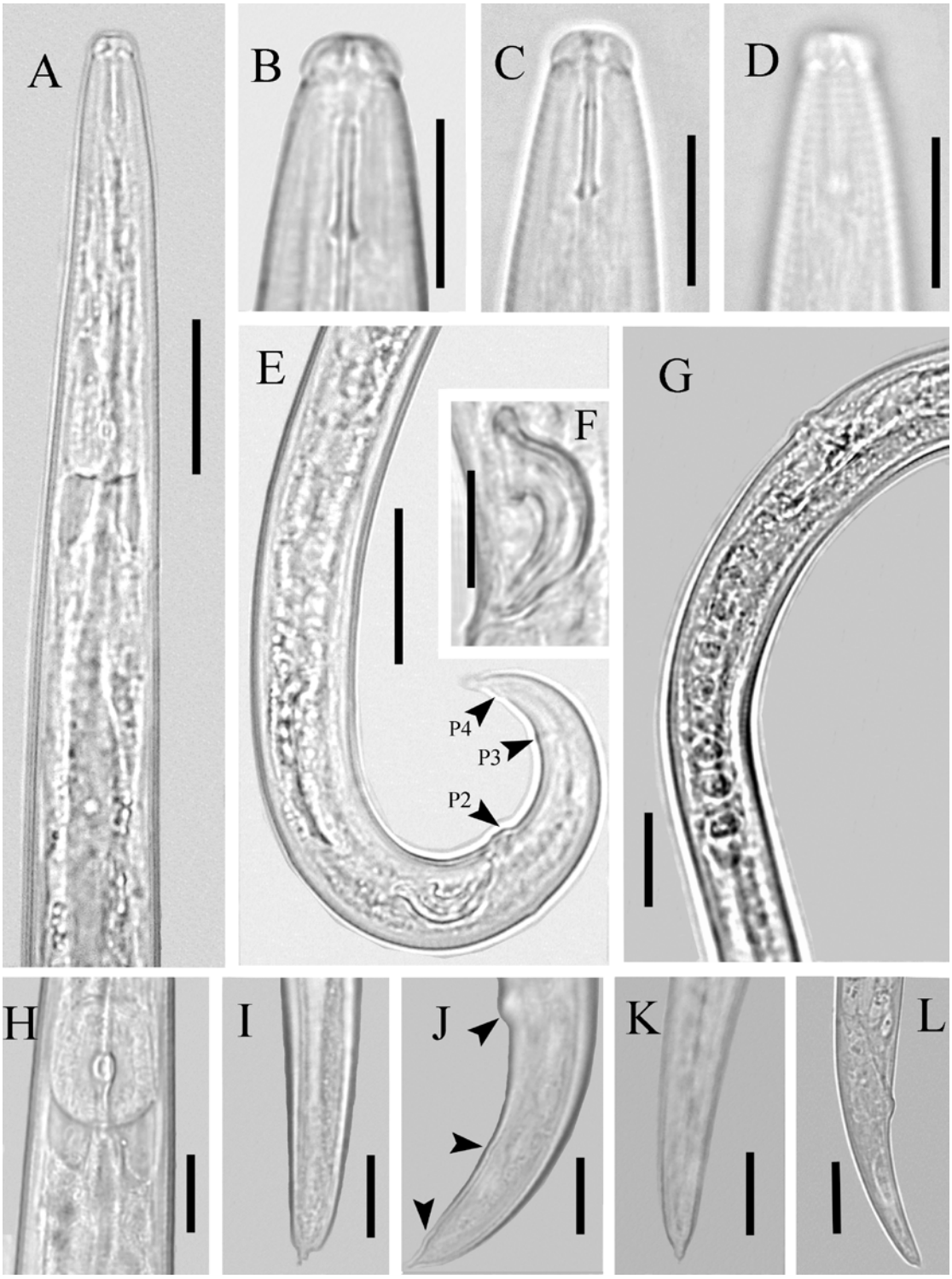

Figure 8 *Aphelenchoides saprophilus*. A: Female pharyngeal region; B-D: Anterior end; E, F & J: Posterior end of male showing spicules and caudal papillae arrangement (arrowheads); G: Vulva region; H: Metacorpus region; I, K & L: Various shapes of tail. (Scale bars 20 µm, except A, E & G 10 µm).

www.SID.ir

Table 5 Morphometric data of *Aphelenchoides saprophilus* and its comparison with type population.

Characters[1]	Fars province population		Franklin (1957)	
	Female	Male	Female	Male
n	10	5	20	20
L	586.4 ± 38.4 (526-643)	555 ± 30.6 (514-586)	546 (454-623)	545 (476-627)
a	35.5 ± 2.1 (32.8-38.1)	36.1 ± 202 (33.3-38.4)	30.4 ± 2.8 (25.5-34.7)	30 (27-34)
b	9.1 ± 0.5 (8.2-9.9)	8.3 ± 0.5 (7.6-8.7)	10.8 ± 1.2 (9-12.6)	9 (8-11)
b'	3.8 ± 0.2 (3.5-4.2)	3.8 ± 0.1 (3.7-3.9)	5.3 ± 0.8 (4-6.7)	-
c	14.7 ± 1.1 (12.6-16.2)	14.1 ± 0.8 (12.9-14.9)	24.7 ± 2.6 (21.5-28.4)	15 (13-18)
c'	4.2 ± 0.4 (3.8-4.8)	3.4 ± 0.1 (3.3-3.5)	2.2 ± 0.2 (1.9-2.5)	-
V or T (%)	66.1 ± 1.4 (64-68.1)	61.3 ± 2.9 (57.5-65.4)	69.5 ± 1.5 (67.3-71.3)	-
Stylet	11.3 ± 0.4 (11-12)	10.8 ± 0.4 (10-11)	11	12
m	45.8 ± 2.5 (41.7-50)	44.3 ± 2.4 (40-45.5)	-	-
End of glands	153.5 ± 10.3 (136-174)	146 ± 7.9 (138-158)	-	-
Overlapping	89 ± 7.8 (77-103)	79 ± 7.9 (70-90)	-	-
Median bulb	53.8 ± 2.3 (50-56)	56 ± 1.7 (55-59)	-	-
Pharynx	64.5 ± 3.4 (59-71)	67 ± 2 (65-70)	-	-
Anterior end to Nerve ring	66.8 ± 1.7 (65-70)	65.4 ± 1.3 (64-67)	-	-
Anterior end to Excretory pore	71.4 ± 3.1 (68-78)	70.2 ± 1.8 (68-73)	-	-
Body width	16.5 ± 0.5 (16-17)	15.4 ± 0.5 (15-16)	-	-
PUS length	73.8 ± 15.4 (57-99)	-	-	-
PUS/ BW	4.5 ± 0.9 (3.4-5.8)	-	-	-
PUS/ Vulva –anus (%)	47.2 ± 10.7 (33.5-62.7)	-	-	-
Vulva –anus distance	157.9 ± 17 (130-179)	-	-	-
Anal BW	9.6 ± 0.5 (9-10)	11.6 ± 0.5 (11-12)	-	-
Tail length	40 ± 1.9 (38-43)	39.4 ± 1.7 (38-42)	-	-
Spicule	-	23 ± 0.7 (22-24)	-	23

[1] All measurements are given in micrometer, except V, T and PUS which are in percent.

Reference

Andrássy, I. 2007. Free-living nematodes of Hungary II (Nematoda errantia). Pedozoologica Hungarica 5 (Serieseditors: Csuzdi, C. and Mahunka, S.). Budapest, Hungary, Hungarian Natural History Museum and Systematic Zoology Research Group of the Hungarian Academy of Sciences.

Bastian, H. C. 1865. Monograph on the Anguillulidae, or free nematoids, marine, land, and freshwater; with descriptions of 100 new species. Transactions of the Linnean Society of London, 25: 73-184.

Christie, J. R. 1932. Recent observations on the strawberry dwarf nematode in Massachusetts. Plant Disease Reporter, 16: 113-114.

Christie, J. R. 1942. A description of *Aphelenchoides besseyi* n. sp., the summer-dwarf nematode of strawberries, with comments on the identity of *Aphelenchoides subtenuis* (Cobb, 1926) and *Aphelenchoides hodsoni* Goodey, 1935. Proceedings of the

www.SID.ir

Helminthological Society of Washington, 9: 82-84.

De Grisse, A. T. 1969. Redescription ou modifications de quelques techniques utilisées dans l'étude des nematodes phytoparasitaires. *Mededelingen Rijksfakulteit Landbouwwetenschappen,* Gent, 34: 351-369.

Duncan, L. and Moens, M. 2013. Migratory Endoparasitic Nematodes. In: Perry, R. N. and Moens, M. (Eds.), Plant Nematology. 2nd Edition. CAB International, Wallingford, Oxfordshire, pp. 144-178.

Ebrahimei, N., Kheiri, A. and Pak-Nik, M. 2002. Some new records of plant parasitic nematodes from Iran. Proceedings of the 15th Iranian Plant Protection Congress. Kermanshah, Iran p. 390.

Esmaeili, M. Fang, Y., Li, H. and Heydari, R. 2016a. Description of *Aphelenchoides huntensis* sp. n. (Nematoda: Aphelenchoididae) isolated from *Pinus sylvestris* in western Iran. Nematology, 18: 357-366.

Esmaeili, M., Heydari, R., Ziaie, M. and Gu. F. 2016b. Molecular and Morphological Characterization of *Aphelenchoides fuchsi* sp. n. (Nematoda: Aphelenchoididae) isolated from*Pinus eldarica* in western Iran. Journal of Nematology, 48: 34-42.

Esmaeili, M., Heydari, R., Fang, Y. and Li, H. 2017a. Molecular and morphological characterisation of *Aphelenchoides paraxui* n. sp. (Nematoda: Aphelenchoididae) isolated from *Quercus brantii* in western Iran. European Journal of Plant Pathology (in press).

Esmaeili, M., Heydari, R., Golhasan, B. and Kanzaki, N. 2017b. *Aphelenchoides eldaricus* n. sp. (Nematoda: Aphelenchoididae) isolated from *Pinus eldarica* in western Iran. Nematology (in press).

Fisher, M. 1894. Uber eine Clematis -krankheit. Bericht aus dem Physiolischen Laboratorium des Landwirthschaftlichen, Instituts der Universitat Halle, 3 (11): 1-11.

Franklin, M. T. 1952. A disease of *Scabiosa caucasica* caused by the nematode *Aphelenchoides blastophthorus* n. sp. Annals of Applied Biology, 39: 54-60.

Franklin, M. T. 1957. *Aphelenchoides composticola* n. sp. and *A. saprophilus* n. sp. from Mushroom Compost and Rotting Plant Tissues. Nematologica, 2 (4): 306-313.

Franklin, M. T., and Siddiqi, M. R. 1963. *Aphelenchoides trivialis* n. sp. from South India. Nematologica, 9 (1): 15-18.

Ghaderi, R., Kashi, L. and Karegar, A. 2012. The Nematodes of Iran (Based on the Published Reports until 2011). Agricultural Education and Extension Publication, Tehran, Iran, 371 PP.

Golhasan, B., Heydari, R., Alvarez-Ortega, S., Esmaeili, M., Castillo, P. and Palomares–Rius, J. E. 2016. *Aphelenchoides iranicus* n. sp. (Nematoda: Aphelenchoididae) from West Azerbaijan province, Iran. Nematology, 18: 973-985.

Golhasan, B., Heydari, R., Esmaeili, M. and Miraeiz, E. 2017. Description of *Aphelenchoides macrospica* n. sp. (Nematoda: Aphelenchoididae) from Northwestern Iran. Nematology (in press).

Heyns, J. 1964. *Aphelenchoides helicus* n. sp. and *Ditylenchus equalis* n. sp., two new soil inhabiting nematodes. South African Journal of Agricultural Science, 7 (1): 147-150.

Hooper, D. J. 1958. *Aphelenchoides dactylocercus* n. sp. and *A. sacchari* n. sp. (Nematoda: Aphelenchoidea). Nematologica, 3 (3): 229-235.

Hooper, D. J., and Myers, R. F. 1971. *Aphelenchoides rutgersi* n. sp. (Nematoda: Aphelenchoidea), description and morphometrics, with observations on *A. dactylocercus* Hooper, 1958 and *A. cibolensis* Riffle, 1970. Nematologica, 17 (2): 295-302.

Hunt, D. J. 1993. Aphelenchida, Longidoridae and Trichodoridae: Their systematics and bionomics. CABI Publishing, Wallingford, UK, 352 pp.

Hunt, D. J. 2008. A checklist of the Aphelenchoidea (Nematoda: Tylenchina). Journal of Nematode Morphology and Systematics, 10: 99-135.

Archive of SID

www.SID.ir

Husain, S. I. and Khan, A. M. 1967. On the status of the genera of the superfamily Aphelenchoidea (Fuchs, 1937). Thorne, 1949 with the descriptions of six new species of nematodes from India. Proceedings of the Helminthological Society of Washington, 34: 167-174.

Kanzaki, N. and Giblin-Davis, R. 2012. Aphelenchoidea. In: Manzanilla-Lopez R. and Mendoza, N. (Eds.), Practical Plant Nematology. Biblioteca Básica de Agricultura, Guadalajara, México, pp. 161-208.

Miraeiz, E., Heydari, R. and Bert, W. 2017. *Aphelenchoides gorganensis* n. sp. (Nematoda: Aphelenchoididae), a new species from Iran. European Journal of Plant Pathology (in press).

Rashid, F., Geraert, E., and Sharma, R. D. 1986. *Seinura, Aphelenchoides* and *Aphelenchus* from Brazil (Nematoda: Aphelenchina). Biologisch Jaarboek Dodonaea, 54, 30-45.

Riffle, J. W. 1970. *Aphelenchoides cibolensis* (Nematoda: Aphelenchoididae), a new mycophagous nematode species. Proceedings of the Helminthological Society of Washington, 37 (1): 78-80.

Ritzema Bos, J. 1890. De bloemkoolziekte der aardbeien, veroorzaakt door *Aphelenchus fragariae* nov. spec. (Voorloopige mededeeling). Maanblad Natuurwetensch, 16: 107-117.

Sánchez-Monge, A., Flores, L., Salazar, L., Hockland, S. and Bert, W. 2015.An updated list of the plants associated with plant-parasitic *Aphelenchoides* (Nematoda: Aphelenchoididae) and its implications for plant-parasitism within this genus. Zootaxa, 4013 (2): 207-224.

Schwartz, M. 1911. Die Aphelenchen der Veilchengallen un Blattfelecken an Farnen un Chrusanthemum. Arbeiten aus der Kaiserlich Biologische Anstalt für Land- und Forstwirtschaft, 8: 303-334.

Shahina, F. 1996. A diagnostic compendium of the genus *Aphelenchoides* Fischer, 1894 (Nematoda: Aphelenchida) with some new records of the group from Pakistan. Pakistan Journal of Nematology, 14: 1-32.

Shavrov, G.N. 1967b. [Three new species of *Aphelenchoides* Fischer, 1894 (Nematoda: Aphelenchoididae).] Zoologichesky Zhurnal, 46: 762-764.

Steiner, G. and Buhrer, E. M. 1932. Miscellaneous notes on nemic diseases. Plant Disease Reporter, 16, 137.

Steiner, G. 1936. Opuscula miscellanea nematologica, IV. Proceedings of the Helminthological Society of Washington, 3: 74-80.

Thorne, G. and Malek, R. B. 1968. Nematodes of the Northern Great Plains. Part I. Tylenchida Nemata: Secernentea. Brookings, SD, USA, Agricultural Experimental Station Bulletin, 31.

Wang, X., Wang, P., Gu, J., Wang, J. and Li, H. 2013. Description of *Aphelenchoides xui* n. sp. (Nematoda: Aphelenchoididae) in packaging wood from South Africa. Nematology, 15: 279-289.

Wright, K. M. and Perr, R. N. 1991. Moulting of *Aphelenchoides hamatus*, with especial reference to formation of the stomatostylet. Revue de Nématologie, 14 (4): 497-504.

Archive of SID

www.SID.ir

توصیف چندگونه شناخته شده از جنس *Aphelenchoides* Fisher, 1984 (Nematoda: Aphelenchoididae) از ایران

یاسر عادل‌دوست، رامین حیدری*، محراب اسمعیلی و اسماعیل میرائیز

گروه گیاه‌پزشکی، پردیس کشاورزی و منابع طبیعی، دانشگاه تهران، کرج، ایران.

* پست الکترونیکی نویسنده مسئول مکاتبه: rheydari@ut.ac.ir

دریافت: ۵ اردیبهشت ۱۳۹۵؛ پذیرش: ۱۲ فروردین ۱۳۹۶

چکیده: ۱۲ گونه از جنس *Aphelenchoides* از مناطق مختلف شمال، جنوب و غرب ایران جمع‌آوری و براساس صفات ریخت‌سنجی و ریخت‌شناسی مورد شناسایی قرار گرفت. در میان گونه‌های شناخته شده با نام‌های *A.centralis*، *A. cibolensis*، *A. cyrtus*، *A. hamatus*، *A. helicus*، *A. huntensis*، *A. limberi*، *A. obtusicaudatus*، *A. saprophilus*، *A. sacchari*، *A. spicomucronatus*، *A. tuzeti*، سه گونه *A. cibolensis*، *A. hamatus* و *A. saprophillis* گزارش جدید برای فون نماتدهای ایران هستند. توصیف کامل، داده‌های ریخت‌سنجی، ترسیم‌ها و عکس‌های میکروسکوپ نوری برای این گونه‌ها ارائه شده است. هم‌چنین گونه *A. helicus* که قبلاً گزارش شده ولی توصیف نشده، در این‌جا شرح داده شده است.

واژگان کلیدی: اولین گزارش، شکل‌شناسی، ریخت‌سنجی

Archive of SID

www.SID.ir