*J. Agr. Sci. Tech. (2016) Vol. 18: 1953-1966*

# Description of Some Nematode Species of Tylenchidae, Associated with *Polianthes tuberosa* from Iran

M. Husseinvand[1], M. Abdollahi[1*], and A. Karegar[2]

## ABSTRACT

**In order to identify the plant parasitic nematodes associated with *Polianthes tuberosa* in Dezful Regions, Iran, 300 soil and root samples were collected from different parts of the region, during 2012-2014. The samples were washed and the nematodes were extracted by centrifugal flotation technique. The nematodes were fixed and transferred to glycerin, and then the permanent slides of the nematode specimen were prepared. After microscopic observation, the measurements (morphological and morphometrical characters) were made using a drawing tube attached to light microscope. In this study, 17 species belonging to nine genera of the family Tylenchidae were identified as: *Atetylenchus graminus, A. abulbosus, Basiria aberrans, B. tumida, Boleodorus thylactus, Filenchus elegantulus, F. sandneri, F. vulgaris, F. andrassyi, F. facultativus, Irantylenchus vicinus, Lelenchus leptosoma, Neopsilenchus magnidens, Psilenchus hilarulus, P. iranicus, P. vinciguerrae* and *Tylenchus capitatus*. Among them, *A. graminus, L. leptosome* and *T. capitatus,* are new reports and were first described in Iran. This is the first report of male of *A. graminus* in the world.**

**Keywords:** Atetylenchus graminus, Dezful, Lelenchus leptosoma, Tylenchus capitatus, Tuberose.

## INTRODUCTION

Tuberose, *Polianthes tuberosa* L., of the family Agavaceae, is a perennial plant, originated from Mexico (Edwards, 2006). It is one of the twenty species of the genus *Polianthes* L., which is widely cultivated in many tropical and subtropical countries including France, India, Italy, South Africa and North Carolina, USA, for the use as a perfumery plant (Sheela, 2008). There are two subgenera, *Polianthes* and *Bravoa,* in the genus. *Polianthes* subgenus *Polianthes* comprises twelve species including *P. tuberosa* (Castro-Castro *et al.,* 2015). Tuberose is one of the most important cut flowers in Iran which is grown in Markazi, Gilan, Mazandaran, Tehran and Khuzestan Provinces (Mortezaeinezhad and Etemadi, 2010). In Khuzestan, Dezful County has the highest hectarage with 6,196 hectares under tuberose cultivation. Bonvar, Gavmishabad, Jateh, Sanjar and Zavieh Moradi are the main cultivation areas of tuberose in Dezful (Anonymous, 2014).

Many biotic and abiotic disorders have affected tuberose (Chen and Chang, 1998; Mahinpoo *et al.,* 2013). Plant parasitic nematodes are one of the serious threats in commercial cultivation of tuberose. Little work has been done on nematode problems of tuberose. *Aphelenchoides besseyi* Christie, 1942; *Meloidogyne incognita* (Kofoid and White) Chitwood and *Rotylenchulus reniformis* Linford and Oliveira, 1940 have been reported as major agricultural pathogens and are known to attack tuberose and cause serious crop losses

[1] Department of Plant Protection, College of Agriculture, Yasouj University, Yasouj, Islamic Republic of Iran.
[*] Corresponding author; e-mail: abdollahi@yu.ac.ir
[2] Department of Plant Protection, College of Agriculture, Shiraz University, Shiraz, Islamic Republic of Iran.





[ DOR: 20.1001.1.16807073.2016.18.7.1.1 ]

(Holtzmann, 1968; Ganguly *et al.,* 1993; Khan and Pal, 2001; Chawla *et al.,* 2006; Cuc and Pilon, 2007).

In Iran, little work has been done on associated nematode. The only record is the occurrence of *Meloidogyne javanica* in Khuzestan Province (Khoie, 2008). The importance of plant parasitic nematodes of the family Tylenchidae Örley, 1880 in tuberose is unknown. Recently, Ghaemi *et al.* (2012), Atighi *et al.* (2013), Panahandeh *et al.* (2014 and 2015) and Mirbabaei Karani *et al*. (2015) have given morphological and morphometric data of some species of the family Tylenchidae in other plants. Considering the significance of tuberose in the region, the aim of this study was identification of plant parasitic nematodes fauna associated with tuberose root in Dezful County.

## MATERIALS AND METHODS

Soil samples were collected from Senjar (32° 22' 69.47" N, 48° 22' 43.42" E), Almahdi (32° 25' 03.25" N, 48° 32' 42.36" E), Mamili (32° 35' 68.35" N, 48° 37' 71.45" E), Segerion (32° 39' 04.41" N, 48° 44' 89.58" E), Zavieh Moradi (32° 18' 40.49" N, 48° 17' 15.56" E) and Kohnak (32° 13' 13.49" N, 48° 38' 35.32" E), Dezful County, Khuzestan Province, Iran. After labeling, samples were transported to the laboratory and stored at 5–10°C until the nematodes were extracted by using the tray method (Whitehead and Hemming, 1965). The collected nematodes were heat killed by hot solution of FGA (4:1:1; Formaldehyde: Glycerin: Acetic acid), and mounted on the glass slides in a drop of glycerin using the De Grisse method (De Grisse, 1969). Photomicrographs were taken with a USB AM7023 Dino-Eye digital camera coupled to an Olympus BX31 compound light microscope, and the nematode drawings were made with the aid of a drawing tube attached to the microscope. Measurements were taken using Dino-Lite Pro software. Identification was done using the most updated key of the family Tylenchidae (Geraert, 2008).

## RESULTS

In this study, 17 species from nine genera were identified as: *Atetylenchus graminus* (Bajaj, Kaushik and Bhatti, 1982) Siddiqi, 1986*, A. abulbosus* (Thorne, 1949) Khan, 1973*, Basiria aberrans* (Thorne, 1949) Siddiqi, 1963*, B. tumida* (Colbran, 1960) Geraert, 1968*, Boleodorus thylactus* Thorne, 1941*, Filenchus elegantulus* Raski and Geraert, 1987*, F. sandneri* (Wasilewska, 1965) Raski and Geraert, 1987*, F. vulgaris* (Brzeski, 1963) Lownsbery and Lownsbery, 1985*, F. andrassyi* (Szczygiel, 1969) Andrássy, 1979*, F. facultativus* (Szczygiel, 1970) Raski and Geraert, 1987*, Irantylenchus vicinus* (Szczygiel, 1970) Brzeski and Sauer, 1983*, Lelenchus leptosoma* (de Man, 1880) Andrássy, 1954*, Neopsilenchus magnidens* (Thorne, 1949) Thorne and Malek, 1968*, Psilenchus hilarulus* de Man, 1921*, P. iranicus* Kheiri, 1970*, P. vinciguerrae* Brzeski, 1991 and *Tylenchus capitatus* Andrássy, 1979. Among them, *A. graminus, L. leptosoma* and *T. capitatus* are new reports and were first described in Iran. These three species were described as below.

***Tylenchus capitatus*** Andrássy, 1979
(Figures 1 and 2; Table 1)

### Females

Medium size body, vermiform, ventrally curved and C-formed to coil after fixation [Figure 2, (A-C)]. Cuticle finely striated, striations 1.5–1.9 µm at mid-body. Lateral fields 5.0–7.9 µm, about 22–32% of body width, with four lines and three bands [Figure 2, (G-I)]. Head flattened and continuous with body contour, 2.4–3.6 µm high and 7.0–8.0 µm wide, with 4–5 annules [Figure 2, (D-F)]. Cephalic framework weakly sclerotized, amphidial aperture starts from the head apex, in some specimens from





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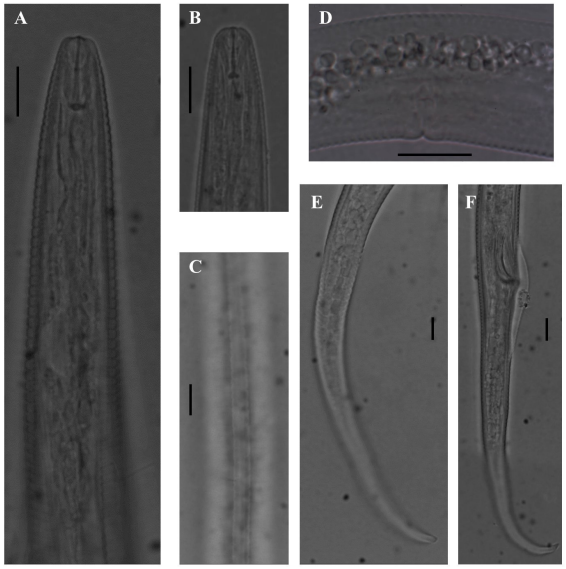


**Figure 1**. Light micrographs of *Tylenchus capitatus* Andrássy, 1979: Female (A-E), Male (F). (A) Anterior region; (B) Head region; (C) Lateral field showing areolation; (D) Vulval region showing post-vulval uterine sac; (E) Tail region, and (F) Tail region showing bursa and tail tip (Scale bars: A- F= 10 µm).

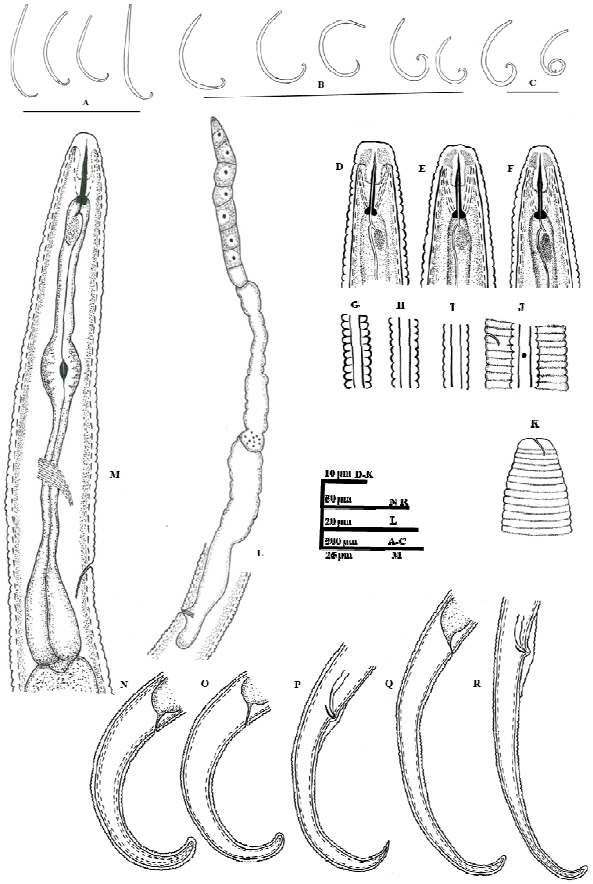


**Figure 2**. Morphology of *Tylenchus capitatus* Andrássy, 1979: Female (A-O and Q), Male (P and R). (A-C) Variation in general body shape; (D-F) Variation in head shape; (G-I) Variation in lateral field; (J) Secretory-excretory pore and deirid; (K) Amphid; (L) Reproductive tract; (M) Anterior region, and (N-R) Variation in tail.





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**Table 1.** Morphometric data of *Tylenchus capitatus* Andrássy, 1979 from Iran (measurements in µm).

| Characters | *Tylenchus capitatus* | | | *T. elegans* | |
|---|---|---|---|---|---|
| | Dezful Region Mean±*sd* (Range) | | Andrássy (1979) | Mirbabaei Karani *et al*. (2015) | |
| | Female | Male | Female | Female | Male |
| n | 26 | 11 | ? | 12 | 9 |
| L | 813 ± 8.0 (675-940) | 748 ± 55 (619-805) | 830 | 775 ± 43 (707-840) | 754 ± 73 (617-860) |
| a | 32.7 ± 9.8 (27.0-39.0) | 39.0 ± 11.0 (33.2-48.0) | 41.0 | 27.8 ± 1.9 (25.1-31.9) | 30.1 ± 2.4 (26.9-34.6) |
| b | 6.3 ± 5.5 (5.5-7.1) | 5.9 ± 0.4 (5.2-6.5) | - | 5.9 ± 0.4 (4.9-6.4) | 5.6 ± 0.4 (5.0-6.2) |
| c | 6.5 ± 11.1 (5.4-8.1) | 6.1 ± 0.5 (5.6-7.2) | 7.9 | 7.6 ± 0.7 (6.6-8.6) | 7.3 ± 0.5 (6.7-8.1) |
| c' | 8.1 ± 16.8 (5.4-10.7) | 7.9 ± 9.7 (6.2-9.0) | 8.5 | 6.2 ± 0.7 (5.4-7.5) | 6.2 ± 0.6 (4.9-6.8) |
| V | 65.0 ±2.8 (62.0-68.0) | - | 66 | 68.9 ± 2.4 (64.1-74.1) | - |
| V' | 77.0 ± 2.0 (74.0-81.0) | - | - | 79.5 ± 2.3 (75.6-85.6) | - |
| T | - | 39 ± 15.0 (31-48) | - | - | - |
| Stylet | 14.2 ± 6.3 (13.0-15.7) | 13.6 ± 6.3 (12.5-15.8) | 14.0 | 15.3 ± 0.9 (14.2-17.0) | 15.0 ± 1.0 (12.7-16.3) |
| m | 45.0 ± 5.9 (41.0-50.0) | 45.0 ± 4.8 (43.0-49.0) | - | 50.7 ± 5.1 (43.9-60.2) | 49.7 ± 3.5 (45.7-56.4) |
| Esophagus | 129 ± 8.6 (114-151) | 127 ± 5.4 (119-142) | 126 | 132 ± 8.1 (115-143) | 134 ± 7.7 (124-150) |
| MB | 45.0 ± 3.3 (41.0-47.5) | 44.0 ± 4.2 (41.0-46.0) | - | 58.5 ± 2.9 (53.5-62.4) | 61.7 ± 3.7 (56.5-67.5) |
| SE pore | 107.5 ± 7.7 (88-127) | 101 ± 8.5 (84-110) | 45 | 118 ± 7.6 (104-129) | 119 ± 7.9 (105-130) |
| Nerve ring | 86 ± 6.0 (73-94) | 82 ± 7.5 (72-92) | - | - | - |
| Deirid | 111 ± 9.3 (87-128) | 108 ± 7.2 (94-115) | - | - | - |
| H-V | 527 ± 7.6 (450-604) | - | - | 534 ± 31 (455-569) | - |
| H-A | 686 ± 8.2 (527-791) | 625 ± 44 (512-670) | - | 672 ± 38 (602-715) | 651 ± 59 (541-733) |
| Tail/V-A | 0.8 ± 14.3 (0.1-0.6) | - | - | - | - |
| Annulus width | 1.6 ± 11.3(1.2-1.9) | 1.5 ± 0.2 (1.3-1.7) | 1.6 | - | - |
| Tail length | 127 ± 13 (97-157) | 123 ± 14.2 (99-140) | 105 | 103 ± 11.6 (89-124) | 105 ± 15.8 (76-127) |
| Spicule | - | 21.7 ± 8.2 (18.5-24) | 21-23 | - | 23.2 ± 1.9 (20.4-27.5) |
| Gubernaculum | - | 6.3 ± 0.7 (5.5-8.2) | 6.0 | - | 6.7 ± 1.5 (4.9-9.0) |
| Bursa | - | 36 ± 7.0 (25-48) | 36-42 | - | - |
| Body Width | 25.0 ± 7.6 (21.0-28.0) | 19.6 ± 2.5 (16.0-24.0) | - | 28.0 ± 2.7 (23.8-32.1) | 25.1 ± 2.3 (20.6-27.6) |
| Vulva body width | 22.6 ± 2.0 (18.5-27.4) | - | - | - | - |
| Anal body width | 15.8 ± 11.4 (13-19.5) | 13.7 ± 3.2 (9-17) | - | 16.8 ± 1.3 (14.4-18.8) | 16.7 ± 1.5 (14.7-19.3) |

near the oral opening (Figure 2-K). Stylet delicate with conus about 41–50% of total length, with small knobs (2.6–3.7 µm wide) [Figure 2, (D-F)]. Dorsal esophageal gland orifice at 1.3–2.0 µm of stylet base. Procorpus cylindrical, same length as isthmus; median bulb developed and muscular, located at first half of the esophagus, 7.6–10.4 µm in width, with distinct cuticular thickenings; isthmus slender, nerve ring at mid-isthmus (Figure 2-M). Excretory pore at the level of basal bulb or just anterior, with internal cuticularised opening (Figure 2-J). Terminal bulb pyriform, 18–36 µm long and 9–13 µm diameter, abutting intestine; nucleus of dorsal gland conspicuous, at about mid-basal bulb and the level of ventral glands. Cardia conspicuous, short and triangular (Figure 2-M). Hemizonid 1–4 µm anterior to excretory pore. Deirids 5 µm anterior to 5 µm posterior to excretory pore. Ovary outstretched; oocytes in a single row; spermatheca round, with small, rounded sperm. Vagina 5.3–8.7 µm, perpendicular to body axis and 20%–40% of vulval body diameter; vulva with a transverse slit, without lateral membranes (Figure 2-L). Tail conoid, hook-shaped, annulated along most of its length to a rounded terminus [Figure 2, (N, O and Q)]; phasmid not observed.

**Males**

In general they are similar to females; spicules arcuate ventrally; gubernaculum simple; bursa adanal, extending the same length as spicules both anterior and posterior to cloacal aperture [Figure 2, (P and R)].

**Habitat and Locality**

The population studied has been found around the rhizosphere of *P. tuberosa* in Dezful County, Iran.

***Atetylenchus graminus*** (Bajaj, Kaushik and Bhatti, 1982) Siddiqi, 1986

(Figures 3 and 4; Table 2)

**Females**

Medium size body, vermiform, straight to slightly ventrally curved on relaxation (Figure 4-A). Cuticle finely striated, striations 1.2–1.3 µm at mid-body. Lateral field 4.7–4.9 µm, about 22%–23% of body width with four lines and three bands. Head flattened and continuous with body contour, 3.4–3.9 µm high and 6.4–7.0 µm wide, with 3–4 annules [Figure 4, (B-D)]. Cephalic framework weakly sclerotized, amphidial aperture inconspicuous, in some specimens near the lips (Figure 4-E). Stylet delicate with conus about one third of total length, without knobs. Dorsal esophageal gland orifice at 6.2–9.0 µm of stylet base. Procorpus cylindrical, shorter than isthmus; median bulb developed and oval with conspicuous valve, located at first half of the esophagus, 9.0–9.8 µm in width; isthmus slender, nerve ring located at mid-isthmus (Figure 4-F). Excretory pore at the level of isthmus or just anterior to basal bulb, with internal cuticularised opening. Terminal bulb medium to large, cylindroid, 22–30 µm long and 9.9–14 µm diameter, abutting intestine; nucleus of dorsal gland conspicuous, at about mid-basal bulb and the level of ventral glands. Cardia conspicuous and almost triangular. Hemizonid 2–3 µm anterior to excretory pore. Deirids at the level of or posterior to the excretory pore. Didelphic, amphidelphic; ovaries outstretched, oocytes in rows, spermatheca elongated and axial, with rounded sperm. Vagina 6.3–7.7 µm, perpendicular to body axis and 30–50% of vulval body diameter; vulva with a transverse slit, without lateral membranes (Figure 4-G). Tail short to long, conoid, straight or slightly ventrally curved, tapering to a beak-shaped tip with a rounded terminus. Tail annulated along most of its length, but the annuli disappear or are less distinct at the tail tip; phasmid located at one third (in individuals with long tail) to mid (in individuals with short tail) of the tail [Figure 4, (H and J)].





[ DOR: 20.1001.1.16807073.2016.18.7.1.1 ]

**Table 2.** Morphometric data of *Atetylenchus graminus* (Bajaj, Kaushik and Bhatti, 1982) Siddiqi, 1986 from Iran (measurements in µm).

| Characters | Present study | | | Bajaj *et al.* (1982) |
|---|---|---|---|---|
| | Dezful Region Mean±*sd* (Range) | | Boyer-Ahmad Region | |
| | Female | Male | Female | Female |
| n | 4 | 1 | 2 | ? |
| L | 700 ± 65.7 (643-794) | 606 | 751,786 | 810-1070 |
| Lip diameter | 6.6 ± 0.3 (6.4-7.0) | 6.0 | 6.5,7.0 | - |
| Lip height | 3.6 ± 0.2 (3.4-3.9) | 3.5 | 3.5,3.7 | - |
| a | 35.0 ± 2.0 (33.0-37.0) | 38.6 | 36.0,37.0 | 32.0-41.0 |
| b | 5.7 ± 0.7 (5.1-6.6) | 5.5 | 6.1,7.1 | - |
| c | 7.7 ± 2.0 (6.4-10.7) | 9.2 | 10.6,11.4 | 11.0-13.0 |
| c' | 7.0 ± 1.5 (5.5-8.8) | 4.9 | 5.3,5.7 | 4.4-5.6 |
| V | 53 ± 2.8 (50-56) | - | 52,55 | 45-51 |
| V' | 61.5 ± 2.0 (59-64) | - | 57,61 | - |
| T | - | 34 | - | - |
| St | 10.8 ± 0.6 (10.2-11.4) | 10.8 | 11,11.5 | 13 |
| m | 31 ± 1.9 (29-34) | 31 | 29,36 | - |
| DGO | 7.3 ± 1.2 (6.2-9.0) | 5.8 | 4.0,7.5 | - |
| St+DGO | 18 ± 1.5 (16.6-20) | 16.6 | 15.5,18.5 | - |
| Esophagus | 123 ± 6.7 (118-133) | 111 | 106,127 | 120 |
| MB | 42 ± 3.2 (38-45) | 42 | 40,46 | 43-45 |
| Median bulb width | 9.5 ± 0.4 (9.0-9.8) | 8.0 | 9.0,10 | - |
| SE pore | 91.5 ± 11.6 (75-102) | 84 | 68,107 | - |
| Nerve ring | 83 ± 6.2 (78-92) | 74 | 58,87 | - |
| Deirid | 96 ± 10.4 (83-108) | 78 | 72,104 | - |
| Width of basal bulb | 12 ± 2.1 (9.9-14) | 9.0 | 11,13 | - |
| Length of basal bulb | 26 ± 3.9 (22-30) | 23 | 27,32 | - |
| H-V | 371 ± 21.4 (350-397) | - | 408,415 | - |
| H-A | 604 ± 50.6 (547-669) | 537 | 685,712 | - |
| Tail/V-A | 0.4 ± 0.1 (0.3-0.5) | - | 0.2 | - |
| Annulus width | 1.2 ± 0.1 (1.2-1.3) | 1.0 | 1.1,1.2 | - |
| Tail length | 96 ± 25.4 (63-125) | 66 | 66,74 | 75 |
| Spicule | - | 15 | - | - |
| Gubernaculum | - | 6.0 | - | - |
| Bursa | - | 25 | - | - |
| Body Width | 20 ± 1.6 (18-22) | 15.7 | 20,22 | - |
| Anal body width | 13.5 ± 1.7 (11.5-15) | 13.4 | 11.5,14 | - |
| Vagina/VBW | 0.4 ± 0.1 (0.3-0.5) | - | 0.5 | - |
| Phasmid | 41 ± 15.8 (22-61) | 23 | 21,25 | - |
| Phasmid/Tail % | 43 ± 14.2 (32-63) | 35 | 32,34 | - |
| Lateral field/BW% | 23 ± 0.6 (22.5-23.5) | 25.5 | 25 | - |

### Males

They are in general similar to females, but have a shorter and broader tail with a rounded tip; spicules arcuate ventrally; gubernaculum simple; bursa adanal, extending same length as spicules, both anterior and posterior to cloacal aperture; cloacal opening with hypoptygmata (Figure 4-I).

### Habitat and Locality

The population studied has been found around the rhizosphere of *P. tuberosa* and





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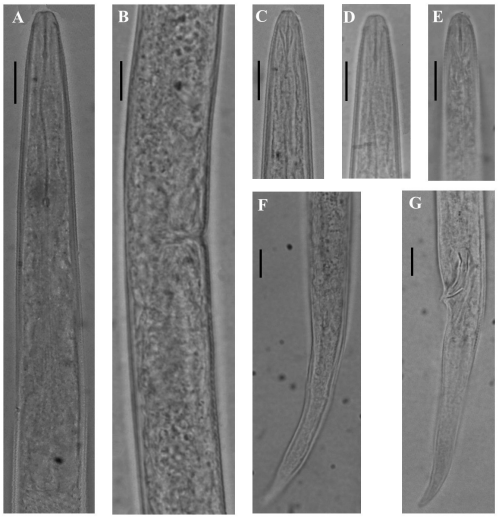


**Figure 3**. Light micrographs of *Atetylenchus graminus* (Bajaj, Kaushik and Bhatti, 1982) Siddiqi, 1986: Female (A-F), Male (G). (A) Anterior region; (B) Vulval region showing reproductive tract; (C-E) Head region showing variation; (F) Tail region showing tail tip, and (G) Tail region showing tail tip (Scale bars: A-G= 10 µm).

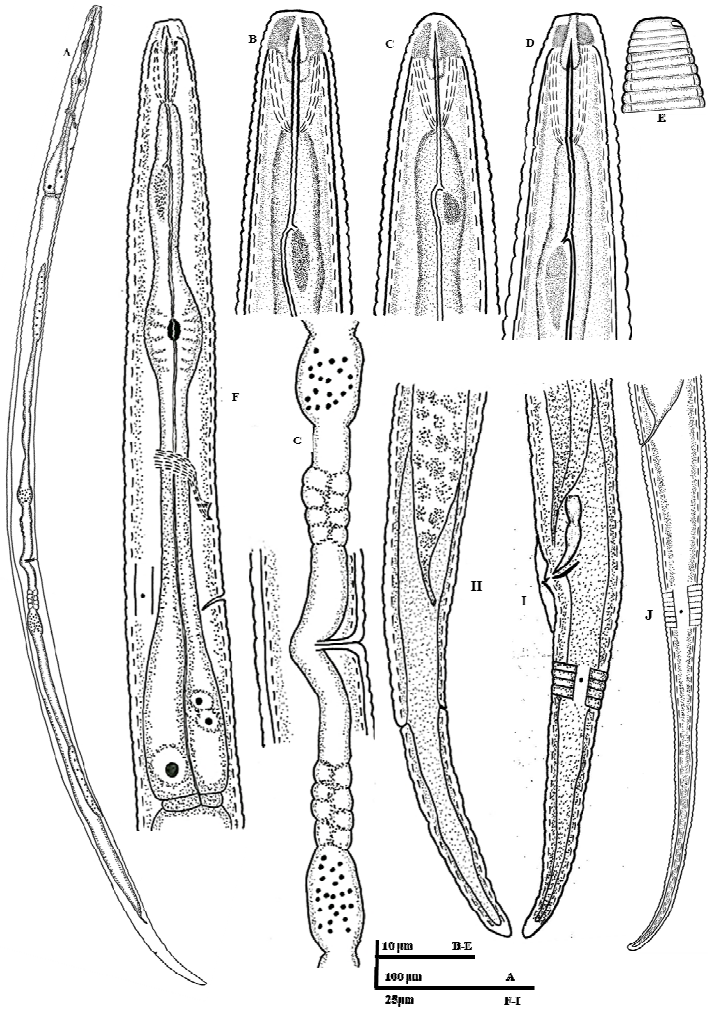


**Figure 4.** Morphology of Dezful population of *Atetylenchus graminus* (Bajaj, Kaushik and Bhatti, 1982) Siddiqi, 1986: Female (A-H), Male (I). (A) General body shape; (B-D) Variation in anterior region, head and stylet shape; (E) Amphid (F) Esophageal region; (G) Female reproductive tract; (H and J) Variation in tail, and (I) Posterior region.





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*Pistacia atlantica* in Dezful and Boyer-Ahmad Regions, respectively.

***Lelenchus leptosoma* (De Man, 1880) Andrássy, 1954**

(Figures 5 and 6; Table 3)

**Females**

Slender Body, vermiform, straight to slightly ventrally curved on relaxation (Figure 6-A). Cuticle finely striated, striations 1.4–2.0 µm at mid-body. There is no longitudinal groove in the lateral field. Head dorsoventrally flattened and continuous with body contour, 1.4–2.6 µm high and 3.4–4.4 µm wide; cephalic framework weakly sclerotized. Long slit amphidial apertures with capacious pouch like pockets starting from near the oral opening and extend to cephalic framework [Figure 6, (C-E)]. Stylet delicate with conspicuous knobs, conus about one third of total length. Dorsal esophageal gland orifice at 0.9–2.0 µm of stylet base. Procorpus cylindrical, shorter than isthmus; median bulb not developed and spindle-shaped with conspicuous valve, located at first half of the esophagus, 2.8–4.4 µm in width; isthmus long and slender, nerve ring at mid-isthmus, 55-62 µm from anterior end (Figure 6-F). Excretory pore at second half of isthmus, anterior to basal bulb, with internal cuticularised opening. Terminal bulb pyriform, 12.5–16 µm long and 3.8–6 µm diameter, abutting intestine; nucleus of dorsal gland inconspicuous, cardia inconspicuous. Hemizonid at the level of or up to 3 µm anterior to excretory pore, 63-72 µm from anterior end. Deirid not seen. Monodelphic, prodelphic; ovaries short and outstretched, oocytes in a single row, spermatheca axial, full of rounded sperm. Short vulval flaps; vagina 2.5–4 µm and 20–

**Table 3.** Morphometric data of *Lelenchus leptosoma* (de Man, 1880) Andrássy, 1954 from Iran (measurements in µm).

| | Dezful Region Mean±*sd* (Range) | | Geraert (2008) |
|---|---|---|---|
| Characters | Female | Male | Female/Male |
| n | 15 | 9 | ? |
| L | 571 ± 16 (537-605) | 555 ± 27 (524-603) | 470-780 |
| a | 54.0 ± 4.1 (47.5-61.7) | 59.0 ± 5.6 (49.0-68.0) | 44.0-67.0 |
| b | 6.4 ± 0.3 (5.7-6.9) | 6.1 ± 0.4 (5.7-7.1) | - |
| c | 3.2 ± 0.1 (2.9-3.4) | 3.1 ± 0.1 (2.9-3.2) | 1.8-3.3 |
| c' | 25.0 ± 2.5 (22.0-28.0) | 22.6 ± 1.8 (20.5-25.5) | 23.0-41.0 |
| V | 52 ± 1.1 (51-54) | - | 47-53 |
| V' | 76.5 ± 1.7 (74-79) | - | 72-79 |
| T | - | 21 ± 2.9 (17-24) | - |
| St | 7.4 ± 0.2 (6.9-7.7) | 7.4 ± 0.2 (7.1-7.5) | 7.0-11 |
| m | 32.3 ± 2.5 (27-37) | 33 ± 2.4 (31-37) | - |
| Oeso | 90 ± 3.6 (84-95) | 91 ± 3.6 (85-96) | 92-133 |
| MB | 47 ± 2.7 (42-51) | 48 ± 3.9 (44-55) | 38-46 |
| SE pore | 68 ± 2.4 (64-73) | 66 ± 5.7 (57-75) | - |
| H-V | 299 ±9.7 (278-312) | - | - |
| H-A | 391 ± 10.3 (373-408) | 375 ± 16 (348-399) | - |
| Tail/V-A | 2.0 ± 0.2 (1.6-2.5) | - | - |
| Tail length | 180 ± 11.3 (164-203) | 180 ± 13 (162-204) | 145-278 |
| Spicule | - | 13.6 ± 0.5 (12.3-14) | 14-16 |
| Gubernaculum | - | 3.5 ± 0.5 (3.0-4.4) | 3.0-4.0 |
| Bursa | - | 15 ± 2.0 (12-20) | - |
| Body Width | 10.7 ± 0.6 (9.8-11.5) | 9.5 ± 0.9 (8.2-11) | - |
| Anal body width | 7.2 ± 0.4 (6.6-8.1) | 8.0 ± 0.3 (7.6-8.4) | - |





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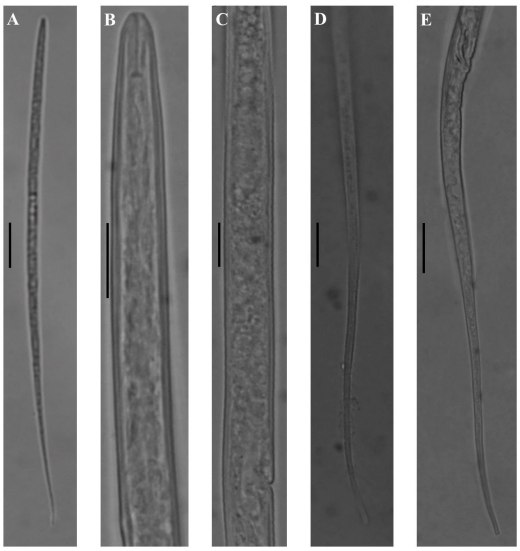


**Figure 5**. Light micrographs of *Lelenchus leptosoma* (de Man, 1880) Andrássy, 1954: Female (A-D), Male (E). (A) Whole body; (B) Anterior region; (C) Vulval region showing reproductive tract; (C) Tail tip, and (D) Tail region showing tail tip (Scale bars: A= 50 µm, B and C= 10 µm, D and E= 20 µm).

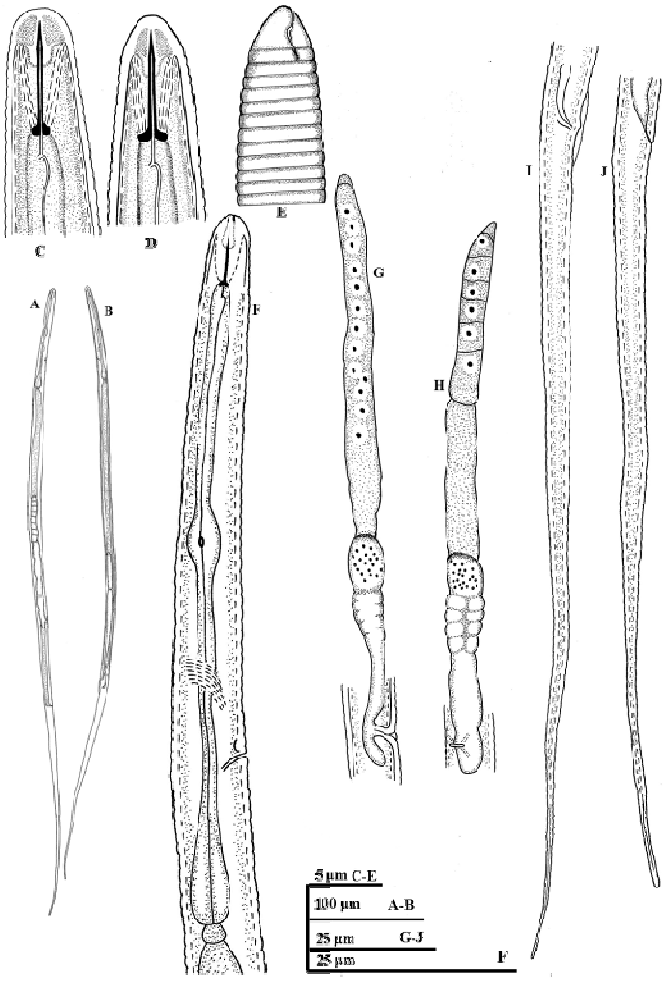


**Figure 6.** Morphology of Iranian population of *Lelenchus leptosoma* (De Man, 1880) Andrássy, 1954: Female (A, C-H and J), Male (B and I). (A and B) General body shape; (C) Dorsoventral view of head; (D) Lateral view of head; (E) Amphid; (F) Esophageal region; (G and H) Reproductive tract, and (I and J) Posterior region.





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40% of vulval body diameter, anteriorly directed; short post vulva uterine sac 4.3-7.9 µm long [Figure 6, (G and H)]. Tail very long and filiform, not annulated on the last one fifth, with a rounded terminus. (Figure 6- J).

### Males

In general similar to females; spicules arcuate ventrally; gubernaculum simple; bursa adanal, extending half-length of spicules, both anterior and posterior to cloacal aperture (Figure 6-I).

### Habitat and Locality

The population studied has been found around the rhizosphere of *Cynodon dactylon* in Dezful County.

## DISCUSSION

Bastian (1865) erected and placed the genus *Tylenchus* in family Anguillulidae Gervais and Van Beneden (1859) and described six plant parasitic and free-living species without a designated type-species. De Man (1876) placed the genera *Aphelenchus*, *Tylopharynx* and *Tylencholaimus* in Tylolaimidae. Orley (1880) proposed the family Tylenchidae, including the genera *Aphelenchus* and *Tylopharynx*. Filipjev (1934; 1936) separated out the genera *Anguillulina* and *Tylenchus,* the latter includes 22 species and *T. davainei* (Bastian, 1865), as the type species. He also moved out the genera *Ditylenchus*, *Tetylenchus*, *Rotylenchus* and *Pratylenchus* from *Tylenchus*. Andrássy (1954) designated four subgenera *Aglenchus*, *Filenchus*, *Lelenchus* and *Tylenchus* in the genus *Tylenchus*. Considering dorsolateral flattened head, rounded lip region, sac-like amphidial pouch, larger "a" ratio, and having a vulval flap, Geraert (2008) transferred the genus *Lelenchus* to subfamily Ecphyadophorinae.

Siddiqi (1959) has erected the genus *Basiria* which includes the nematodes with a single reproductive tract, post labial amphidial apertures that start from behind of the base of the lateral lips; a slender stylet with rounded knobs and a shorter conus than shaft; dorsal esophageal gland orifice at more than half a stylet length behind stylet base; bursa adanal and tail filiform. Khan (1973) and Sher (1974) proposed the genera *Leipotylenchus* and *Atetylenchus* for the same species, thus both of the species have been synonymized. *Atetylenchus* has been differentiated from *Psilenchus* by possessing low, flat lip region and absence of slit-like amphidia1 apertures on the lip region. The position of the median bulb is also different in *Atetylenchus* and *Psilenchus*, it is slightly anterior to the middle in *A. abulbosus* while distinctly behind the middle in *Psilenchus* (Sher, 1974). Siddiqi (1986) and Raski and Geraert (1987) put the species *P. graminus* and *Leipotylenchus amiri* to the genus *Atetylenchus*, respectively. Andrássy (2007) also transferred *P. intermedius*, *P. klingleri* and *P. terextremus* to this genus.

### *Tylenchus capitatus*

Based on the morphological and morphometric characters and compared to the identification key (Geraert, 2008), the population was identified as *T. capitatus*. The species is similar to *T. elegans*, but it can be separated in having a broader head, a smaller central band of lateral field as compared to the marginal bands, a weaker median bulb, and a conoid tail with broadly rounded tail tip. In the studied population, the smallest value of the range of "a" ratio is smaller and the largest value of the range of tail length is larger than the population reported by Andrássy (1979), which may be due to host or climatic condition differences. The range of stylet and spicules length in the studied population was wider, which can be considered as intraspecific variation.





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Brzeski (1996) synonymized *T. capitatus* with *T. elegans*, but it was not accepted by Siddiqi (2000) and Andrássy (2007). In the present study, 120 individuals have been studied. Based on our study, it seems that the characters which are currently used for separation of *T. capitatus* from *T. elegans* [wide labial region, narrower central band on lateral field (*vs*. the wider central band in *T. elegans*), weaker median bulb, and the shape of tail terminus in *T. capitatus*], are not strong. We observed a broad range of variation in body shape (slightly curved to spiral), head width (narrow to broad), width of central band of lateral field as compared to the marginal bands, areolation of the lateral fields along the whole of body (Figure 1-C) and tail shape. Body shape of 58% of the studied nematodes was slightly curved (Figure 2-A), 39% were C-shaped or semicircular (Figure 2-B) and 3% were spiral (Figure 2-C). Head width was equal in both base and apex in 40% of the studied population (Figure 2-D), as it has drawn for *T. capitatus,* by Andrássy (1979), whereas in 49% head was rounded trapezoid (Figure 2-E) and in 9% of the population, head width in apex was less than the base (Figure 2-F).

Variable extension of transverse striae to lateral field has been observed, along with short extension in 48% of studied individuals (Figure 2-I), average length of extension in 48% (Figure 2-H) and areolation in 2% of the population (Figure 2-G). The width of three bands of lateral field was equal in 72% of cases and the central band was wider than the marginal bands in 28% of the population. In the current study, various tail shape has been observed. Twenty percent of individuals had a conoid tail with a pointed tip (Figure 2, P). Tail tip in 70% was finely rounded [Figure 2, (Q and R)], and in 10% was broadly rounded [Figure 2, (N and O)]. Based on our observations as well as the comparisons with the morphological and morphometrical data on Iranian population of *T. elegans* (Table 1) (Mirbabaei Karani *et al*., 2015), synonymization of *T. capitatus* with *T. elegans* can be approved. *T. capitatus* was first described by Andrássy (1979) from Antibes, France and in Iran it has been isolated from the rhizosphere of *P. tuberosa* in Dezful Regions, Iran and described.

### *Atetylenchus Graminus*

Based on the morphological and morphometric characters and compared to the identification key (Erum and Shahina, 2008; Geraert, 2008), the population was identified as *A. graminus*. The species is similar to *A. abulbosus*, but the body is shorter than 1mm in *A. graminus* and longer than 1mm in *A. abulbosus*. *A. graminus* may be separated from *A. abulbosus* by numbers of head annuli (four annuli *vs.* six annuli in *A. abulbosus*). Last tail annuli in *A. graminus* are very fine to indistinct, but in *A. abulbosus* are wider than the annules of beginning of the tail and mid-body. According to Table 2, maximum body length of Iranian population is lesser than the minimum body length of Indian population. Besides this difference, in Dezful population, "V", "c" and "c'" ratios are greater than that of the Indian population. These differences can be considered as intraspecific variation or some mistakes in measuring the Indian population, as compared to the population studied by Bajaj *et al.* (1982). MB% and stylet length of Iranian population is lesser than the Indian population, but the range of DGO in Dezful population is broader. In Iranian population the "V" ratio is broad, therefore it is not a good character for separation of *A. graminus* from *A. abulbosus*. Male has not been found in Indian population and the spermatheca of female individuals had no sperm, but we found a male in Dezful population and spermatheca in females of this population was full of rounded sperms. *A. graminus* was first described by Bajaj *et al.* (1982) as *Psilenchus graminus* from Haryana, India, but after examining a type specimen, Siddiqi (1986) transferred that to the genus *Atetylenchus*, as *A. graminus*. The species has been reported only from India.





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In Iran, it has been isolated from the rhizosphere of *P. tuberosa* and *Pistacia atlantica* in Dezful and Boyer-Ahmad Counties, respectively and described. This is the first report of male *A. graminus* in the world.

### *Lelenchus Leptosoma*

Based on the morphological and morphometric characters and compared to the identification key (Geraert, 2008), the population was identified as *L. leptosoma*. The species which has no groove in lateral sides can easily separate from *L. filicaudatus* and *L. schmitti* with two and four longitudinal striae, respectively. The morphometric of Dezful population fit well with the description of Raski and Geraert (1986), but they differ in body striation (deeper *vs* smooth), esophagus length (82–95 *vs.* 92–113 µm), spicule (12.3–14 *vs.* 14–16 µm) and MB% (42–51 *vs.* 38–46%). In Iran, the species has been isolated from the rhizosphere of *Cynodon dactylon* in Dezful County and reported by Houseinvand *et al.* (2014). It was the first report of the genus *Lelenchus* from Iran, as well.

## ACKNOWLEDGEMENTS

The research was supported by Research and Technology office and Post Graduate office of Yasouj University, Yasouj, Iran. The authors thank them for their valuable assistance.

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## توصیف چند گونه نماتد از خانواده Tylenchidae، همراه با ریشه گل مریم، *Polianthes tuberosa*، از ایران

**م. حسین وند، م. عبدالهی، و ا. کارگر**

## چکیده

به منظور شناسایی نماتدهای انگل گیاهی مرتبط با گل مریم، *Polianthes tuberosa*، در دزفول، ایران، در طی سال‌های ۱۳۹۲ و ۱۳۹۳ تعداد ۳۰۰ نمونه خاک و ریشه از مناطق مختلف شهرستان جمع‌آوری شد. پس از شستشو و استخراج نماتدها با روش غوطه‌وری و سانتریفوژ، کشتن و تثبیت آن‌ها و انتقال به گلیسیرین انجام شد و اسلاید دایمی میکروسکوپی تهیه گردید. با استفاده از میکروسکوپ مجهز به لوله ترسیم، نمونه‌ها مورد بررسی مورفولوژیکی و مورفومتریکی قرار گرفت. در این مطالعه تعداد ۱۷ گونه متعلق به نه جنس از خانواده Tylenchidae شناسایی شد که عبارتند از: *Boleodorus* ،*B. tumida* ،*Basiria aberrans* ،*A. abulbosus* ،*Atetylenchus graminus* ،*F. facultativus* ،*F. andrassyi* ،*F. vulgaris* ،*F. sandneri* ،*Filenchus elegantulus* ،*thylactus Psilenchus* ،*Neopsilenchus magnidens* ،*Lelenchus leptosoma* ،*Irantylenchus vicinus hilarulus*، *P. iranicus*، *P. vinciguerrae* و *Tylenchus capitatus*. از بین این گونه‌ها، *A. graminus*، *L. leptosome* و *T. capitatus* برای اولین بار از ایران گزارش و توصیف می‌شوند. این اولین گزارش از وجود نماتد نر *A. graminus* از دنیا است.



[ DOR: 20.1001.1.16807073.2016.18.7.1.1 ]