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Research article

Description of *Aphelenchoides parvus* n. sp. (Rhabditida: Aphelenchoididae) from Tehran province, Iran

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Abstract

Aphelenchoides parvus n. sp. is described and illustrated on the basis of morphological and morphometric characters. It was recovered from bark samples of a dead fallen pine tree (*Pinus eldarica*) in Tehran city. The new species is characterized mainly by a short body length of 307-375 μm , four lateral lines, rounded lip region, well set off from the body contour, short stylet 6-8 μm long with small basal swellings, secretory-excretory pore usually posterior to the median bulb, post-vulval uterine sac (PUS) 34-40 μm long, conical tail with broadly rounded tip bearing a very small mucro and absence of male. It belongs to the group 2 of the morphological intragenus grouping of the genus, by having mucronated tail. By having a small body size and mucronated tail, the new species is compared with eight most relevant species, viz. *A. absari*, *A. curiolis*, *A. eradicatus*, *A. lagenoferrus*, *A. minoris*, *A. neominoris*, *A. parabicaudatus* and *A. tuzeti*.

Keywords: Aphelenchoidea, Morphology, Morphometrics, *Pinus eldarica*, Urban green environment

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توصیف گونه جدید (*Aphelenchoides parvus* n. sp. (Rhabditida: Aphelenchoididae)

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چکیده:

گونه جدید *Aphelenchoides parvus* n. sp. بر اساس مشخصات ریخت‌شناختی و ریخت‌سنجی توصیف می‌شود. این گونه از نمونه‌های چوب مرده درخت کاج (*Pinus eldarica*) در شهر تهران جداسازی شد. مشخصات اصلی گونه شامل بدنی کوچک به طول ۳۰۷ تا ۳۷۵ میکرومتر، سطوح جانبی دارای چهار شیار طولی، سر گرد و دارای فرورفتگی نسبت به بدن، استایلت کوتاه به طول هفت تا هشت میکرومتر با تورم‌های کوچک انتهایی، روزنه ترش‌حی - دفعی معمولاً عقب تر از حباب میانی، کیسه عقبی رحم (PUS) به طول ۳۴ تا ۴۰ میکرومتر، دم مخروطی با انتهای گرد و پهن با یک زائده بسیار کوچک و نبود نر است. گونه جدید با داشتن یک زائده در انتهای دم بر اساس گروه‌بندی ریخت‌شناختی درون جنس، متعلق به گروه دوم است و نیز با داشتن طول بدن کوچک با ۹ گونه مشابه به نام‌های *A. tuzeti* و *A. parabicaudatus* *A. neominoris* *A. minoris* *A. lagenoferrus* *A. eradicitus* *A. curiolis* *absari* است.

واژه‌های کلیدی: *Aphelenchoidea*، ریخت‌شناسی، ریخت‌سنجی، فضای سبز، *Pinus eldarica*

Introduction

The genus *Aphelenchoides* Fischer, 1894 is a species-rich genus belongs to the family Aphelenchoididae (Skarbilovich, 1947) Paramonov, 1953. It represents mycetophagus and/or plant parasitic lifestyle and could be found in soil, decaying plants or organic material, the galleries of wood-boring beetles and the rhizosphere or above-ground parts of plant tissues (Shahina 1996; Kanzaki & Giblin-Davis 2012). Some species are well-known plant parasites such as *A. besseyi* Christie, 1942; *A. fragariae* Ritzema Bos, 1890 and *A. ritzemabosi* (Schwartz, 1911) Steiner & Buhner, 1932. So far, the following species of the genus have been described from different localities of Iran:

- A. eldaricus* Esmaeili, Heydari, Golhasan & Kanzaki, 2017
- A. fuchsi* Esmaeili, Heydari, Ziaie & Gu, 2016
- A. giblindavisi* Aliramaji, Pourjam, Álvarez-Ortega, Jahanshahi Afshar & Pedram, 2018
- A. gorganensis* Miraeiz, Heydari & Bert, 2017
- A. hamospiculatus* Mortazavi & Pedram, 2020
- A. huntensis* Esmaeili, Fang, Li & Heydari, 2016
- A. iranicus* Golhasan, Heydari, Álvarez-Ortega, Esmaeili, Castillo & Palomares-Rius, 2016
- A. kheirii* Golhasan, Heydari, Esmaeili & Kanzaki, 2018
- A. macrospica* Golhasan, Heydari, Esmaeili & Miraeiz, 2017
- A. paraxui* Esmaeili, Heydari, Fang & Li, 2017
- A. persicus* Aliramaji, Taheri & Shokoohi, 2023.
- A. primadentus* Mobasseri, Pourjam & Pedram, 2018
- A. salixae* Esmaeili, Heydari, Tahmoures & Ye, 2017
- A. tabarestanensis* Golhasan, Fang, Li, Tanha Maafi & Heydari, 2019

In Tehran province, northern Iran, coniferous trees have been planted in urban landscape. The devastating species *Bursaphelenchus xylophilus* (Steiner & Buhner, 1934) Nickle, 1970, which is widespread in East Asian countries including Japan, Korea and China (Mota & Vieira 2008) and in European countries such as Portugal (Mota *et al.* 1999) and Spain (Robertson *et al.* 2011), has not yet been recorded from Iran.

In recent years, decline syndrome has been widely seen in coniferous trees in Tehran province and several

pathogenic fungi and pests have been attributed to this syndrome (Alizadeh *et al.* 2022). In previous studies, several aphelenchoidid genera and species were described or reported in association with weak, dead, or dying conifers in Tehran province including *Ektaphelenchoides sylvestris* Pedram, Pourjam, Atighi, Ye & Houshmand, 2012, *E. poinari* Aliramaji, Pourjam, Atighi, Ye, Roshan-Bakhsh & Pedram, 2014, *Cryptaphelenchus varicaudatus* Pedram, 2017, *Ektaphelenchus kanzakii* Pedram, 2019 and *Devibursaphelenchus teratospicularis* Kakulia & Devdariani, 1965 (Pedram 2019).

In our recent studies on dead or dying conifers in Tehran province, an aphelenchoidid population was recovered from a fallen pine tree in Tehran city. Comparisons with all known species revealed that it is an unknown species, therefore, the population described and illustrated here as *Aphelenchoides parvus* n. sp.

Materials and methods

Several wood and bark samples were taken from dead pine (*Pinus eldarica* L.) trees in the district six of Tehran city, Tehran province, Iran in the summer of 2022. The samples were packed in plastic bags and kept at 4°C in the laboratory. Nematodes were extracted from the samples using the tray method (Whitehead & Hemming 1965), heat-killed by adding hot 4% formalin solution and transferred to anhydrous glycerol (De Grisse 1969). The specimens were mounted on microscopic permanent slides and photographed using an Olympus DP72 digital camera connected to an Olympus BX51 microscope powered with differential interference contrast (DIC). The drawings were made with a drawing tube attached to the microscope and sketched digitally using CorelDRAW® software version 17. The new species was identified on the basis of morphological and morphometric data using the available species identification key (Shahina 1996) and the original descriptions of the species added to the genus since 1995.

Results

Aphelenchoides parvus n. sp.

(Table 1; Figs 1 & 2)

Table 1. Morphometric data for *Aphelenchoides parvus* n. sp. from Iran. All measurements are in µm and in from: mean ± s.d. (range).

Characters	Female	
	Holotype	Paratypes
N	1	14
L	321	338 ± 22.3 (307-375)
a	32.5	33.1 ± 1.5 (30.5-35.4)
b	7.5	7.8 ± 0.6 (6.8-8.9)
b'	3.4	3.7 ± 0.3 (3.3-4.4)
c	19.1	18.6 ± 1.4 (15.6-20.5)
c'	2.6	2.7 ± 0.2 (2.4-3.2)
V	71.7	71.3 ± 1.4 (68.6-73.0)
Lip region height	2	2.0 ± 0.2 (1.6-2.5)
Lip region diam.	4.5	5 ± 0 (5-5)
Anterior end to vulva	230	241 ± 15.8 (224-268)
Stylet	7	7.5 ± 0.5 (7-8)
Stylet conus	3	3.5 ± 0.5 (3-4)
Anterior end to valve of median bulb	39.5	39.7 ± 1.1 (37.6-41.3)
m	43	46.7 ± 3.7 (42.9-50.0)
Secretory-excretory pore	40.5	43.2 ± 3.2 (35.9-48.2)
Hemizonid	47.8	45.7 ± 3.0 (38.7-49.6)
Pharynx	42.5	43.3 ± 1.3 (41.1-45.7)
Nerve ring	53	53.4 ± 3.8 (46.3-58.3)
Median bulb length	11	10.0 ± 0.4 (9.2-10.8)
Median bulb diam.	7	7.2 ± 0.5 (6.4-8.3)
Median bulb length/diam.	1.5	1.4 ± 0.1 (1.2-1.6)
Pharyngeal overlapping	51	48.1 ± 3.2 (42.4-56.0)
Vulval body diam. (VBD)	10	10.2 ± 0.7 (9.2-11.5)
Body diam. at median bulb	9	9.5 ± 0.7 (9-11)
Post-vulval uterine sac (PUS)	39	37.2 ± 1.9 (34-40)
PUS/VBD	4	3.7 ± 0.3 (3.1-4.0)
Vulva-anus	73	67.5 ± 4.9 (64-71)
Ovary length	85.5	99.0 ± 6.6 (92-106)
Anal body diam.	6.5	6.8 ± 0.4 (6.2-7.5)
Tail length	17	18.2 ± 1.2 (16.6-20.7)

Description

Female: Small nematodes. Body slender, slightly ventrally curved when heat-relaxed. Cuticle with fine but distinct annuli, 1 µm wide at mid-body. Lateral fields with four lines, forming three bands, the middle one

slightly wider in cross section. Lip region high, rounded, well set off from body contour, 2-3 times wider than height. Stylet short, with basal small swellings, conus part 43-50% of total stylet.

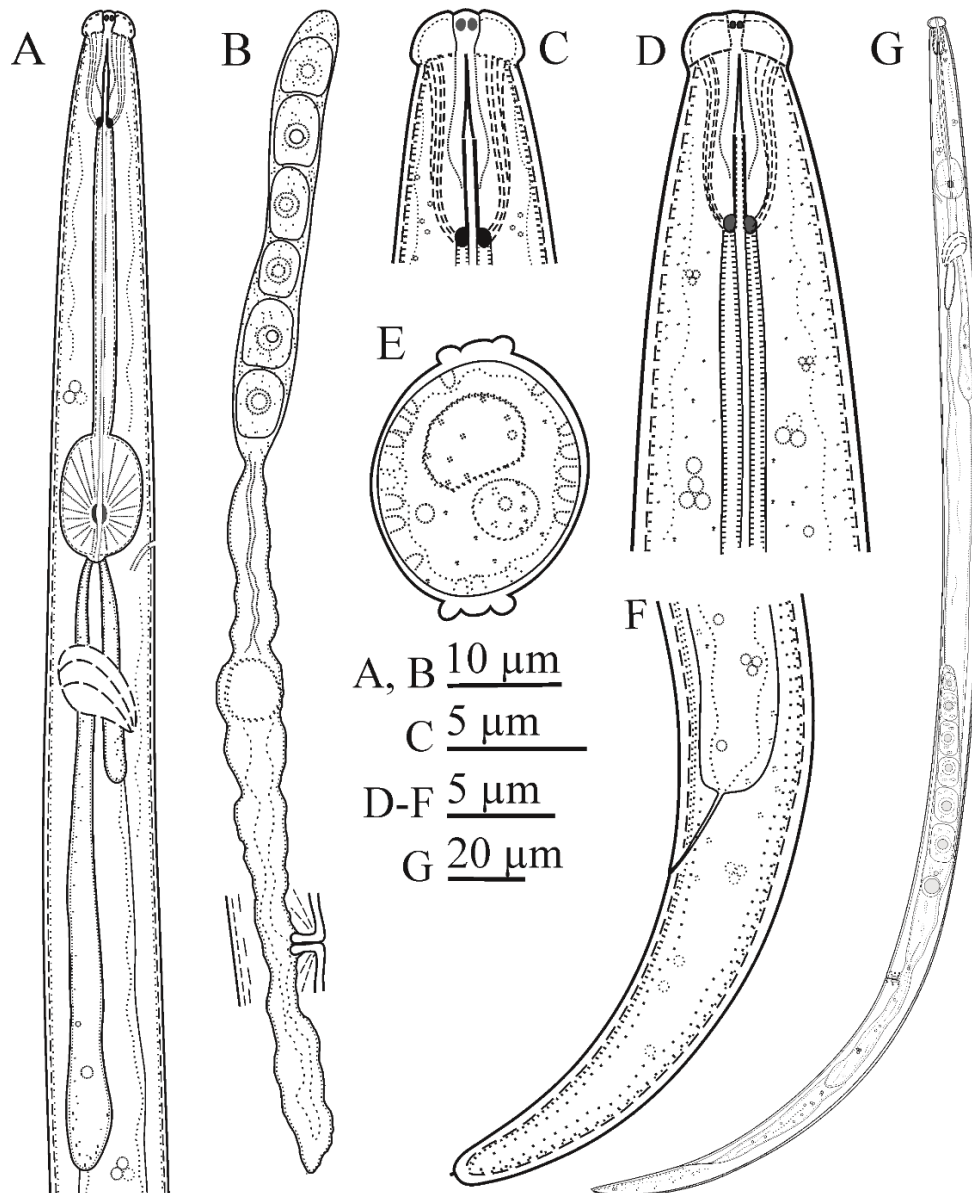


Fig. 1. Line drawings of *Aphelenchoides parvus* n. sp. A: Pharynx; B: Reproductive system; C & D: Anterior body region; E: Cross section at mid-body; F: Tail, G: Total body.

Procorpus cylindrical, median bulb developed, with a conspicuous valve at middle to slightly posterior, reaching body walls at both ventral and dorsal sides, pharyngo-intestinal junction just posterior to median bulb, intestine simple, anus and rectum functional. Secretory-excretory pore usually at level of the base of median bulb to nerve ring level. Nerve ring enveloping anterior intestine and pharyngeal glands. Reproductive system monodelphic-prodelphic, ovary outstretched, developing oocytes in single row, oviduct tubular, spermatheca oval, empty, crustaformera and uterus indistinguishable from each other, uterus short, vagina

straight, vulva a transverse slit and post-vulval uterine sac (PUS) 3-4 times longer than corresponding body width. Tail conical, dorsally convex, ventrally concave, slightly ventrally bent, its tip widely rounded bearing a very small mucro.

Male: Not found.

Type habitat and locality

Bark and wood samples of a dead fallen pine tree (*Pinus eldarica*) in the district six of Tehran city, Tehran province, Iran. The GPS coordinates of the type locality are: 35°43'34.391" N, 51°24'10.862" E.

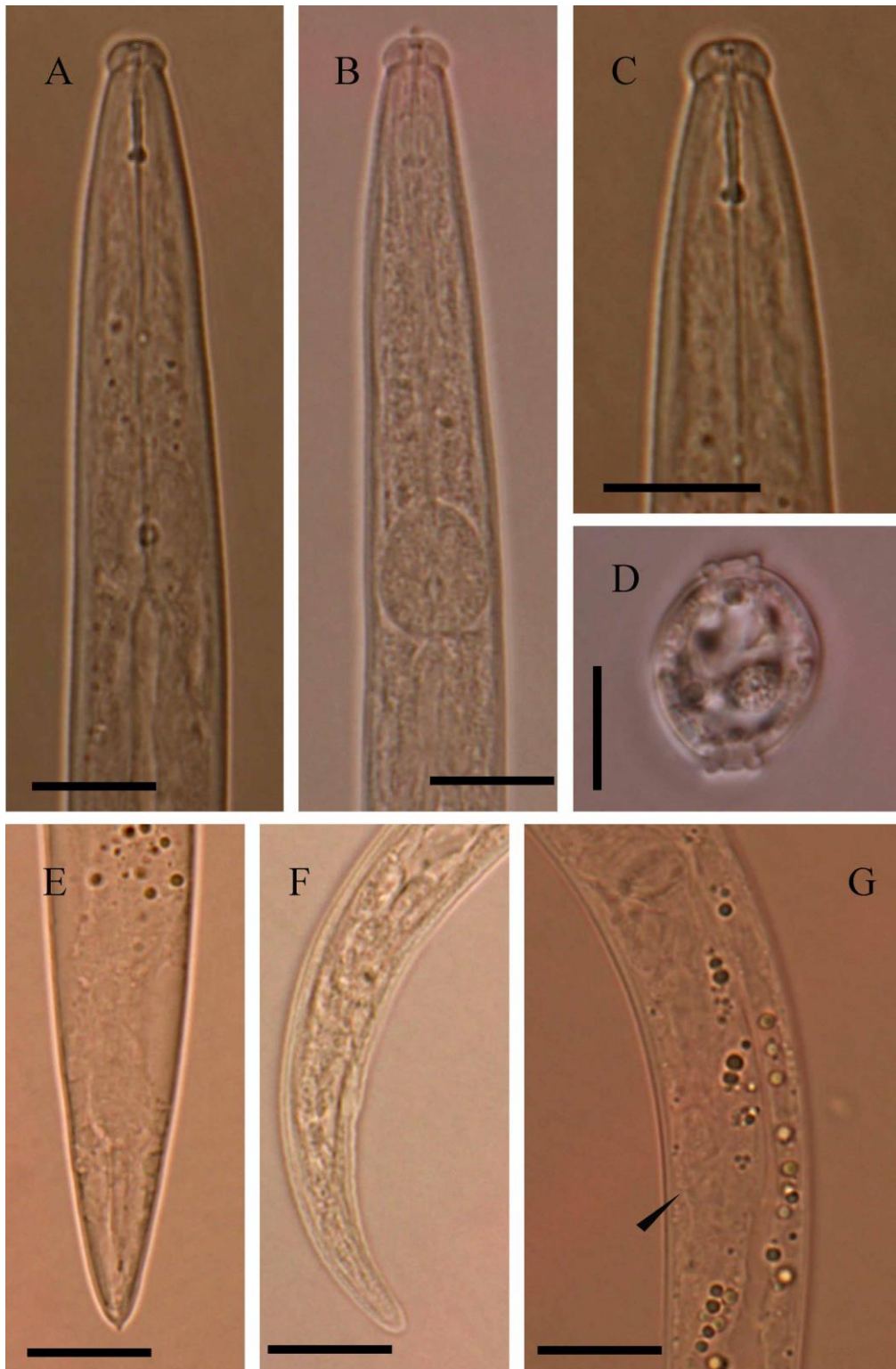


Fig. 2. Light microphotographs of *Aphelenchoides parvus* n. sp. A-B: Part of pharynx; C: Anterior body region; D: Cross section at mid body; E-F: Tail (E: ventral view, fresh material, F: lateral view, permanently mounted specimen); G: Post-vulval uterine sac (arrow showing the end of PUS). (All scale bars=10 μm)

Type material

The holotype female and six paratype females were deposited in the Nematode Collection at Faculty of

Agriculture, Tarbiat Modares University, Tehran, Iran. Seven paratype females were deposited at WaNeCo collection, Wageningen, the Netherlands (<http://>

www.waneco.eu/). The LSID code of this publication is: urn:lsid:zoobank.org:pub:24F770CF-94A5-4759-81E7-4E5A7587B273

Etymology

The specific epithet refers to the short body length of the new species.

Diagnostic and relationships

Aphelenchoides parvus n. sp. is mainly characterised by its small body size 307-375 µm long, offset lip region, four lines in lateral fields, short stylet 7-8 µm long and conical slightly ventrally bent tail with rounded tip having a small mucro. It belongs to the group 2 of morphological intragenus artificial grouping of *Aphelenchoides* (Shahina 1996). By having a short body, rounded lip region well set off from body contour and tail bearing a simple small mucro, it comes close to eight nominal species viz. *A. absari* Husain & Khan, 1967, *A. curiolis* Gritsenko, 1971, *A. eradicitus* Eroshenko, 1968, *A. lagenoferrus* Baramovskaya, 1963, *A. minoris* (Seth & Sharma, 1986) Ebsary, 1991, *A. neominori* Chanu & Mohilal, 2014, *A. parabicaudatus* Shavrov, 1967 and *A. tuzeti* B'Chir, 1979.

Aphelenchoides parvus n. sp. could be distinguished from *A. absari* by its shorter stylet (7-8 vs 11-13 µm), having basal swellings (vs without swellings), greater b ratio (6.8-8.9 vs 4.0-4.5), shorter tail (16.6-20.7 vs 25 µm) with widely rounded (vs not so) tail end and absence of male.

Compared to *A. curiolis*, it has lateral fields with four lines (vs three), longer body (307-375 vs 220-240 µm) and greater a ratio (30.5-35.4 vs 22.3-29.2).

It differs from *A. eradicitus* by having greater V (68.6-73.0 vs 64), greater a ratio (30.5-35.4 vs 23.4-23.9), greater c ratio (15.6-20.5 vs 7.1-8.3) and shorter stylet (7-8 vs 9.6 µm).

In can be distinguished from *A. lagenoferrus* by a shorter stylet (7-8 vs 10 µm), greater a ratio (30.5-35.4 vs 24.0-26.2) and absence of male vs presence.

The new species is separated from *A. minoris*, by lateral fields with four lines (vs three), body not narrowing abruptly after anus (vs narrowing), tail with widely rounded terminus (vs narrower), absence of male

(vs common), greater a ratio (30.5-35.4 vs 26.1-28.8), greater c ratio (15.6-20.5 vs 14.6-14.9) and shorter stylet (7-8 vs 10 µm).

The new species is differentiated from *A. neominoris* by greater b ratio (6.8-8.9 vs 4.23-6.51), shorter pharynx (41.1-45.7 vs 67.47-83.04 µm), longer PUS (34-40 vs 12.1-15.6 µm) and greater PUS/vulval body diam. (VBD) ratio (3.1-4 vs 1.28- 1.4).

It differs from *A. parabicaudatus* by greater a ratio (30.5-35.4 vs 21.4-25.0), greater c ratio (15.6-20.5 vs 10.5- 12.7), lower c' ratio (2.4-3.2 vs 3.75), greater V ratio (68.6-73.0 vs 61.0-64.0), and from *A. tuzeti* by shorter body (307-375 vs 340- 690 µm), shorter stylet (7-8 vs 12.7-14.6 µm), greater c ratio (15.6-20.5 vs 9-12) and shorter tail (16.6-20.7 vs 20- 48 µm)

Discussion

During present study, a new species of the genus *Aphelenchoides* was described based on morphological characters and morphometric characters. It was assigned to the group 2 of the artificial intragenus grouping proposed by Shahina (1996) by having a mucro in tail end. Most of the described species under the genus in recent years (e.g. Mortazavi & Pedram, 2020; Aliramaji *et al.*, 2023; Gu *et al.*, 2023) have established using both morphological and molecular data. However, several attempts in the present study to carry out sequencing of ribosomal loci for the new species were failed. Thus, future molecular studies of topotype or other populations of *Aphelenchoides parvus* n. sp. will reveal its phylogenetic relationships with other relevant genera and species.

Conflict of interest

All authors certify that they do not have any conflict of interest.

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