

Research Article

New records of Macroposthoniinae Skarbilovich, 1959 (Nematoda: Criconematidae) from Iran

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Abstract: Three populations of criconematids belonging to the subfamily Macroposthoniinae, representing three species *Mesocriconema kirjanovae*, *M. surinamense* and *Criconemoides amorphous* were recovered from two different geographical localities in East Azarbaijan province, northwest Iran. The recovered populations were characterized morphologically. Iranian population of *M. kirjanovae* is characterized by 437-542 μm long females, having 86-97 retrorse body annuli with smooth to finely crenated margin, cephalic region with two, non-retrorse annuli, 56-62 μm long stylet, the anterior lip of the vulva with two projections and conical tail with acute tip. The recovered population of *M. surinamense* is characterized by 495-640 μm long females, having 87-94 retrorse body annuli with smooth margin, four very large and flattened submedian lobes, 74-82 μm long stylet, open vulva, its anterior lip with two small lobes, vagina straight and tail rounded with one or two terminal lobes. The Iranian population of *C. amorphous* is characterized by 502-697 μm long females, having 66-73 retrorse body annuli with smooth to rough margin, four pseudo-submedian lobes, labial disc elevated, 72-80 μm long stylet, vulva closed, tail bluntly conoid and its tip uni- to multi-lobed. The characteristics of the three studied species were in agreement with those of the original; and the data of other populations. The two species *M. kirjanovae* and *M. surinamense* are new to nematode fauna of Iran; and the morphological and morphometric data of the Iranian population of *C. amorphous* are presented for the first time.

Keywords: *Criconemoides amorphous*, East Azarbaijan province, *Mesocriconema kirjanovae*, *M. surinamense*, taxonomy

Introduction

According to Geraert (2010), the two genera *Mesocriconema* Andr assy, 1965 and *Criconemoides* Taylor, 1936 belong to the subfamily Macroposthoniinae Skarbilovich,

1959. The genus *Mesocriconema* can be separated from *Criconemoides* by having first labial annulus seldom separated from the succeeding annuli (*vs* first and second labial annuli separated), submedian lobes (true submedian lobes absent) and an open vulva with often ornamented anterior lip (*vs* a closed vulva with a non-ornamented anterior lip) (Geraert, 2010). Furthermore, in a molecular phylogenetic study based upon the near-full-length sequences of the small subunit ribosomal DNA (SSU rDNA) of different criconematid genera,

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Mesocriconema appeared as a monophyletic genus, but *Criconemoides* appeared as a paraphyletic taxon (Powers *et al.*, 2017).

Until now, 10 species of *Mesocriconema* and six species of *Criconemoides* have been reported from Iran (Eskandari, 2018). During present study, three species of two abovementioned genera were recovered from northwest Iran that are characterized by morphological and morphometric data.

Materials and Methods

About 182 soil samples were collected from different regions of East Azarbaijan province, northwest Iran, during 2016-2017. The nematodes were extracted from the soil samples using the rapid flotation-sieving and centrifugation method (Jenkins, 1964). The slow fixation method was used for preparing permanent slides (Jahanshahi Afshar *et al.*, 2019). Morphological characters were studied using an Olympus BX51 light microscope equipped with differential interference contrast optic (DIC). The light microphotographs were taken using an Olympus DP72 digital camera attached to the microscope. Morphometrics were performed using a drawing tube attached to a Nikon E600 light microscope.

Results

Mesocriconema kirjanovae (Andrássy, 1962) Loof and De Grisse, 1989 (Fig. 1; Table 1)

Description

Female: Body short, ventrally arcuate after fixation, tapers towards both ends, more towards the posterior end. Annuli retrorse with smooth to finely crenated margin, sometimes with one to four anastomoses along the body. Lip region not offset, with two annuli, the first annulus 15-18 and the second annulus 17-21 μm wide. Four small submedian lobes and labial plates present. Stylet with anchor shaped knobs. Excretory pore position variable, posterior, at the level, or anterior to the base of pharyngeal bulb. Spermatheca oval to rounded, filled with

sperm. Vulva a wide slit, the anterior lip with two projections. Tail conical, regularly tapering to a single pointed tip, sometimes slightly bent ventrally.

Juvenile: Similar to the female in general morphology. The annuli with distinct crenate posterior margin.

Male: Not found.

The associated plant and locality

The Iranian population was recovered from the rhizosphere of *Rubus* sp. collected in Aynali forest in East Azarbaijan province, northwest Iran. GPS coordinates: 38°53.9245' N, 46°47.09465' E. Altitude: 1219 m.a.s.l.

Remarks

Compared to the type population (Andrássy, 1962) and the data given for the species by Geraert (2010) no remarkable differences were observed. However, in comparison with an American population reported by Cordero *et al.* (2012), minor differences in three indices R, Rex and RPh (86-97, 23-28 and 22-26 vs 98-121, 26-31 and 23-37, respectively) were observed. This is a new report of *M. kirjanovae* from Iran.

Mesocriconema surinamense (De Grisse and Maas, 1970) Loof and De Grisse, 1989 (Fig. 2; Table 2)

Description

Female: Body cylindrical, ventrally arcuate after fixation, anterior end appearing as a thick disc, posterior end rounded. Annuli retrorse with smooth margin. Anastomoses rare, often in the tail region. Lip region not offset. Labial plates present. Four submedian lobes very large and flattened, laterally connected. Labial disc lower than the submedian lobes. Stylet robust with anchor shaped knobs. Excretory pore one or two annuli posterior, or at the level of the base of pharyngeal bulb. Spermatheca slightly developed and empty. Vulva open, its anterior lip bilobed, vagina straight. Tail rounded with one or two terminal lobes.

Juvenile: Not found.

Male: Not found.

The associated plant and locality

This population was recovered from the rhizosphere of *Prunus armeniaca* L., collected in Ahar city, East Azarbaijan province, northwest Iran. GPS coordinates: 38°27.25896' N, 47°4.25654' E. Altitude: 1403 m.a.s.l.

Remarks

The Iranian population of *M. surinamense* fits the type population in its general morphology and morphometric data (De Grisse and Maas, 1970). It looks similar to *M. antipolitanum* (De

Guiran, 1963) Loof and De Ggrisse, 1989 in general body form, morphometric data and having large submedian lobes. However, both species differ in the size of their submedian lobes (very large in *M. surinamense* vs large in *M. antipolitanum*). According to Geraert (2010), the range of the index V for *M. surinamense* is 90-98 vs 93-96 in *M. antipolitanum*. This index is ranged 91.6-93.1 for the presently studied population, fitting the range of *M. surinamense*. This is a new report of *M. surinamense* from Iran.

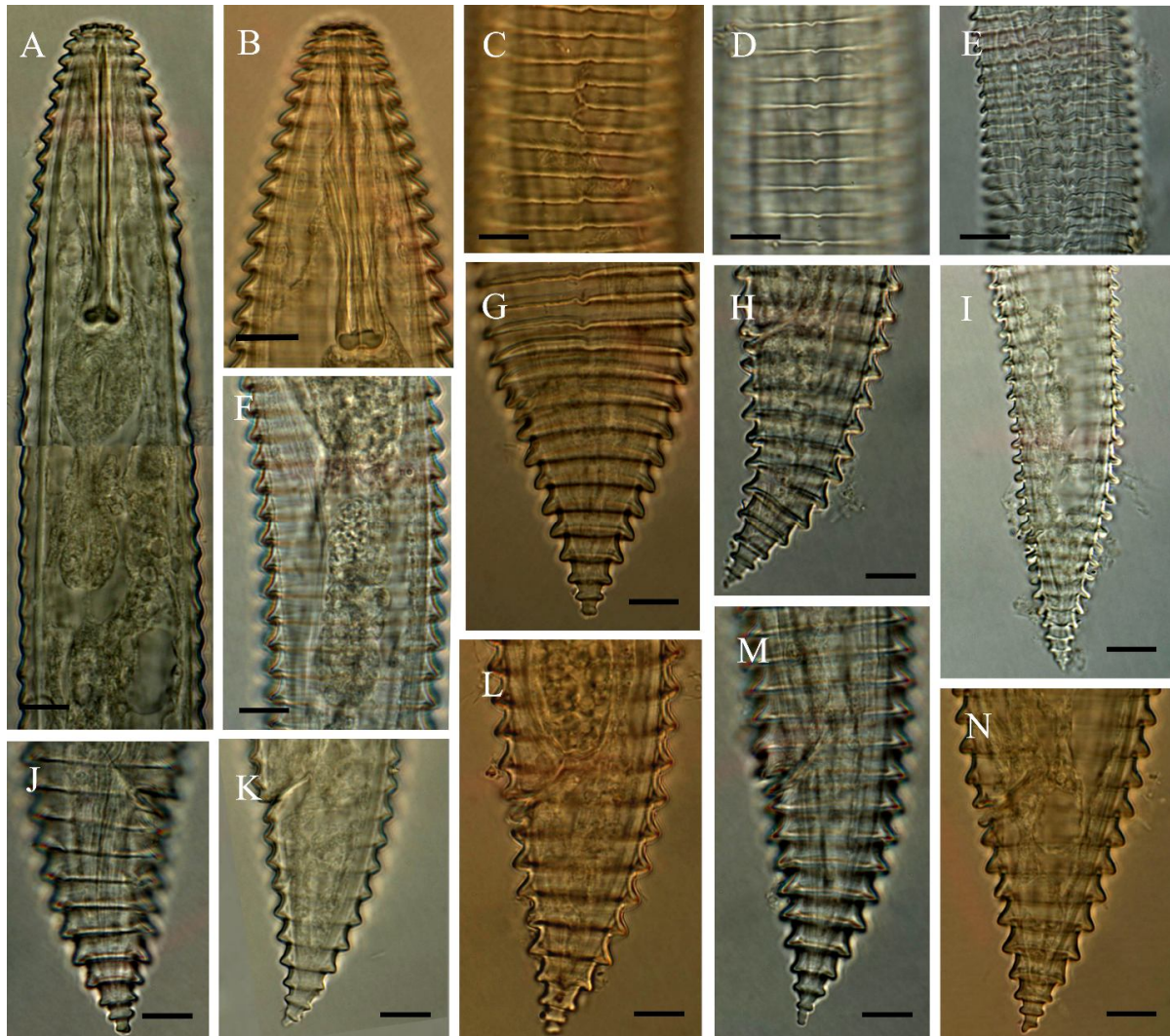


Figure 1 Light photomicrographs of the Iranian population of *Mesocriconema kirjanovae* (Andrássy, 1962) Loof and De Grisse, 1989, female and juvenile. A and B: Anterior body region; C and D: Body annuli with anastomoses and finely crenated margin; E: Body annuli of juvenile; F: Spermatheca; G and H, J-N: Variation of female posterior body end morphology; I: Posterior end of juvenile body. (All scale bars = 10 µm).

Table 1 Morphometrics of *Mesocriconema kirjanovae* (Andrássy, 1962) Loof and De Grisse, 1989 females from Iran and the data from other reports.

Character	This study	Geraert (2010)	Cordero <i>et al.</i> (2012)
n	15	-	38
L	482 ± 29.8 (437-542)	350-790	441 ± 46 (367-570)
a	10.9 ± 1 (9.1-12.4)	-	10.9 ± 1.1 (9.2-13.8)
b	4.2 ± 0.2 (3.9-4.5)	-	4.5 ± 0.4 (3.6-5.8)
c	15.3 ± 2.3 (13.5-21.9)	-	18.0 ± 3.8 (12.2-26.0)
V	89.5 ± 1.4 (88.1-93.7)	85-93	91.5 ± 1.5 (89.1-94.4)
R	91.1 ± 3.0 (86-97)	71-105	110 ± 5.3 (98-121)
RSt	14.0 ± 1.2 (13-17)	-	-
RPh	24.0 ± 1.5 (22-26)	-	29.1 ± 2.6 (23-37)
Rex	26.0 ± 1.3 (23-28)	20-27	29.0 ± 1.4 (26-31)
RV	12.0 ± 0.8 (10-13)	7-14	9.5 ± 1.0 (8-11)
Ran	8.0 ± 0.9 (6-9)	4-10	7.4 ± 1.0 (5-9)
RVan	2-3	0-5	1.3 ± 0.6 (0-2)
Stylet length	59.1 ± 2.1 (56-62)	49-74	54.7 ± 2.6 (47.9-60.9)
Conus length	45.5 ± 2.2 (42-49)	-	-
Shaft length	13.6 ± 1.0 (12-15)	-	14.3 ± 1.2 (13.0-18.3)
m	77.0 ± 1.7 (74.1-80.3)	-	73.8 ± 2.0 (69.2-78.1)
Stylet knob height	3.2 ± 0.4 (3-4)	-	-
Stylet knob width	8.6 ± 0.7 (7-10)	9-11	-
Pharynx length	115 ± 4.3 (109-123)	-	105.5 ± 15.0 (91.4-186.8)
Excretory pore	123 ± 10.8 (109-142)	-	-
Anterior end to vulva	431 ± 27.7 (390-479)	-	404 ± 45.6 (329.5-527.5)
Max. body diam.	44.5 ± 4.4 (38-53)	-	40.4 ± 2.9 (36.5-48.7)
Tail length	31.9 ± 3.9 (24-39)	-	25.5 ± 5.4 (16.2-36.5)
VL	52.1 ± 4.2 (45-62)	-	-
VB	32.1 ± 2.3 (28-36)	-	-
VL/VB	1.6 ± 0.1 (1.5-1.8)	1.0-2.0	1.2 ± 0.2 (0.9-1.6)
VL/ Stylet	0.9 ± 0.1 (0.8-1.0)	-	-
Stylet (% L)	12.3 ± 0.6 (11.1-13.5)	-	-
Stylet (% pharynx)	51.4 ± 2.2 (48.7-55.5)	-	-
Excretory pore (% L)	25.7 ± 1.6 (23.7-29.0)	-	-

All measurements are in µm and in the form: mean ± s. d. (range).

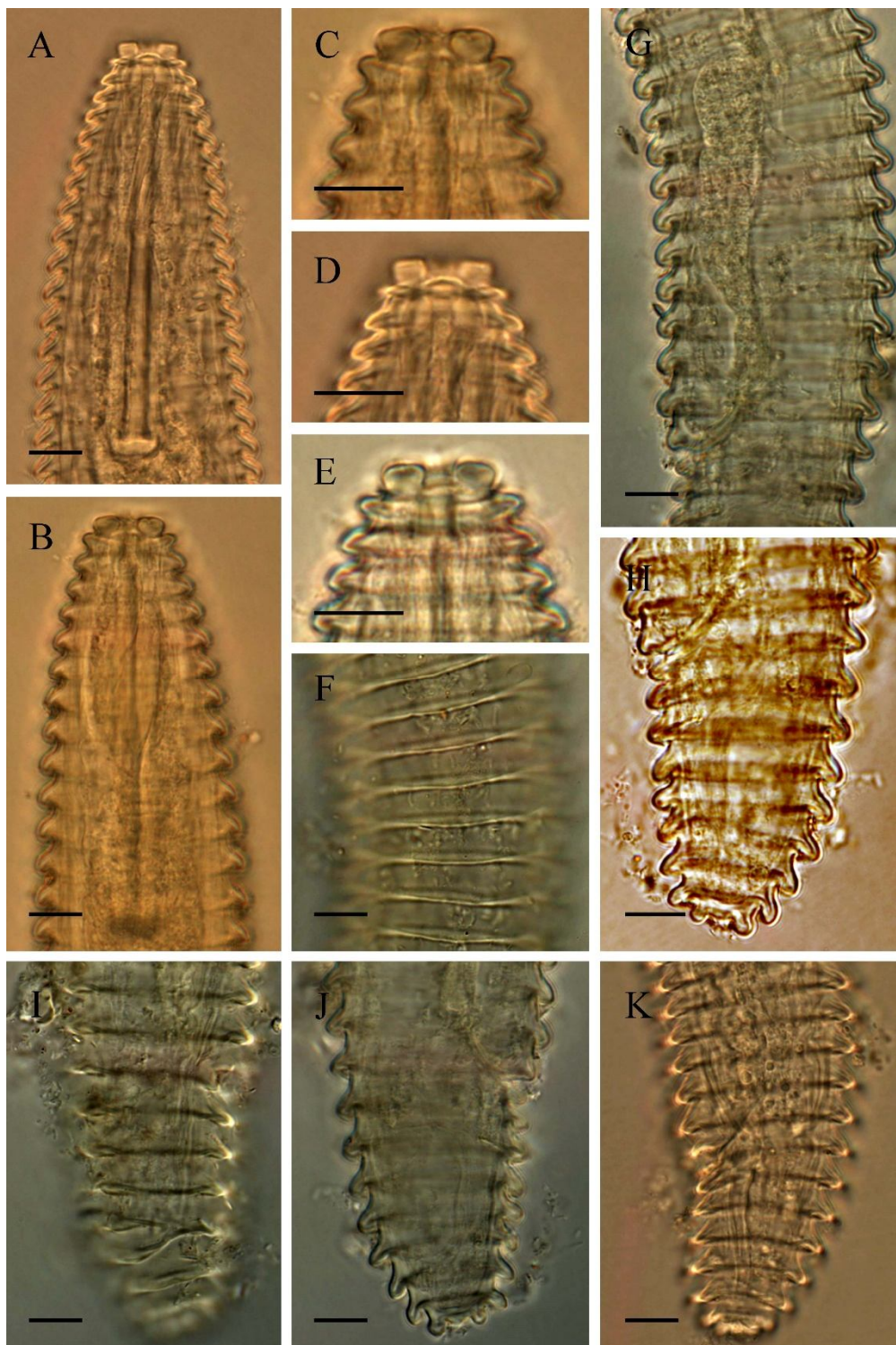


Figure 2 Light photomicrographs of the Iranian population of *Mesocriconema surinamense* (De Grisse and Maas, 1970) Loof and De Grisse, 1989, female. A and B: Anterior body region; C-E: Anterior end with very large submedian lobes; F: Body annuli with smooth margin; G: Part of reproductive system with empty spermatheca; H-K: Posterior body end (an anastomose in the tail region in I). (All scale bars = 10 μ m).

Table 2 Morphometrics of *Mesocriconema surinamense* (De Grisse and Maas, 1970) Loof and De Grisse, 1989 females from Iran and the data from other reports.

Character	This study	De Grisse and Maas (1970)	Geraert (2010)
n	5	20	-
L	571 ± 72.9 (495-640)	447 (365-530)	340-530
a	11.7 ± 1.2 (10.3-12.3)	10 (7-12)	-
b	4.2 (4.2-4.2)	3.9 (3.4-4.5)	-
c	21.3 ± 2.9 (18.3-24.2)	27 (19-39)	-
V	92.5 ± 0.8 (91.6-93.1)	92 (90-93)	90-98
R	91.0 ± 3.6 (87-94)	82 (78-89)	74-91
RSt	15.0 ± 1.7 (14-17)	15 (14-16)	-
RPh	24 (24-24)	22 (19-24)	-
Rex	25 ± 1 (24-26)	23 (21-25)	21-28
RV	8 ± 1 (7-9)	8 (8-9)	5-9
Ran	6 ± 1 (5-7)	5 (4-6)	3-6
RVan	1	3 (2-3)	0-3
Stylet length	77.3 ± 4.2 (74-82)	73 (70-78)	51-81
Conus length	60 ± 3 (57-63)	-	-
Shaft length	17.3 ± 1.5 (16-19)	-	-
m	78.0 ± 1.2 (77-79)	-	-
Stylet knob height	5	-	-
Stylet knob width	10.3 ± 0.6 (10-11)	-	-
1 st -cephalic ann. diam.	17.7 ± 1.5 (16-19)	-	-
2 nd -cephalic ann. diam.	22 ± 1 (21-23)	-	-
Pharynx length	135 ± 23.3 (119-152)	-	-
Excretory pore	143 ± 13.1 (129-155)	-	-
Anterior end to vulva	529 ± 63.8 (460-586)	-	-
Max. body diam.	49.0 ± 2.6 (47-52)	-	-
Tail length	27.3 ± 6.7 (23-35)	-	-
VL	41.3 ± 9.5 (34-52)	-	-
VB	35.7 ± 2.1 (34-38)	-	-
VL/VB	1.2 ± 0.2 (1.0-1.4)	1.0 (0.9-1.2)	0.6-1.2
VL/Stylet	0.5 ± 0.1 (0.5-0.6)	0.5 (0.4-0.6)	-
Stylet (% L)	14 ± 1.2 (12.8-14.9)	16 (14-20)	-
Stylet (% pharynx)	58.0 ± 5.8 (53.9-62.2)	64 (58-69)	-
Excretory pore (% L)	25.0 ± 0.9 (24.2-26.1)	-	-

All measurements are in µm and in the form: mean ± s.d. (range).

***Criconemoides amorphus* De Grisse, 1967**

(Fig. 3; Table 3)

Description

Female: Body cylindrical, ventrally arcuate after fixation, anterior end rounded and posterior end conical. Annuli retrorse with smooth to rough margin. No anastomoses or few. Lateral differentiation absent. Lip region with two annuli. First labial annulus separated from the second one

by a narrow constriction, slightly directed forwardly. Four pseudo-submedian lobes present. Labial disc elevated above submedian lobes. Stylet slender with anchor shaped knobs. Excretory pore posterior to the pharynx base. Spermatheca not observed. Vulva closed. Tail conical with one, two or three terminal lobes.

Juvenile: Not found.

Male: Not found.

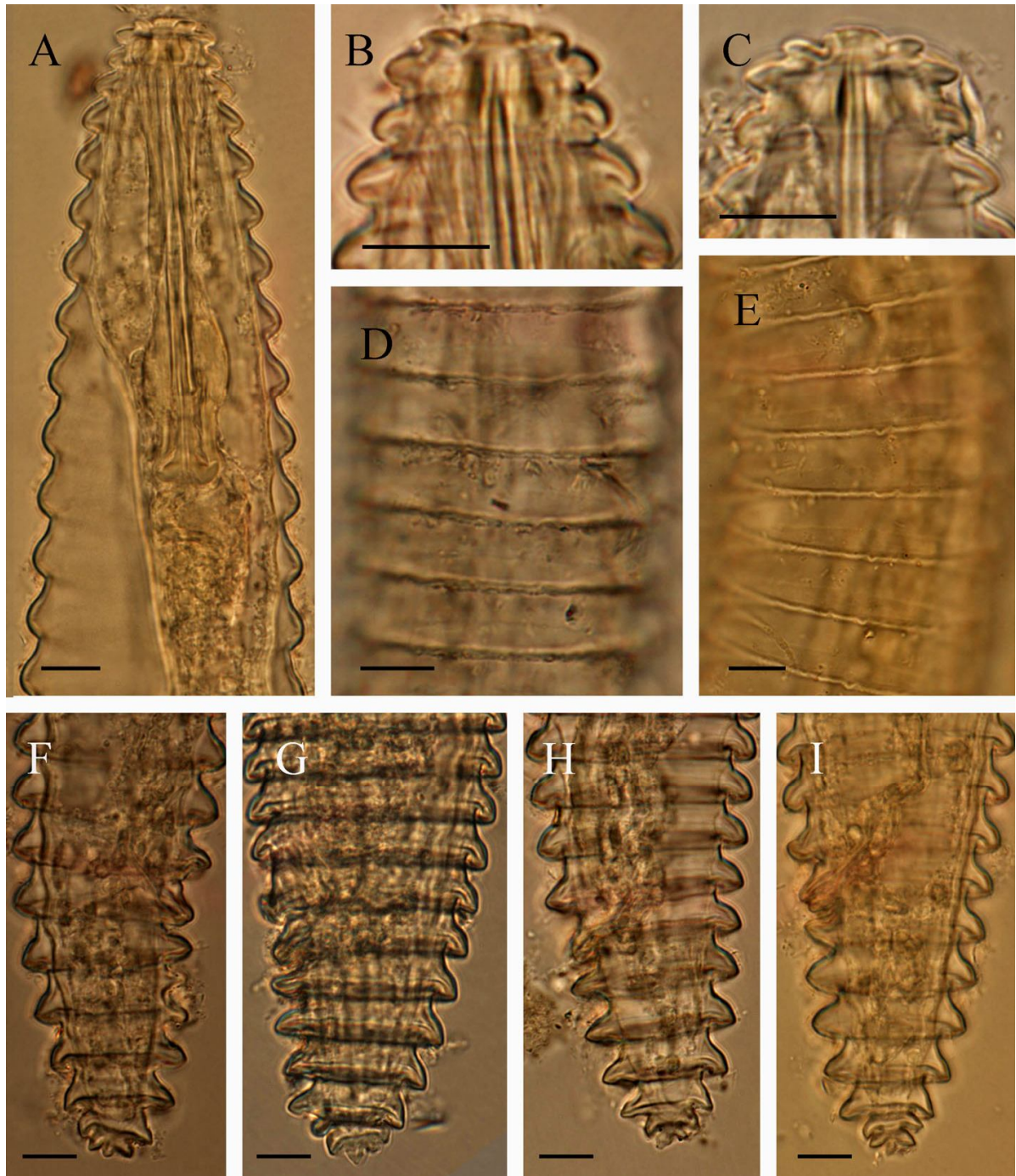


Figure 3 Light photomicrographs of the Iranian population of *Criconemoides amorphous* De Grisse, 1967, female. A: Anterior body region; B and C: Cephalic region with two annuli, pseudo-submedian lobes and elevated labial disc; D and E: Body annuli with smooth to rough margin; F-I: Variation of posterior body end morphology. (All scale bars = 10 μ m).

Table 3 Morphometrics of *Criconemoides amorphus* De Grisse, 1967 females from Iran and the data from other reports.

Character	This study	De Grisse (1967)	Geraert (2010)
n	8	21	-
L	581 ± 68.5 (502-697)	529 (365-644)	350-640
a	10.9 ± 1.5 (9.0-12.7)	12 (10-14)	-
b	4.2 ± 0.5 (3.6-4.8)	4.0 (3.3-4.7)	-
c	29.9 ± 5.9 (22.1-38.7)	24 (18-36)	-
V	91.8 ± 1.3 (89.2-92.8)	91 (88-92)	88-92
R	70.3 ± 2.4 (66-73)	65 (59-70)	55-76
RSt	11.0 ± 1.0 (10-13)	10 (9-12)	-
RPh	18.0 ± 1.8 (16-20)	15 (13-20)	-
Rex	22.0 ± 1.2 (21-23)	20 (17-22)	17-22
RV	8.0 ± 0.8 (7-9)	8 (7-10)	6-10
Ran	4-5	5 (4-6)	3-6
RVan	2-3	1-4	1-4
Stylet length	76.3 ± 2.6 (72-80)	67 (65-82)	62-84
Conus length	60.5 ± 2.3 (57-63)	-	-
Shaft length	15.8 ± 1.2 (14-17)	-	-
m	79.3 ± 1.4 (77.6-81.8)	-	-
Stylet knob height	4.3 ± 0.5 (4-5)	-	-
Stylet knob width	10.7 ± 0.8 (10-12)	-	-
1 st -cephalic ann. diam.	17.5 ± 1.6 (15-19)	-	-
2 nd -cephalic ann. diam.	20.2 ± 0.8 (19-21)	-	-
Pharynx length	139 ± 5.7 (130-145)	-	-
Excretory pore	175 ± 25.5 (147-220)	-	-
Anterior end to vulva	533 ± 67.3 (463-647)	-	-
Max. body diam.	53.7 ± 2.9 (49-56)	-	-
Tail length	19.8 ± 2.9 (17-24)	-	-
VL	47.7 ± 6.9 (39-58)	-	-
VB	36.8 ± 1.3 (35-39)	-	-
VL/VB	1.3 ± 0.2 (1.1-1.6)	1.4 (1.1-1.7)	1.1-1.7
VL/ Stylet	0.6 ± 0.1 (0.5-0.8)	0.6 (0.5-0.8)	-
Stylet (% L)	13.3 ± 1.6 (11.0-15.1)	14 (13-18)	-
Stylet (% pharynx)	54.3 ± 1.0 (53.1-55.4)	58 (55-62)	-
Excretory pore (% L)	30.1 ± 1.7 (27.7-32.2)	-	-

All measurements are in μm and in the form: mean \pm s.d. (range).

The associated plant and locality

This population was recovered from the rhizosphere of *Prunus armeniaca* L. collected in Ahar city, East Azarbaijan province, northwest Iran. GPS coordinates: 38°27.25896' N, 47°4.25654' E. Altitude: 508 m.a.s.l.

Remarks

In comparison with the type population (De Grisse, 1967) and the data given for the species by Geraert (2010), no remarkable differences were observed. Morphological and morphometric data of the Iranian population of

this species are presented in this study for the first time (the data of a previously reported population in a conference abstract (Golmohammadzadeh Khiyaban and Barooti, 2003) are not available).

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References

- Andrássy, I. 1962. Neue Nematoden-Arten aus Ungarn, 11. Fünf neue Arten der Unterklasse Secernentea (Phasmodia). Acta Zoologica Academiae Scientiarum Hungariae, 8: 1-23.
- Andrássy, I. 1965. Verzeichnis und Bestimmungsschlüssel der Arten der Nematoden-Gattungen *Criconemoides* Taylor, 1936 und *Mesocriconema* n. gen. Opuscula Zoologica Budapest, 5: 153-171.
- Cordero, M. A., Robbins, R. T. and Szalanski, A. L. 2012. Taxonomic and molecular identification of *Mesocriconema* and *Criconemoides* species (Nematoda: Criconematidae). Journal of Nematology, 44: 399-426.
- De Grisse, A. 1967. Description of fourteen new species of Criconematidae with remarks on different species of the family. Biologische Jaarboek Dodonaea, 35: 66-125.
- De Grisse, A. and Mass, P. W. 1970. *Macroposthonia longistyleta* n. sp. and *Discocriconemella surinamensis* n. sp. from Surinam (Nematoda: Criconematidae). Nematologica, 16: 123-132.
- De Guiran, G. 1963. Quatre espèces nouvelles du genre *Criconemoides* Taylor (Nematoda – Criconematidae). Revue de Pathologie Végétale et d'Entomologie Agricole de France, 42: 1-11.
- Eskandari, A. 2018. Nematodes of the families Criconematidae and Hemicycliophoridae. In: Ghaderi, R., Kashi, L. and Karegar, A. (Eds). Plant-parasitic nematodes in Iran. Science Reference in collaboration with the Iranian Society of Nematology, pp. 113-192.
- Geraert, E. 2010. The Criconematidae of the world: identification of the family Criconematidae (Nematoda). Academia Press. 615 PP.
- Golmohammadzadeh Khiyaban, N. and Barooti, S. 2003. Plant parasitic nematodes fauna from Baluchistan Region. Proceedings of the 15th Iranian Plant Protection Congress, 309.
- Jahanshahi Afshar, F., Pourjam, E. and Pedram, M. 2019. New morphological observations on *Neolobocriconema serratum* (Khan and Siddiqi, 1963) Mehta and Raski, 1971 (Rhabditida: Criconematidae). Nematology, 21: 419-434.
- Jenkins, W. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Disease Reporter, 48: 692.
- Loof, P. A. A. and De Grisse, A. 1989. Taxonomic and nomenclatorial observations on the genus *Criconemella* De Grisse and Loof, 1965 sensu Luc and Raski, 1981 (Criconematidae). Mededelingen Faculteit Landbouwwetenschappen Rijksuniversiteit Gent, 54: 53-74.
- Powers, T. O., Harris, T., Higgins, R., Mullin, P. and Powers, K. 2017. An 18S rDNA perspective on the classification of Criconematoidea. Journal of Nematology, 49: 236-244.
- Skarbilovich, T. S. 1959. On the structure of systematics of nematodes order Tylenchida Thorne, 1949. Acta Parasitologica Polonica, 7: 117-132.
- Taylor, A. L. 1936. The genera and species of the Criconematinae, a sub-family of the Anguilluliniidae (Nematoda). Transactions of the American Microscopical Society, 55: 391-421.

گزارشات جدید از زیرخانواده (Nematoda: Macroposthoniinae Skarbilovich, 1959) Criconematidae از ایران

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چکیده: سه جمعیت کریکونماتید متعلق به زیرخانواده Macroposthoniinae، شامل گونه‌های *Mesocriconema kirjanovae*، *M. surinamense* و *Criconemoides amorphus* از استان آذربایجان شرقی، شمال غربی ایران، جداسازی و براساس داده‌های ریخت‌شناسی و ریخت‌سنجی شناسایی شدند. جمعیت ایرانی گونه *M. kirjanovae* دارای ماده‌هایی به طول ۵۴۲-۴۳۷ میکرومتر، ۸۶-۹۷ حلقه متمایل به سمت عقب بدن با حاشیه صاف تا کنگره‌ای ظریف، ناحیه سر با دو حلقه غیرمتمایل به سمت عقب بدن، استایلت به طول ۶۲-۵۶ میکرومتر، لب جلویی فرج با دو زائده و دم مخروطی با نوک تیز می‌باشد. جمعیت ایرانی گونه *M. surinamense* دارای ماده‌هایی به طول ۶۴۰-۴۹۵ میکرومتر، ۸۷-۹۴ حلقه متمایل به سمت عقب بدن با حاشیه صاف، برجستگی‌های چهارگانه فوق‌العاده بزرگ با انتهای تخت، استایلت به طول ۷۴-۸۲ میکرومتر، فرج باز، لب جلویی فرج دارای دو لوب کوچک، واژن مستقیم و دم گرد با یک یا دو لوب در انتها می‌باشد. جمعیت ایرانی گونه *C. amorphus* دارای ماده‌هایی به طول ۶۹۷-۵۰۲ میکرومتر، ۶۶-۷۳ حلقه متمایل به سمت عقب بدن با حاشیه صاف تا ناهموار، برجستگی‌های چهارگانه کاذب، دیسک لیبی برآمده، استایلت به طول ۷۲-۸۰ میکرومتر، فرج بسته، دم مخروطی با انتهای گرد یک تا چندلویی می‌باشد. خصوصیات سه گونه مورد مطالعه با مشخصات جمعیت‌های تیپ این سه گونه و داده‌های سایر جمعیت‌ها مطابقت دارد. دو گونه *M. kirjanovae* و *M. surinamense* گزارش‌های جدید برای فون نماتدهای ایران هستند و داده‌های ریخت‌شناسی و ریخت‌سنجی جمعیت ایرانی گونه *C. amorphus* برای اولین بار ارائه می‌گردد.

واژگان کلیدی: استان آذربایجان شرقی، *Mesocriconema kirjanovae*، *Criconemoides amorphus*، *M. surinamense*، طبقه‌بندی