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Research Article

# Description of *Criconema iranicum* n. sp. (Nematoda: Criconematidae) from Iran

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**Abstract:** *Criconema iranicum* n. sp. was recovered from the rhizospheric soil of date palm in Khuzestan province, southwest Iran, and described and illustrated based upon morphological and morphometric data. The new species is characterized by 435-515 µm long females having a lip region with two annuli, the first labial annulus slightly wider than the second annulus, 76.5-84.0 µm long stylet with anchor-shaped knobs, vulva closed, its anterior lip not curving over the posterior lip, anus small, 5-7 annuli posterior to vulva, 16.4-23.0 µm long conical tail, bearing 3-5 annuli, its terminal annulus simple or bifurcate, R = 61-65, RV = 9-11, juvenile present and males absent. Morphologically, the new species looks similar to four known species under the genus *viz. C. annuliferum*, *C. duplicivestitum*, *C. navarinoense* and *C. sanctusfrancisci*. Comparisons with the four aforementioned species are discussed. This is the first species of the genus being originally described from Iran.

**Keywords:** Date palm, Khuzestan province, morphology, morphometric data, new species, taxonomy

## Introduction

The family Criconematidae Taylor, 1936, commonly known as ring nematodes, comprises obligatory ectoparasitic nematodes of economic importance on some crops in high populations. They mostly prefer sandy soil habitats, feed on the root cortex with anterior body region usually push into the root surface (Siddiqi, 2000). According to him, the family includes three subfamilies *viz.* Criconematinae Taylor, 1936, Hemicriconemoidinae Andrássy, 1979 and Macroposthoniinae Skarbilovich, 1959. However, in addition to three abovementioned subfamilies, Geraert (2010) included two further subfamilies, Blandicephalanematinae Geraert, 2010 and Discocriconemellinae Geraert, 2010.

According to Eskandari (2018), around 36 Criconematidae spp. occur in Iran (based on the reports until 2016). In recent years, some taxonomic and phylogenetic studies (Jahanshahi Afshar *et al.*, 2019 a, b; Hosseinvand *et al.*, 2020; Azimi and Pedram, 2020) have further increased our knowledge on diversity of the family in Iran.

The genus *Criconema* Hofmänner & Menzel, 1914 belongs to the subfamily Criconematinae and currently contains 101 valid species (Geraert, 2010; Cordero *et al.*, 2012; Powers *et al.*, 2017; Hosseinvand *et al.*, 2020). It is known in Iran with eight representatives including *C. annuliferum* (de Man, 1921) Micoletzky, 1925, *C. jaejuense* (Choi & Geraert, 1975) Raski & Luc, 1985, *C. longulum* Gunhold, 1953, *C. mutabile* (Taylor, 1936) Raski & Luc, 1985, *C. neoaxeste* (Jairajpuri & Siddiqi, 1963) Raski & Luc, 1985, *C. cylindraceum* (Ivanova & Shagalina, 1986) Raski & Luc, 1987,

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*C. crotaloides* (Cobb, 1924) Schuurmans Stekhoven & Teunissen, 1938 and *C. princeps* (Andrássy, 1962) Raski & Luc, 1985 (Eskandari, 2018; Hosseinvand *et al.*, 2020; Jahanshahi Afshar *et al.*, 2020).

In present study, a *Criconema* population was recovered from rhizospheric soil of date palm (*Phoenix dactylifera* L.) in Khuzestan province, southwest Iran. The morphological comparisons with the nominal species under the genus revealed it belongs to a new species of the genus, being described herein as *Criconema iranicum* n. sp.

## Materials and Methods

Several soil samples were collected from date palm gardens in Khuzestan province, southwest Iran during April 2019. The Jenkins (1964) method was used to extract the nematodes from soil samples. The collected specimens were killed in hot 4% formaldehyde solution, transferred to anhydrous glycerin according to De Grisse's (1969) method. Observations and measurements were done using a Leitz SM-LUX light microscope equipped with drawing tube. Some of the specimens were photographed using an Olympus DP72 digital camera attached to an Olympus BX51 light microscope equipped with differential interference contrast (DIC).

## Results

***Criconema iranicum* n. sp.**
(Figs 1-3)

**Measurements**
See Table 1.

**Description**
*Female*
Body slightly ventrally arcuate after heat relaxation, bluntly truncate in anterior end, slightly tapers towards posterior end. Lip region low, rounded, with two annuli, the first labial annulus slightly wider than the second annulus. Body annuli slightly retrorse with smooth margin, rarely a single anastomosis present. Stylet long, slightly bent in some specimens, knobs anchor-shaped. Excretory pore opposite to pharynx base, to three annuli posterior. Hemizonid not clearly seen. Reproductive system monodelphic-prodelphic, outstretched, composed of a long ovary with oocytes arranged in one or two rows, spermatheca almost round, filled with spheroid sperm cells, vulva closed and without vulval flaps, its anterior lip not curving over the posterior one. Anus small, 5-7 annuli posterior to vulva. Tail short, conical, bearing 3-5 annuli, the terminal annulus simple or bifurcate.
*Male*
Not found, probably present as spermatheca contained sperm.
*Juvenile*
One juvenile specimen was found. The recovered juvenile looks similar to females except for its smaller body and not developed sexual organs, and is characterized by having longitudinal rows of projected scales.

**Type host and locality**
Rhizospheric soil of date palm collected in city of Behbahan, Khuzestan province, southwest Iran. The geographical position of the sampling site is 30°35′ 45″N, 50°14′ 30″E.

**Etymology**
The specific epithet refers to the country name where it was found.

**Type material**
Holotype female, five paratype females and one paratype juvenile were deposited in USDA nematode collection (USDNC), Beltsville, MD, USA.

**Diagnosis and relationships**
*Criconema iranicum* n. sp. is mainly characterized by 435-515 µm long females having a lip region with two annuli, the first labial annulus slightly wider than the second one, 76.5-84.0 µm long stylet with anchor-shaped knobs, closed vulva with simple lips, anus 5-7 annuli posterior to vulva, conical tail with 3-5 annuli, its terminal annulus simple or bifurcate, R = 61-65, RV = 9-11, juvenile present and males absent.

By similar general morphology, the new species looks similar to four known species under the genus *viz. C. annuliferum*, *C. duplicivestitum* (Andrássy, 1963) Raski & Luc, 1985, *C. navarinoense* Raski & Valenzuela, 1988 and *C. sanctusfrancisci* (Van den Berg & Heyns, 1977) Raski & Luc, 1985. The comparisons with the aforementioned species follow (the used data of the compared species after Geraert, 2010). The present new species differs:

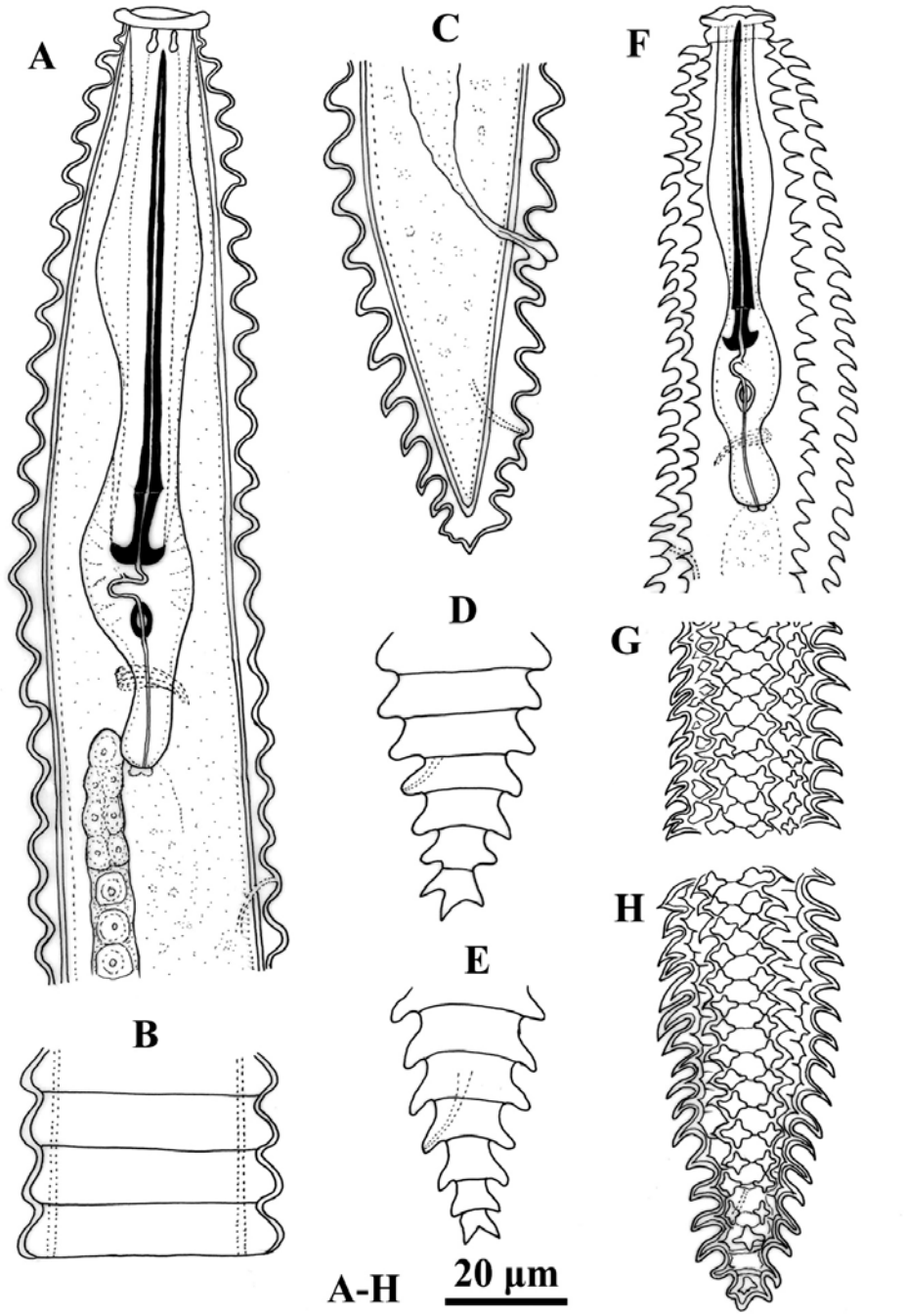


**Figure 1** Line drawings of *Criconema iranicum* n. sp. A-E: Female and F-H: Juvenile. A & F: Anterior body region; B & G: Annuli at mid-body; C-E&H: Posterior body region.

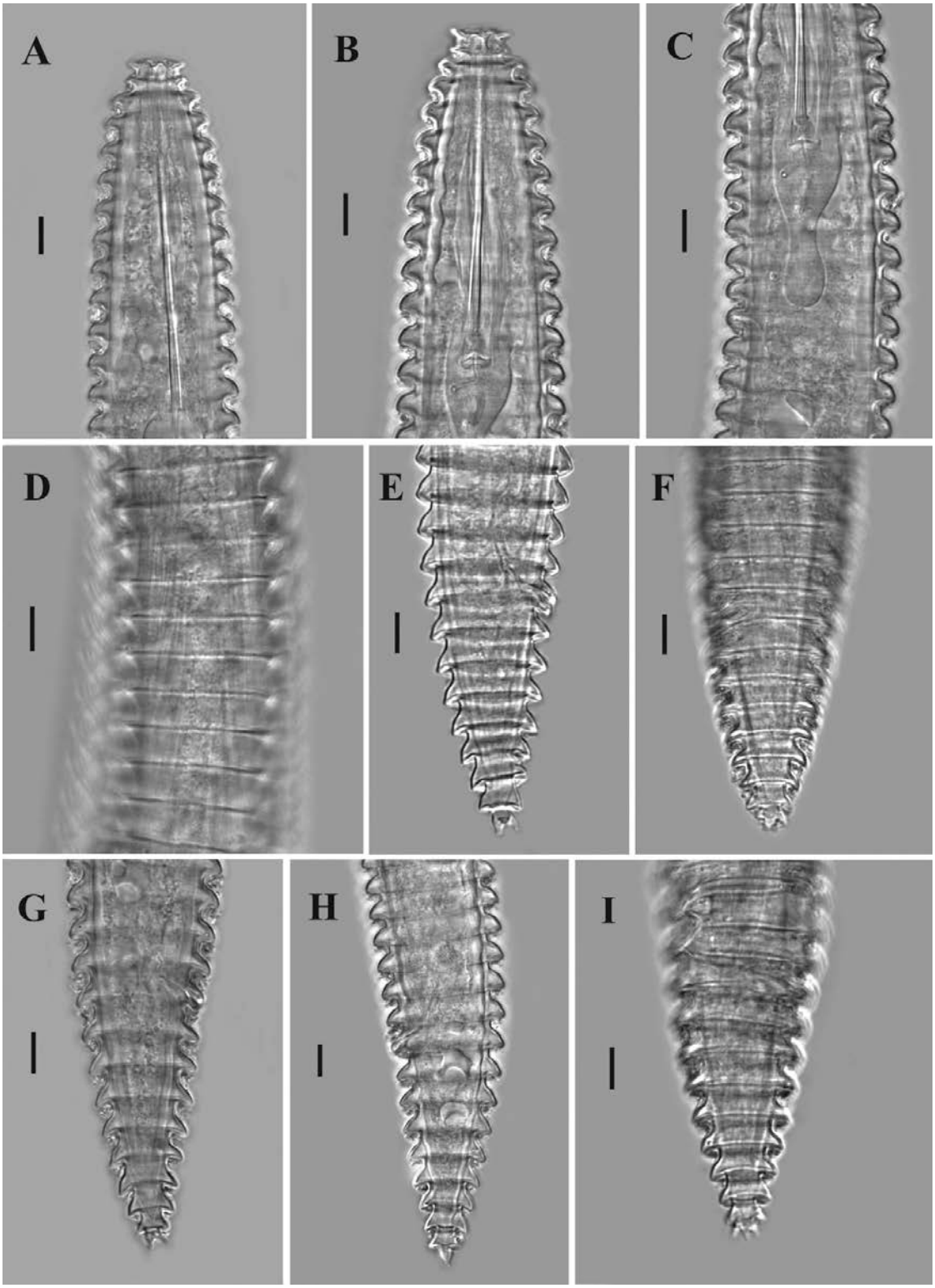


**Figure 2** Light microphotographs of *Criconema iranicum* n. sp., female. A&B: Anterior body region; C: Part of pharynx; D: Annuli at mid-body; E-I: Variation of posterior body region. (Scale bars = 10 $\mu$m).

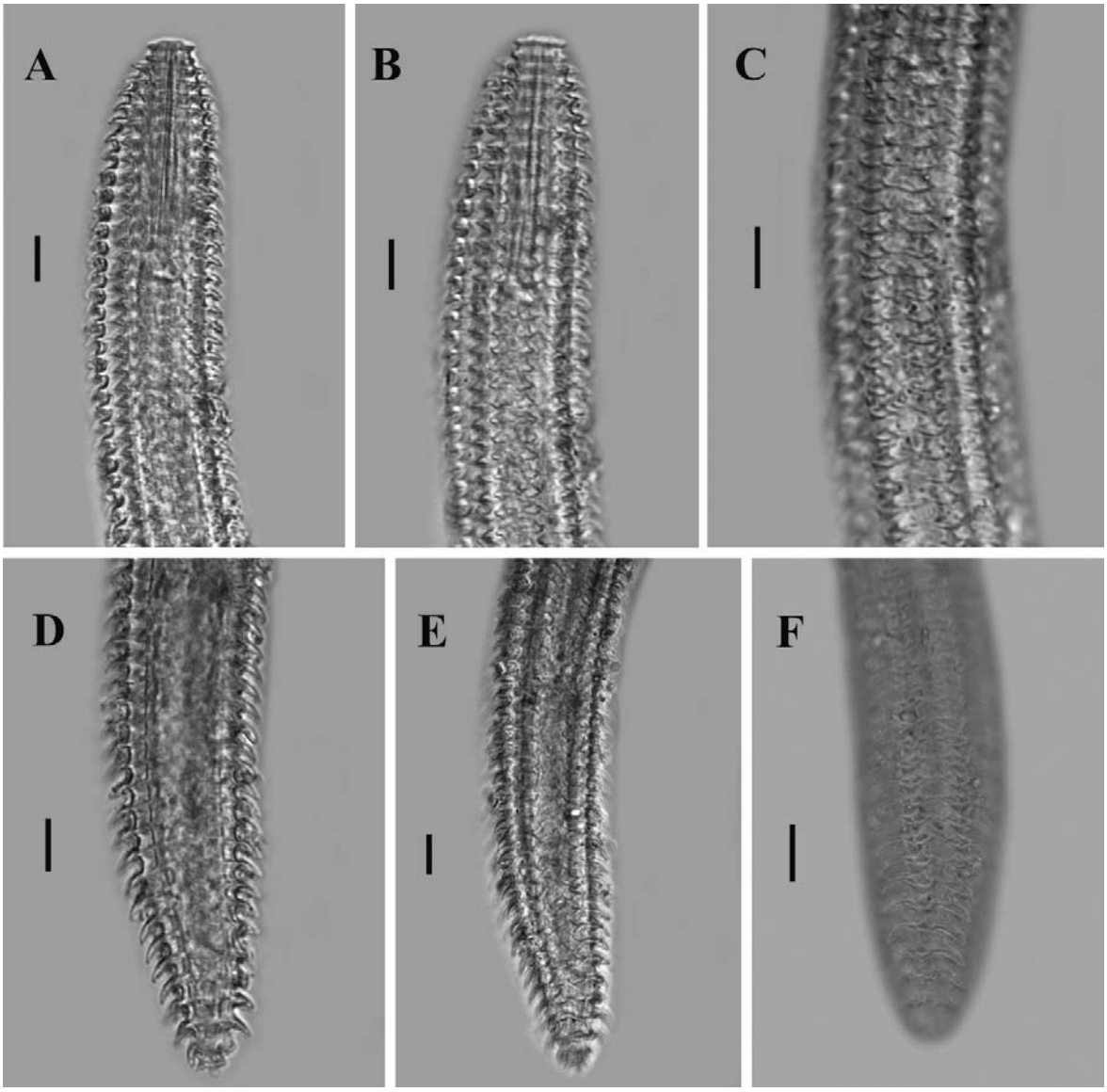


**Figure 3** Light microphotographs of *Criconema iranicum* n. sp., juvenile. A & B: Anterior body region; C: Mid-body; D-F: Posterior body region. (Scale bars = 10 $\mu$m).

From *C. annuliferum*, by slightly shorter body (435-515 *vs* 430-680 µm), shorter stylet (76.5-84.0 *vs* 80-113 µm), slightly less R and Rex (61-65 *vs* 58-78 and 18-20 *vs* 18-26, respectively), lip region with two annuli (*vs* two or three), body annuli slightly retrorse (*vs* not retrorse) and anterior vulval lip not curving over the posterior lip (*vs* forming flap covering the vulva).

From *C. duplicivestitum*, by longer stylet (76.5-84.0 *vs* 60-72 µm), higher RV (9-11 *vs* 6-9), higher RVan (5-7 *vs* 2-3), higher VL/VB ratio (1.3-1.9 *vs* 1.0-1.3), anterior vulval lip not curving over posterior lip (*vs* covering the posterior vulval lip) and tail shape (conical *vs* bluntly conical).

From *C. navarinoense* by longer stylet (76.5-84.0 *vs* 67-72 µm), slightly lower R (61-65 *vs* 63-71), higher VL/VB (1.3-1.9 *vs* 1.1-1.3), lip region with two annuli (*vs* one), anterior vulval lip not curving over posterior lip (*vs* covering the posterior lip) and the terminal annulus of the tail slightly pointed, simple or bifurcate (*vs* simple with rounded terminus).

**Table 1** Morphometrics of *Criconema iranicum* n. sp. from Khuzestan province, Iran.

| Character | Holotype | Paratypes | Juvenile |
|---|---|---|---|
| n | 1 | 5 | 1 |
| L | 512 | 480 ± 33.9 (435-515) | 254 |
| a | 11.9 | 11.1 ± 0.7 (10.0-11.9) | 7.4 |
| b | 3.8 | 3.9 ± 0.2 (3.8-4.2) | 3.1 |
| c | 30.6 | 24.7 ± 5.4 (19.8-31.4) | 19.2 |
| c' | 1.0 | 1.1 ± 0.2 (0.9-1.4) | 0.7 |
| o | 9.6 | 9.1 ± 1.3 (6.4-10.0) | 5.1 |
| DGO | 8.0 | 7.5 ± 1.1 (5.3-8.5) | 2.7 |
| V | 88.6 | 88.4 ± 2.4 (85.2-91.0) | - |
| Stylet | 83 | 81.1 ± 2.9 (76.5-84.0) | 52.7 |
| m | 89 | 88.2 ± 1.9 (85.7-91.0) | 87.2 |
| Stylet knob height | 3.0 | 3.5 ± 0.4 (3.0-4.5) | 2.5 |
| Stylet knob width | 8.1 | 8.1 ± 0.5 (7.3-8.6) | 5.5 |
| Excretory pore from anterior end | 136.8 | 135 ± 7.2 (126-145) | 86 |
| Diam. at mid-body | 43 | 42.6 ± 0.6 (41-43) | 34 |
| Diam. at anus (ABD) | 16.7 | 17.2 ± 1.6 (14.8-19.5) | 17.7 |
| Diam. at vulva | 34 | 33.9 ± 1.0 (32-35) | - |
| Vulva-anterior body distance | 453.8 | 422 ± 35.4 (375-468) | - |
| Vulva-tail terminus distance | 58.2 | 57.6 ± 7.4 (46.6-67.8) | - |
| First lip annulus diam. | 16.7 | 17.2 ± 1.5 (15-19) | 12.4 |
| Second lip annulus diam. | 15.7 | 15.2 ± 0.9 (14-17) | 11.2 |
| First body annulus diam. | 20.9 | 20.8 ± 1.2 (19-22) | 17.7 |
| Second body annulus diam. | 26.3 | 26.1 ± 1.4 (24.0-28.6) | 20.7 |
| Third body annulus diam. | 28.3 | 28.8 ± 2.1 (26-31) | 22.5 |
| Pharynx length | 133.8 | 124 ± 6.9 (115-134) | 80.1 |
| Annulus width | 8.1 | 8.6 ± 0.8 (7.6-9.6) | 3.5 |
| Tail length | 16.7 | 19.8 ± 3.5 (16.4-23.0) | 13.2 |
| R | 65 | 63.0 ± 1.6 (61-65) | 64 |
| RSt | 13 | 12.8 ± 0.9 (11-15) | 16 |
| ROes | 19 | 17.6 ± 1.1 (16-19) | 23 |
| Rex | 20 | 19.2 ± 1.1 (18-20) | 25 |
| RV | 10 | 10.0 ± 0.6 (9-11) | - |
| RVan | 7 | 6.1 ± 0.7 (5-7) | - |
| Ran | 3 | 4.2 ± 0.7 (3-5) | 4 |
| VL/VB | 1.7 | 1.6 ± 0.2 (1.3-1.9) | - |
| St%L | 16.2 | 16.8 ± 0.6 (16.2-17.5) | 20.7 |

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

From *C. sanctusfrancisci* by lower R (61-65 *vs* 70-84), lower Rex (18-20 *vs* 20-24), wider annuli at mid-body (7.6-9.6 *vs* 4.5-7.0 µm wide), margins of annuli smooth (*vs* slightly serrated, especially in the tail region) and the terminal annulus of the tail slightly pointed,

simple or bifurcate (*vs* simple with narrowly rounded terminus).

## Discussion

The objective of this study was the morphological characterization of *Criconema iranicum* n. sp., a new member of the genus. Based on the available information (Eskandari, 2018), the genus *Criconema* is considered as a rare plant parasitic nematode genus in Iran. The two previously reported species of the genus from the country (out of eight species), *C. cylindraceum* and *C. jaejuense* (Eskandari, 2018; Hosseinvand *et al.*, 2020), have been recovered from Khuzestan province, having a warm and semi-desert climate. *C. iranicum* n. sp. represents the ninth species of this genus occurring in Iran and the first representative being originally described from the country.

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## Conflict of Interests

No potential conflict of interest was reported by the authors.

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# توصیف گونه *Criconema iranicum* n. sp. (Nematoda: Criconematidae) از ایران

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**چکیده:** گونه *Criconema iranicum* n. sp. به‌دست آمده از ریزوسفر درخت خرما در استان خوزستان واقع در جنوب غرب ایران، براساس داده‌های ریخت‌شناسی و ریخت‌سنجی توصیف شده است. این‌گونه جدید با داشتن ماده‌هایی به طول ۴۳۵ تا ۵۱۵ میکرومتر، ناحیه لب با دو حلقه، حلقه اول کمی عریض‌تر از حلقه دوم، استایلت به طول ۷۶/۵ تا ۸۴/۰ میکرومتر با گره‌های لنگری‌شکل، فرج بسته، لب جلوئی فرج بدون خمیدگی روی لب عقبی، مخرج ۵ تا ۷ حلقه عقب‌تر از فرج، دم به طول ۱۶/۴ تا ۲۳/۰ میکرومتر، مخروطی، دارای ۳ تا ۵ حلقه و حلقه انتهایی ساده و یا دو شاخه، شاخص R مساوی ۶۱ تا ۶۵، شاخص RV مساوی ۹ تا ۱۱، وجود لارو و عدم وجود جنس نر مشخص می‌شود. از نظر ویژگی‌های ریخت‌شناسی، گونه جدید به گونه‌های *C. annuliferum*، *C. duplicivestitum*، *C. navarinoense* و *C. sanctusfrancisci* شباهت دارد. تفاوت‌های گونه جدید با گونه‌های مشابه ذکر شده مورد بحث قرارگرفته است. این اولین گونه از جنس است که از ایران توصیف می‌شود.

**واژگان کلیدی:** استان خوزستان، خرما، داده‌های ریخت‌سنجی، ریخت‌شناسی، طبقه‌بندی، گونه جدید