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Three species of the genus *Basiria* (Nematoda: Tylenchidae) from fruit orchards in Khuzestan province, Southwestern Iran

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Abstract

The soil samples were collected from pomegranate, fig, grapevine, berry, date palm, lemon and orange to identify the nematodes of the genus *Basiria* in the fruit orchards of Khuzestan province (Southwestern Iran). After extraction, fixation and transferring to anhydrous glycerol, the nematodes were mounted on microscopic slides. Nematodes identified at the species level, based on morphological and morphometrical characters, using a light microscope equipped with a drawing tube and valid keys. In this study, three species were identified, namely: *B. berylla*, *B. gracilis* and *B. graminophila*. Morphometrics and light micrography were provided for the studied species. This is a new record of *B. berylla* and *B. gracilis* for the nematode fauna in the Khuzestan province. According to available references, this is the first report of *B. berylla* from berry and fig and *B. gracilis* from grapevine in Iran.

Keywords: First record, Morphology, Morphometric, Plant-parasitic

1 Introduction

The members of the family Tylenchidae Örley, 1880 are abundant and diverse such that they may constitute up to 30% of the nematodes in any given soil sample (Qing et al. 2017). The family Tylenchidae includes five subfamilies, namely: Atylenchinae Skarbilovich, 1959; Boleodorinae Khan, 1964; Ecphyadophorinae Skarbilovich, 1959; Tylenchinae Örley, 1880; and Tylodorinae Paramonov, 1967 (Geraert 2008).

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The genus *Basiria* Siddiqi, 1959 belongs to the subfamily Boleodorinae and currently contains 42 valid species (Geraert 2008). Recently, two species include *B. birjandiensis* Alvani, Mahdikhani-Moghadam, Rouhani, Mohammadi & Karssen, 2016 (Alvani et al. 2016) and *B. khouzestanensis* Eisvand, Farrokhi-Nejad& Azimi, 2019 (Eisvand et al. 2019), were described from Iran. The present study aims to provide morphological and morphometric data for three species of the genus *Basiria* in the fruit orchards of Khuzestan province, Southwestern Iran .

2 Materials and Methods

Several soil samples were collected from fruit orchards include pomegranate, fig, grapevine, berry, date palm, lemon and orange in Khuzestan province, southwestern Iran. 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. In some samples, the tray method (Whitehead & Hemming 1965) was employed to obtain a suspension of nematodes from the soil.

Nematodes were mounted in a small drop of glycerin on permanent slides. Observations and measurements were done using an Olympus CX31 light microscope equipped with a drawing tube. Some of the specimens were photographed using an Olympus DP12 digital camera attached to an Olympus BX51 light microscope. Nematode species of the genus *Basiria* were identified based on morphological and morphometric characters using the key given by Geraert (2008).

3 Results and Discussion

Based on morphological and morphometric characters, three species of the genus *Basiria* were identified, namely: *B. berylla* (Khan & Khan, 1975) Bajaj & Bhatti, 1979, *B. gracilis* (Thome, 1949) Siddiqi, 1963 and *B. graminophila* Siddiqi, 1959. Morphometric measurements of the identified species closely matched published reports. The most important morphological characters of the studied species are illustrated in Figures 1-3. The morphometrics of the studied species are given in Tables 1-3.

***Basiria berylla* (Khan & Khan, 1975) Bajaj & Bhatti, 1979**
(Fig. 1)
Measurments See Table 1.

The general morphology of the recovered population of the species closely resembles the characters given by Geraert, 2008. However, the Gubernaculum length is slightly longer (4.5-6 vs 2.5-3.5 μm). *B. berylla* has been reported from the rhizosphere of bamboo in Kerman province (Karegar & Geraert, 1997a), banana in Kerman province (Jahanshahi Afshar et al. 2006) and apple in West Azarbaijan province (Ghorbanzad et al. 2014) of Iran. The population of Khuzestan province has differences with the population of the same species from Kerman province. These differences are in body length (600-692 vs 510-615 µm), length of excretory pore from anterior end (80-101 vs 64-72 µm) and tail length (99-145 vs 88-102 µm).

In the present study, this species was recovered from the rhizosphere of berry and fig in the vicinity of Shoosh (GPS coordinates: 32°11' 39.12" N, 48° 14' 36.96" E) city, Khuzestan province, southwestern Iran. This is a new record of *B. berylla* for the nematode fauna in Khuzestan province. Also, this is the first report of *B. berylla* from berry and fig in Iran.

Table 1. Morphometrics of *Basiria berylla* collected from southwestern Iran and their comparison with the type population. All measurements are in μm and in the form: mean ± s.d. (range).

Character	Khuzestan province		Geraert, 2008	
	Female	Male	Female	Male
n	7	6	-	-
L	638.3±39.5 (600-692)	605.7±66.4 (567-646)	510-700	-
a	35.4±2.9 (31.6-37.4)	37.9±1.8 (36.5-40)	33-39	-
b	5.6±0.2 (5.5-5.8)	5.4± 0.3 (5-5.6)	-	-
c	5.1±1.1 (4.1-6.3)	4.4± 0.8 (3.7-5.3)	4.0-5.5	-
c'	11.9±1.0 (10.9-13.2)	10.4±1.5 (9-12)	12	-
V	60.2±4.8 (56.5-67)	-	55-64	-
V'	76±4.1 (72.3-81)	-	75-79	-
Stylet length	10.2±1.4 (9.2-11.5)	9.1±0.5 (8.7-9.8)	10.5-12	-
DGO	3.2±0.4 (2.7-3.4)	3.1±0.4 (2.6-3.3)	2-3	-
MB	37.8±1.6 (35.7-39.2)	38.3±1.5 (37-40)	36-38	-
Body width	18±1.2 (16.7-19)	15.9±1.9 (14-17.7)	-	-
Excretory pore	88.7±10.9 (80-101)	86.7±3.8 (84-91)	-	-
Vulval body width	17.2±2.8 (14-19.2)	-	-	-
Vulva-anus	118.6±28.5 (95-151)	-	-	-
Anal body width	11±2.4 (8.6-13.5)	11.8±2.1 (11-12.5)	-	-
Tail length	129.3±26.4 (99-145)	138.3±15 (121-148)	119-128	-
T/VA	0.9 ± 0.2 (0.7-1.1)	-	1.0-1.1	-
PVUS	9.4 ± 1.0 (8-10)	-	-	-
Spicule length	-	14.7±2.1 (13.2-17)	-	13.5-14.5
Gubernaculum length	-	5.5±0.9 (4.5-6)	-	2.5-3.5

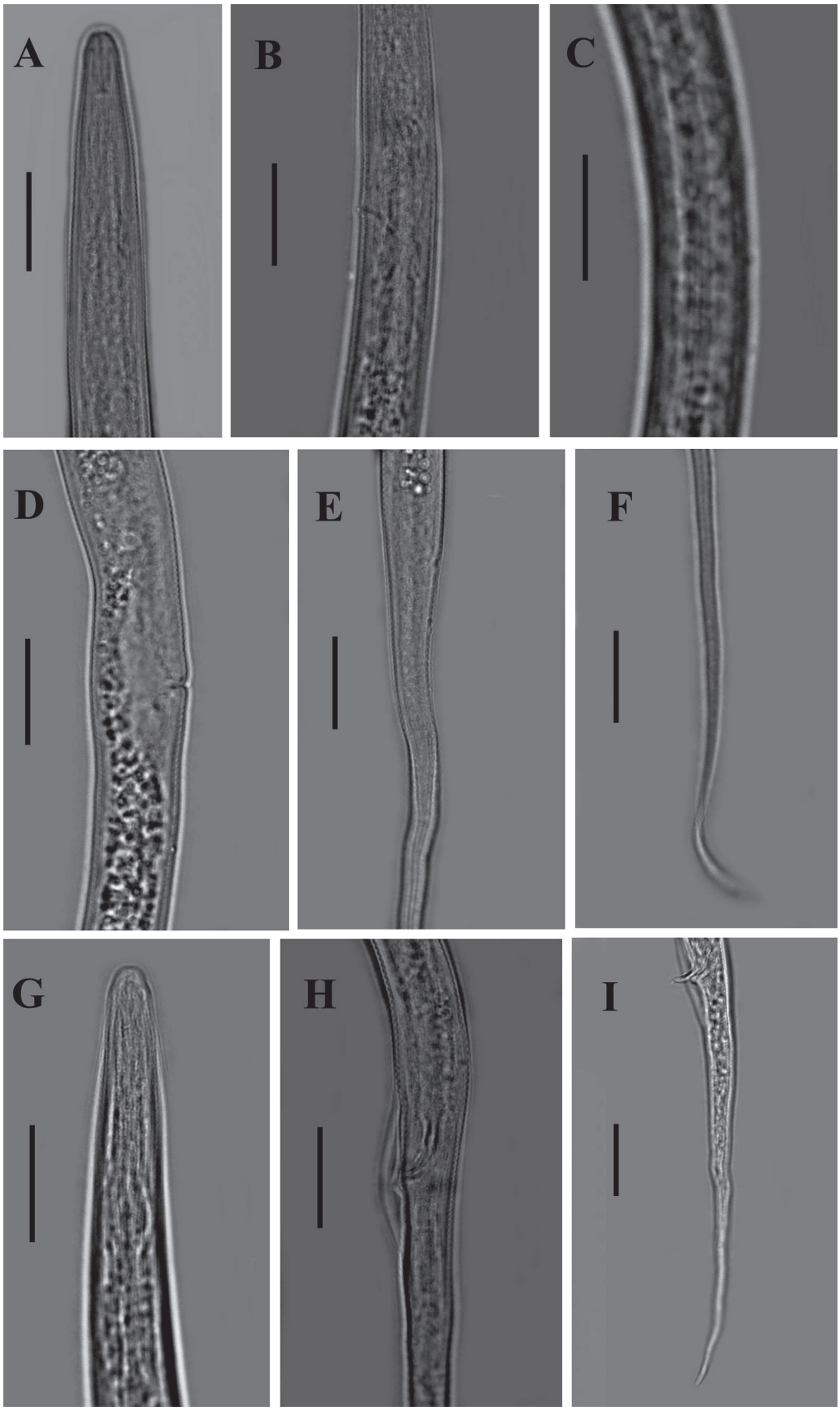

Figure 1.*Basiria berylla* A&B: Female anterior region, C: Lateral field at mid-body, D: Vulval region, E&F: Female tail, G: Male anterior region, H&I: Male tail. (Scale bars = 20 μm).

***Basiria gracilis* (Thome, 1949) Siddiqi, 1963**

(Fig. 2)

Measurments See Table 2.

The general morphology of the Iranian population of the species closely resembles the characters given in the original description. *B. gracilis* has been reported from the rhizosphere of tea and citrus in Guilan and Mazandaran provinces (Kheiri, 1972), pea in Mazandaran province, bamboo in Kerman province, plum in Guilan province (Karegar & Geraert, 1997b) and onion in North Khorasan province (Shahi-Bajestani & Mahdikhani-Moghadam, 2014) of Iran.

In the present study, this species was recovered from the rhizosphere of grapevine in the vicinity of Shoosh (GPS coordinates: 32°11' 39.12" N, 48° 14' 36.96" E) city, Khuzestan province, southwestern Iran. This is a new record of *B. gracilis* for the nematode fauna in Khuzestan province. Also, this is the first report of *B. gracilis* from grapevine in Iran.

Table 2. Morphometrics of *Basiria gracilis* collected from southwestern Iran and their comparison with the type population. All measurements are in μm and in the form: mean ± s.d. (range).

Character	Khuzestan province		Geraert, 2008	
	Female	Male	Female	Male
n	7	3	-	-
L	622.5±17.6 (610-635)	615.4±39.6 (602-658)	470-990	-
a	32.4±5.1 (29.8-37)	33.9±6.1 (28.3-40)	26-41	-
b	5.5±0.6 (5.0-6.0)	5.6± 0.7 (5.5-7)	-	-
c	4.7±0.4 (4.4-5.1)	4.4± 0.8 (3.7-5.1)	3.7-7.2	-
c'	11.6±0.7 (10.8-13)	10.8±1.5 (10.5-13)	8.6-14.5	-
V	60.1±1.4 (59-61)	-	58-69	-
V'	76.8±1.2 (76-77.8)	-	77-82	-
Stylet length	10.8±1.1 (10-11.6)	10.5±1.0 (9.5-11)	9-12.5	-
DGO	3.5±0.5 (3.0-4.0)	3.2±0.4 (3-3.8)	-	-
MB	48.3±2.3 (47-50.2)	50.2±4.2 (49-55.1)	48-55	-
Body width	20.1±1.4 (19-21)	18.3±1.5 (17-19)	-	-
Excretory pore	85.7±6.8 (81-91)	87.5±9.8 (75-94)	-	-
Vulval body width	18.4±1.2 (17-19.2)	-	-	-
Vulva-anus	106.7±7.5 (104-116)	-	-	-
Anal body width	12.3±1.6 (11-13.2)	11.7±1.2 (11-12.5)	-	-
Tail length	130.3±10.6 (128-143)	131.4±18.2 (125-164)	72-205	-
T/VA	1.1 ± 0.3 (0.9-1.3)	-	0.7-1.6	-
PVUS	12.5 ± 2.1 (11-14)	-	-	-
Spicule length	-	21.2±2.8 (19-23)	-	-
Gubernaculum length	-	9.3±1.5 (8.5-10.6)	-	-

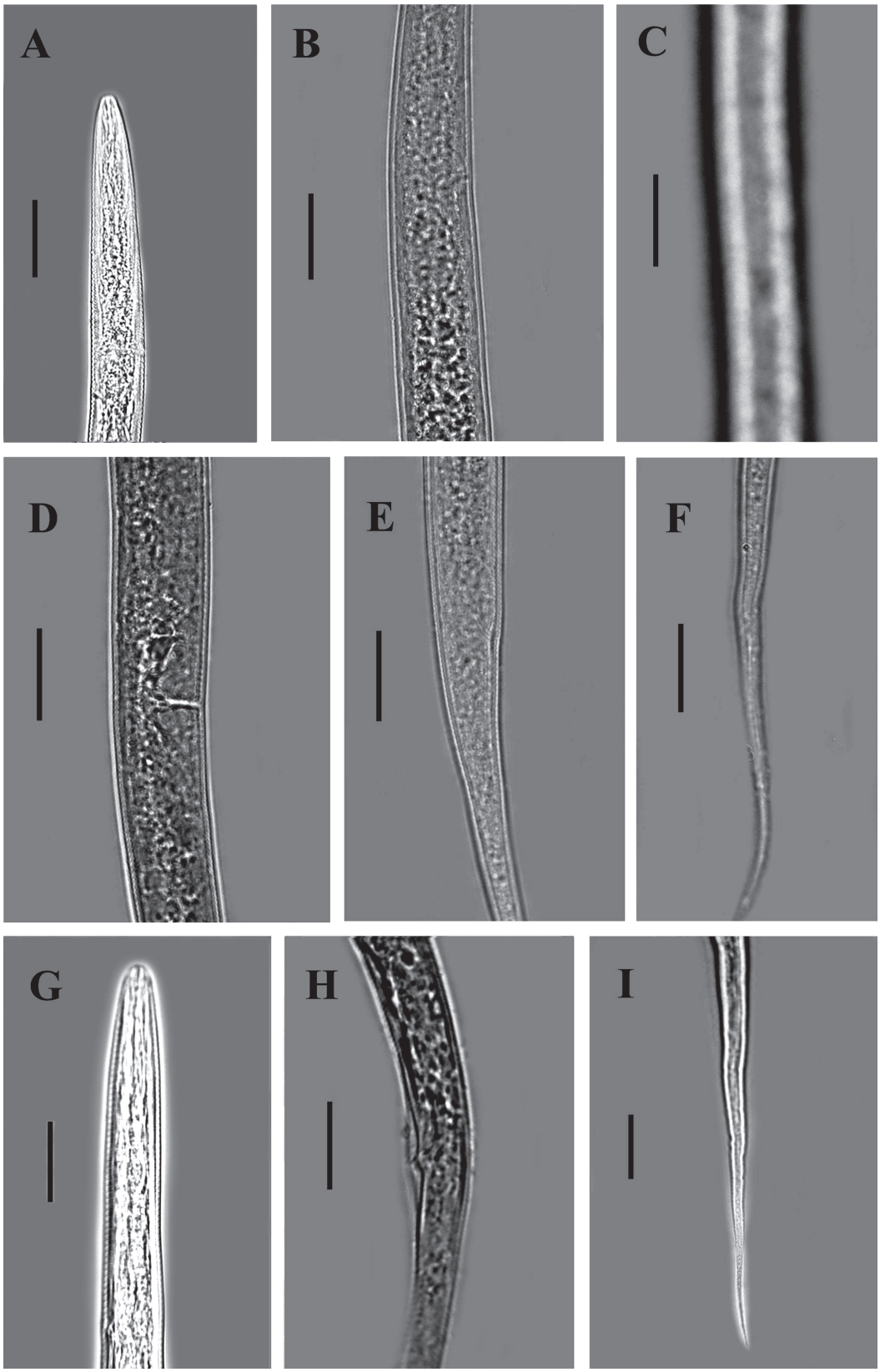

Figure 2. *Basiria gracilis* A&B: Female anterior region, C: Lateral field at mid-body, D: Vulval region, E&F: Female tail, G: Male anterior region, H&I: Male tail. (Scale bars = 20 μm).

Basiria graminophila **Siddiqi, 1959**
(Fig. 3)

Measurments See Table 3.
The general morphology of the recovered population of the species closely resembles the characters given by Geraert, 2008. *B. graminophila* has been reported from the rhizosphere of various plants like rice and citrus in Guilan and Mazandaran provinces (Kheiri, 1972), olive in Guilan province (Hoseini Nejad et al. 1997), citrus in Mazandaran province (Divsalar et al. 2011) and peanut in Guilan province (Mirghasemi et al. 2014).

In the present study , this species was recovered from the rhizosphere of lemon and orange in the vicinity of Shoosh (GPS coordinates: 32°11' 39.12" N, 48° 14' 36.96" E) city, Khuzestan province, southwestern Iran .

Table 3. Morphometrics of *Basiria graminophila* collected from southwestern Iran and their comparison with the type population. All measurements are in μm and in the form: mean ± s.d. (range).

Character	Khuzestan province		Geraert, 2008	
	Female	Male	Female	Male
n	8	5	-	-
L	627.4±50.1 (605-696)	612.4 ±42.1 (565-674)	510-700	-
a	35.7±4.2 (31.2-41.4)	31.7 ±3.8 (31.4-39.8)	30-39	-
b	6.4±1.1 (5.5-7.6)	6.1 ± 0.8 (5.2-6.8)	-	-
c	5.6 ±0.6 (5.1 -6.1)	5.5± 0.6 (5.0-6.0)	5.5-6.8	-
c'	10.8 ± 1.1 (10.9-12.3)	8.9±0.8 (8.0-10.2)	7.0-12.6	-
V	62.2 ±1.1 (61.5-63.1)	-	57.5-72.5	-
V'	78.5±1.6 (77.2-79.5)	-	73.5-84	-
Stylet length	10.4±0.8 (9.5-11)	9.1±0.9 (8.5-10.8)	8-13.5	-
DGO	3.1±0.5 (2.5-3.5)	3±0.4 (2.6-3.4)	2.5-10	-
MB	53.1±3.8 (50.4-56)	51.4±3.4 (48-56)	49-57.5	-
Body width	19.3±1.5 (18-21)	18±1.2 (16-18.5)	-	-
Excretory pore	78.1±3.2 (75-80.3)	75.4±3.5 (70.6-76.3)	-	-
Vulval body width	15.6±2.1 (14-18)	-	-	-
Vulva-anus	112.3±17.8 (92-125)	-	-	-
Anal body width	9.7±2.1 (8-12)	9.4±1.3 (8.8-11.5)	-	-
Tail length	119±22.5 (97-142)	115.6±18.9 (89-136)	56-208	-
T/VA	0.9 ± 0.2 (0.7-1.1)	-	0.6-1.5	-
PVUS	10.1 ± 1 (9.0-12)	-	-	-
Spicule length	-	15.8±2.4 (14-17.6)	-	-
Gubernaculum length	-	4.6±0.5 (4.0-5.5)	-	-

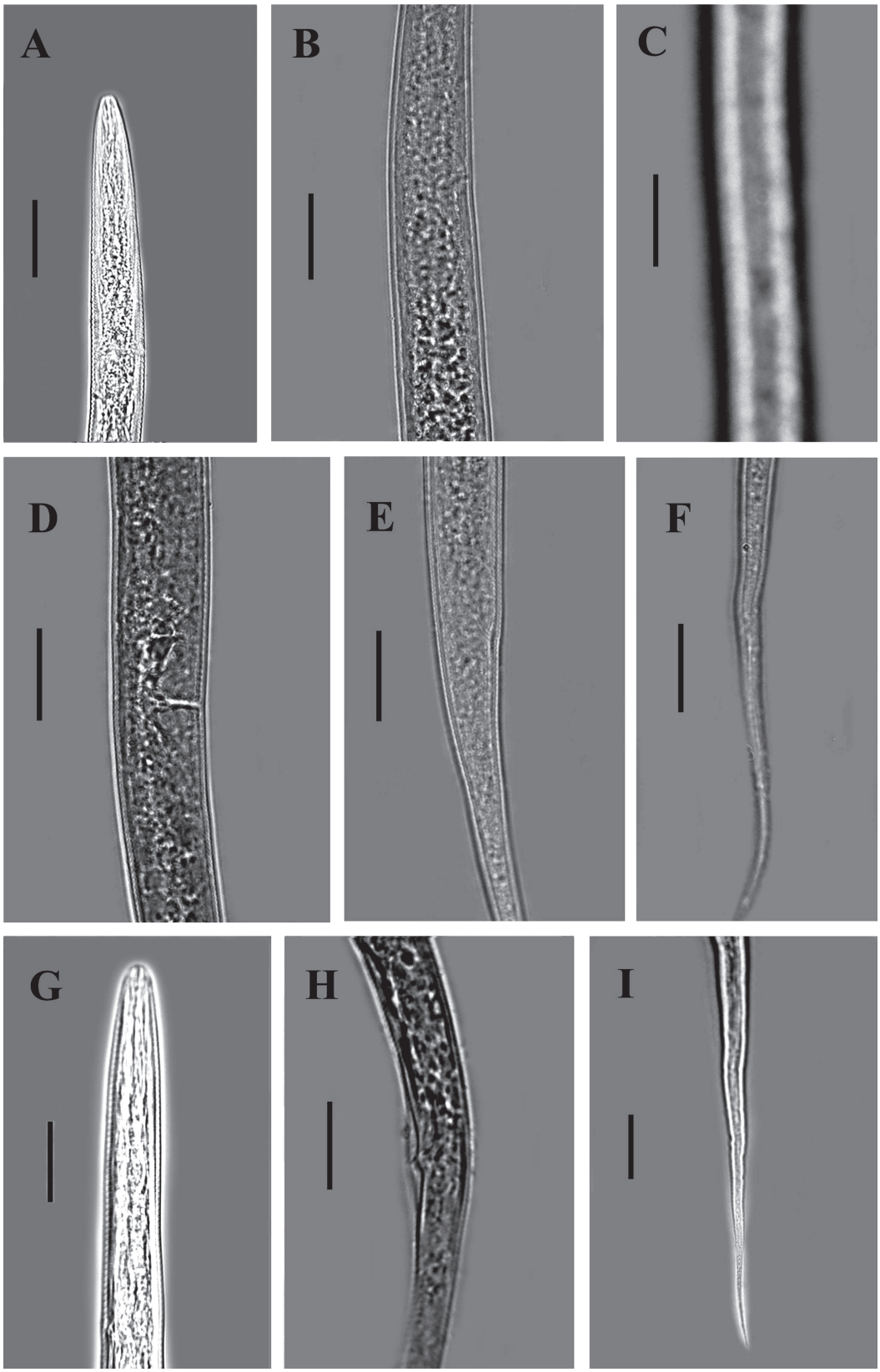

Figure 3. *Basiria graminophila* A&B: Female anterior region, C: Lateral field at mid-body, D: Vulval region, E&F: Female tail, G: Male anterior region, H&I: Male tail. (Scale bars: A-F = 20μm, G-I = 10 μm).

Conflict of interests

There are no conflicts of interest.

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