

Centro de Investigacion y Desarrollo Agrario — 18080 Granada, Spain<sup>1</sup>  
 Istituto di Nematologia Agraria, C.N.R. — 70126 Bari, Italy<sup>2</sup>  
 Instituto de Agronomia y Proteccion Vegetal, C.S.I.C. — 14080 Cordoba, Spain

## MORPHOMETRICS AND SEM OBSERVATIONS OF FOUR CRICONEMATID SPECIES FROM SPAIN

by  
 A. GOMEZ BARCINA<sup>1</sup>, N. VOVLAS<sup>2</sup>, P. CASTILLO<sup>3</sup> and M.A. GONZALES PAIS<sup>1</sup>

**Summary.** Four criconematid species identified as *Criconema annuliferum* (de Man, 1921) Micoletzky, 1925; *Criconema princeps* (Andrassy, 1962) Raski *et* Luc, 1984; *Mesocriconema solivagum* (Andrassy, 1962) Loof *et* De Grisse, 1989 and *Mesocriconema sphaerocephalum* (Taylor, 1936) Loof *et* De Grisse, 1989, are reported from several hosts and habitats in southeastern and central Spain. Each species is briefly described using scanning electron microscopy (SEM) observations. Measurements and SEM illustrations are included for each species and compared with previous data.

During nematode surveys carried out in the southeastern and central regions of Spain soil samples were collected from several natural and cultivated habitats. Some of the samples contained abundant female populations of four species of criconematids identified as follow: *Criconema annuliferum* (De Man, 1921) Micoletzky, 1925, *Criconema princeps* (Andrassy, 1962) Raski *et* Luc, 1984, *Mesocriconema solivagum* (Andrassy, 1962) Loof *et* De Grisse, 1989 and *M. sphaerocephalum* (Taylor, 1936) Loof *et* De Grisse, 1989. Morphology and morphometry of these populations are studied and compared to previous data.

### Materials and methods

Nematodes were extracted from soil samples by centrifugation. Specimens for light microscopy were killed by gentle heat, fixed in a 4% solution of formaldehyde, then processed to glycerin by Seinhorst's (1959, 1962) rapid method. Glycerin totomounts were measured with either a precision curvimeter or ocular micrometer at 1250 $\times$ . Specimens were prepared for SEM by Wergin's methods (Wergin, 1981), coated with gold, and observed with a JEOL 50 A stereoscan at 10 kV accelerating voltage.

### *CRICONEMA ANNULIFERUM* (de Man, 1921) Micoletzky, 1925 (Fig. 1)

*Female.* Body annuli retrorse, without anastomoses and smooth surface. First annulus collar-like, forwardly di-

rected, 15- 18  $\mu$ m wide; second one narrower 10-12  $\mu$ m wide, forming a neck. SEM micrographs show six pseudolips, submedian lobes absent (Fig. 1 A). Vulva located on 8-9th annulus from terminus; vulval lips not prominent, anterior slightly overhanging posterior. Anus difficult to observe even by SEM, located 7-8th annulus from tail terminus. Tail conical, with terminus mostly unilobed, rarely bilobed (Fig. 1 B).

*Male.* Not found.

*Habitat and locality.* Specimens collected from soil of several host and localities: oak tree, *Quercus rotundifolia* Lam., at Sierra Morena, Andujar and olive tree at Lanjaron, Granada; both localities in southeastern Spain.

*Discussion.* Measurements of specimens of this species from Sierra de Cazorla have been presented recently (Gomez Barcina *et al.*, 1989). SEM micrographs are closely similar to those presented by De Grisse and Lagasse (1969) for tail and head regions. It has been recorded previously in Spain from several hosts (Bello, 1979; Bello and Lara, 1986; Peña Santiago, 1990).

### *CRICONEMA PRINCEPS* (Andrassy, 1962) Raski *et* Luc, 1984 (Fig. 2, Table I)

*Female.* Body slightly ventrally curved. Body annuli with smooth margins, retrorse, with rare anastomoses. First annulus hat-like, conspicuously wider than second one, 22.5  $\pm$  1.58 (22- 23)  $\mu$ m wide. Second annulus form-

ing a neck,  $17 \pm 1.82$  (16-18)  $\mu\text{m}$  wide. SEM micrographs show a lip region with six well developed pseudolips (Fig. 2). Vulva closed, located on 8-9th annulus from terminus; anterior vulval lip overhanging. Postvulval body region about one and half times as long as vulval body diameter. Tail conoid elongated.

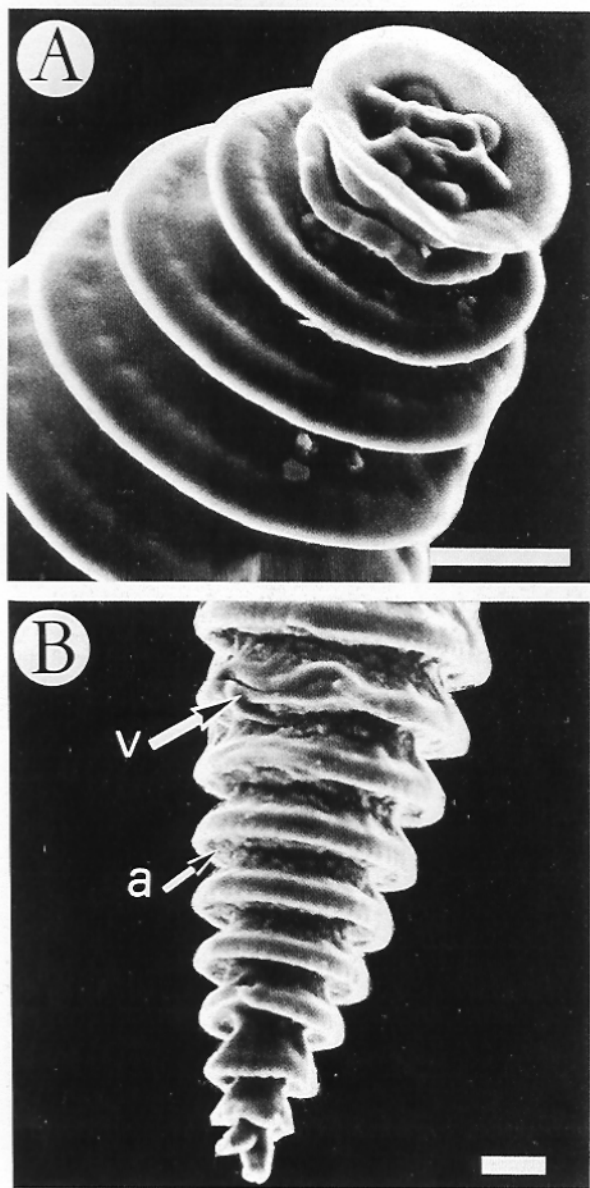


Fig. 1 - SEM micrographs of *Criconema annuliferum* A, anterior region; B, posterior region. (V = vulva; a = anus). Scale bars = 10  $\mu\text{m}$ .

*Male.* Not found.

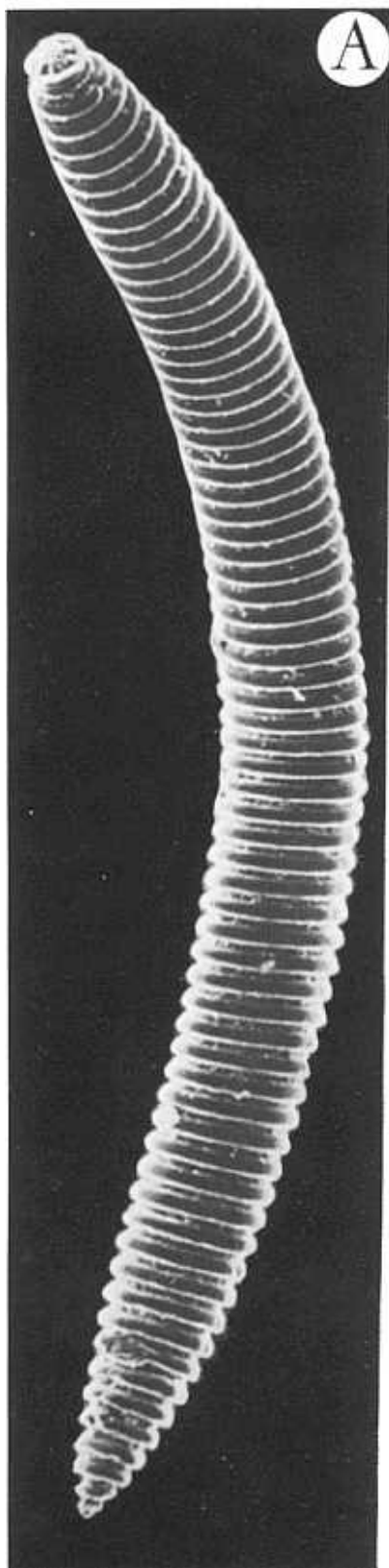
*Habitat and locality.* Specimens collected from soil around the roots of black poplar (*Populus nigro* L.) at Los Molinos, Madrid.

*Discussion.* In general morphology as well as measure-

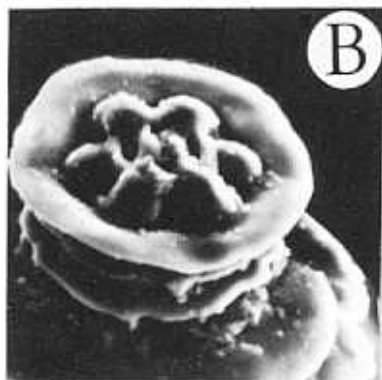
TABLE I - Morphometrics of *Criconema princeps*, females (measurements in  $\mu\text{m}$ ).

	n = 10 Females	
	$\bar{X} \pm \text{SD}$	Range
L	$617.4 \pm 34.8$	571 - 669
a	$9.9 \pm 0.57$	9.5 - 10.8
b	$3.9 \pm 0.26$	3.6 - 4.3
V	$89.5 \pm 0.71$	88 - 90
G <sub>1</sub>	$41 \pm 8.75$	37 - 60
c	$17.9 \pm 1.17$	15.8 - 20.1
c'	$1.15 \pm 0.05$	1.1 - 1.2
stylet	$105.8 \pm 2.44$	102 - 109
stylet % L	$16.9 \pm 1.15$	15.8 - 18.1
stylet % Oes	$66.8 \pm 3.48$	59.3 - 70.9
conus (CP)	$86.9 \pm 1.29$	84 - 88
CP % stylet	$82.1 \pm 1.97$	79.6 - 85.4
R	$68.6 \pm 1.43$	67 - 71
RSt	$13.3 \pm 0.48$	13 - 14
Rex	$23.5 \pm 0.71$	23 - 25
ROes	$17.5 \pm 0.71$	17 - 19
RB	$9.7 \pm 0.57$	9.0 - 11.0
RV	$8.5 \pm 0.53$	8 - 9
RVan	$2.5 \pm 0.53$	2 - 3
Ran	$6.0 \pm 0.67$	5 - 7
VL/VB	$1.4 \pm 0.09$	1.3 - 1.5
oesophagus length	$158.7 \pm 9.02$	148 - 177
nerve ring-anterior end	$139.4 \pm 18.91$	124 - 190
excr. pore-anterior end	$196.6 \pm 18.76$	170 - 227
maximum width	$62.7 \pm 3.02$	59 - 69
ABW	$30.1 \pm 0.99$	29 - 32
tail length	$34.5 \pm 1.43$	32 - 36

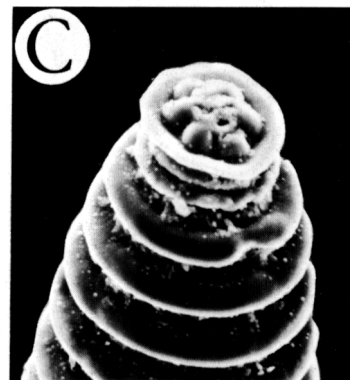
Fig. 2 (Front page) - SEM micrographs of *Criconema princeps* A, entire female; B, C, lip region; D, E, annuli at mid-body; F, posterior body portion; G, vulvar region. (ep = excretory pore, an = anastomose). Scale bars = 10  $\mu\text{m}$ .



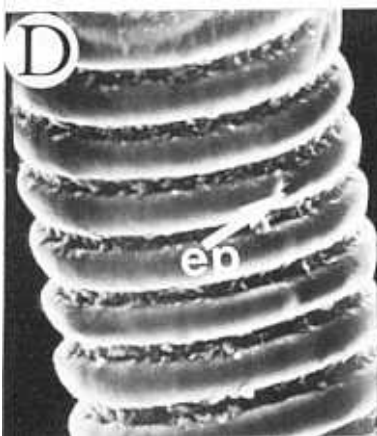
A



B

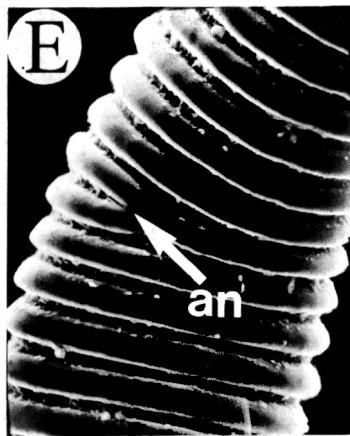


C



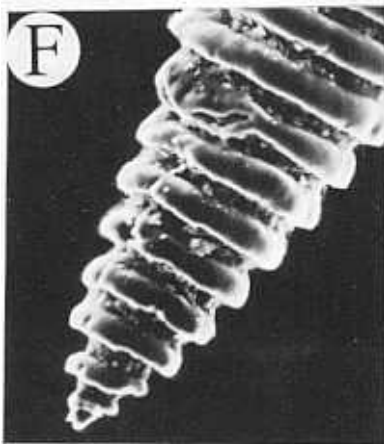
D

eb

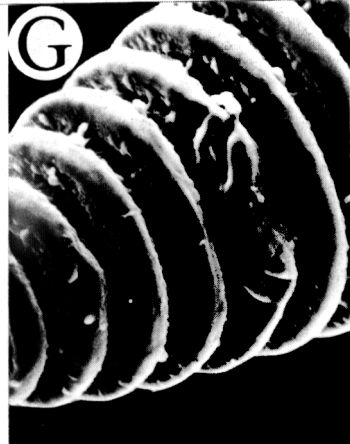


E

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F



G

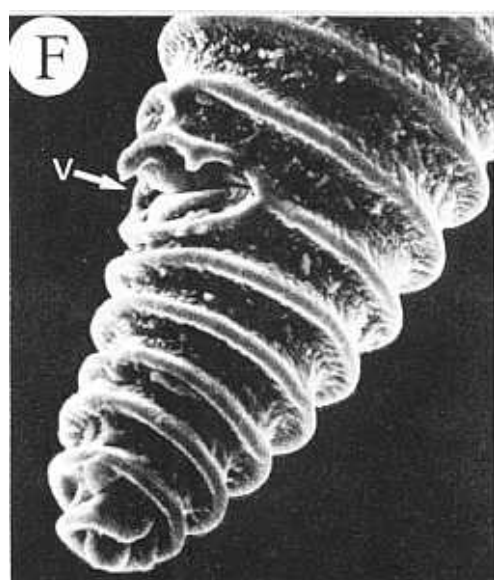
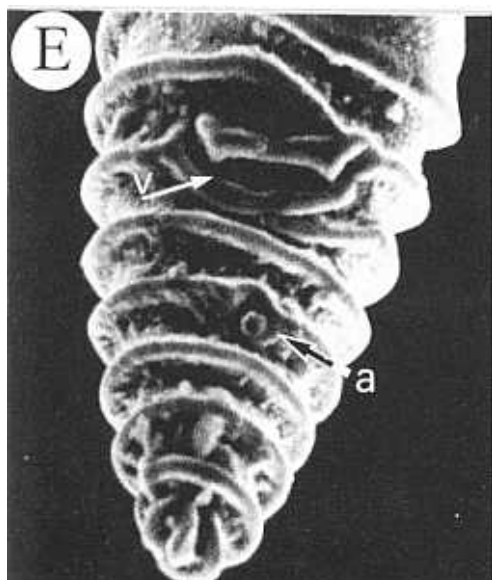
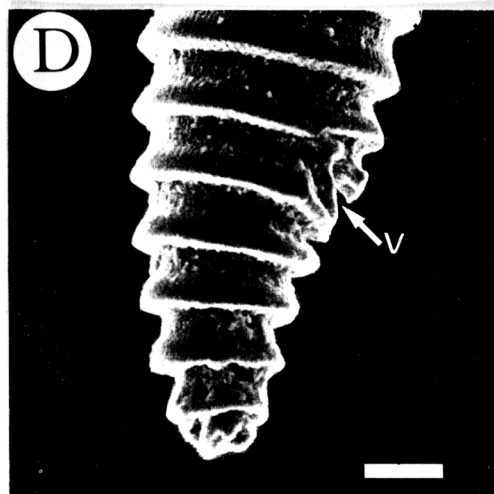
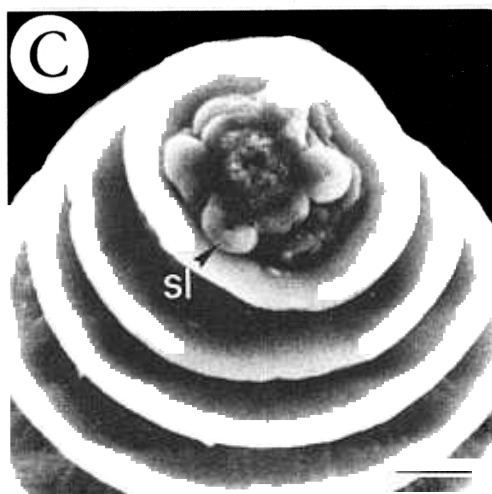
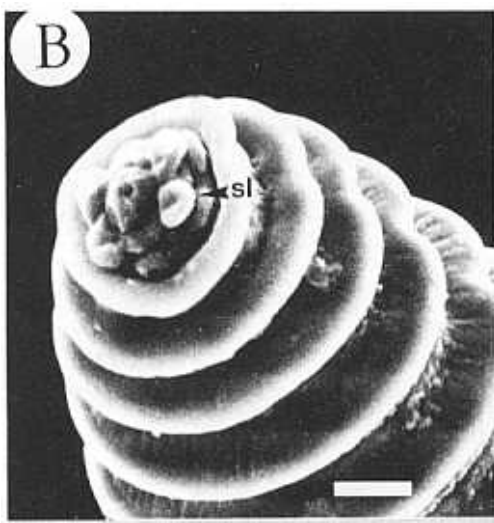
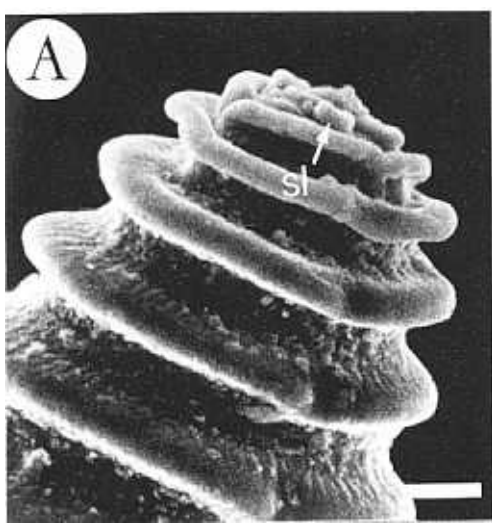
-A

B

-C

-D, E, G

-F



ments, this population fits well with the original description except for slightly higher values of body length and total body annuli. It has been recorded previously in several mediterranean countries, in Spain by Bello (1979), in Italy by Vovlas (1983) and Portugal by Abrantes *et al.* (1987). SEM observations agree well with those of De

Grisse and Lagasse (1969), Vovlas (1983) and Abrantes *et al.*, (1987).

**MESOCRICONEMA SOLIVAGUM**  
(Andrassy, 1962) Loof *et De Grisse*, 1989  
(Fig. 3, Table II)

TABLE II - *Morphometrics of Mesocriconema solivagum, females (measurements in  $\mu\text{m}$ ).*

n = 10 Females		
	$\bar{X} \pm \text{SD}$	Range
L	450.6 $\pm$ 29.80	404 - 508
a	11.6 $\pm$ 1.01	9.9 - 13.0
b	3.9 $\pm$ 0.18	3.7 - 4.3
V	90.6 $\pm$ 1.07	88 - 92
G <sub>1</sub>	51 $\pm$ 6.93	37 - 60
c	17.7 $\pm$ 2.05	15.5 - 21.1
c'	1.1 $\pm$ 0.11	1.0 - 1.3
stylet	64.2 $\pm$ 2.55	60 - 69
stylet % L	14.3 $\pm$ 0.55	13.0 - 14.8
stylet % Oes	56.2 $\pm$ 2.47	53.8 - 61.2
conus (CP)	52.6 $\pm$ 2.17	49 - 56
CP % stylet	82.3 $\pm$ 2.77	77 - 86
R	66.6 $\pm$ 2.99	63 - 71
RSt	11.7 $\pm$ 0.67	11 - 13
Rex	20.6 $\pm$ 0.55	20 - 21
ROes	18.0 $\pm$ 0.94	16 - 19
Rhem	19.6 $\pm$ 0.55	19 - 20
RB	7.2 $\pm$ 0.42	6.5 - 8.0
RV	7.4 $\pm$ 0.52	7 - 8
RVan	2.1 $\pm$ 0.32	2 - 3
Ran	5.3 $\pm$ 0.48	5 - 6
VL/VB	1.4 $\pm$ 0.11	1.2 - 1.6
oesophagus length	114.5 $\pm$ 6.50	98 - 120
nerve ring-anterior end	90.9 $\pm$ 4.65	83 - 97
excr. pore-anterior end	123.6 $\pm$ 11.24	106 - 133
maximum width	39.1 $\pm$ 2.73	35 - 43
ABW	22.0 $\pm$ 1.76	20 - 25
tail length	25.7 $\pm$ 2.31	22 - 29

*Female.* Body annuli retrorse, with smooth posterior margin and without anastomoses. Lip region truncate-rounded, the first annulus not retrorse, forwardly projecting (Fig. 3 A-C), slightly wider than second and measuring  $25.7 \pm 1.8$  (23-27)  $\mu\text{m}$  wide. SEM micrographs show four submedian lobes well developed and clearly connected between them (Fig. 3C). Vulva open, anterior lip overhanging, provided with two spines (Fig. 3 E,F). Anus circular, located 2-3 annuli posterior to vulva (Fig. 3 E). Tail conical, with terminus mostly unilobed, rarely bilobed (Fig. 3D).

*Male.* Not found.

*Habitat and locality.* Specimens collected from mud on the riverbed of the Jandula at Sierra Morena, Andujar, southeastern Spain.

*Discussion.* Measurements as well as general morphology closely agree with the original description (Andrassy, 1961). The species has been recorded previously from Italy associated with vineyards (Bello *et al.*, 1988) and Spain associated with tomato (Romero and Arias, 1969) and vineyards (Zancada and Bello, 1981; Zancada *et al.*, 1982). SEM micrographs confirm the presence of four well developed submedian lobes, the same pattern as that observed by De Grisse (1965).

**MESOCRICONEMA SPHAEROCEPHALUM**  
(Taylor, 1936) Loof *et De Grisse*, 1989  
(Fig. 4, Table III)

*Female.* Body ventrally curved upon relaxation. Body annuli retrorse, with smooth posterior margins and multiple typical anastomoses along body (Fig. 4). Lip region truncate, four distinct separated and well developed submedian lobes, projecting forward; oral disc elevated, rounded (Fig. 4 A). Vulva open, anterior lip simply rounded, without spines, located 4-6 annuli from terminus. Anus circular, located 2-3 annuli from terminus. Tail short, rounded.

*Male.* Not found.

*Habitat and locality.* Specimens collected from soil around the roots of tomato (*Lycopersicon esculentum* Mill.) at Castillo de Locubin, Jaen, southeastern Spain.

Fig. 3 (Front page) - SEM micrographs of *Mesocriconema solivagum* A, B, anterior body region; C, en face view; D-F, posterior body region. (Sl = submedian lobe; V = vulva; a = anus). Scale bars = 10  $\mu\text{m}$ .

TABLE III - Morphometrics of *M. sphaerocephalum*, females (measurements in  $\mu\text{m}$ ).

	n = 10 Females	
	$\bar{X} \pm \text{SD}$	Range
L	381.4 $\pm$ 44.36	322 - 459
a	9.0 $\pm$ 1.17	7.7 - 11.5
b	3.2 $\pm$ 0.30	2.7 - 3.7
V	95.2 $\pm$ 1.03	93 - 96
G <sub>1</sub>	59 $\pm$ 13.6	45 - 75
c	51.9 $\pm$ 5.57	38.2 - 57.6
c'	0.35 $\pm$ 0.06	0.30 - 0.50
stylet	71.2 $\pm$ 3.64	67 - 77
stylet % L	19.1 $\pm$ 2.28	17.1 - 22.2
stylet % Oes	60.4 $\pm$ 3.78	55.5 - 65.4
conus (CP)	57.1 $\pm$ 2.13	54 - 61
CP % stylet	80.2 $\pm$ 1.70	77 - 83
R (ventral)	69 $\pm$ 2.17	67 - 74
R (dorsal)	78 $\pm$ 2.16	74 - 82

	n = 10 Females	
	$\bar{X} \pm \text{SD}$	Range
Rst	15 $\pm$ 1.08	14 - 17
Rex	21 $\pm$ 1.06	19 - 22
ROes	21 $\pm$ 1.27	19 - 23
RB	6.5 $\pm$ 0.53	6 - 7
RV	4.4 $\pm$ 0.70	4 - 6
RVan	2.1 $\pm$ 0.32	2 - 3
Ran	2.3 $\pm$ 0.48	2 - 3
VL/VB	0.56 $\pm$ 0.06	0.49 - 0.62
oesophagus	118.4 $\pm$ 6.97	107 - 128
nerve ring	108.3 $\pm$ 11.2	90 - 120
excr. pore	121.2 $\pm$ 13.1	94 - 131
maximum width	42.2 $\pm$ 2.66	39 - 46
ABW	21.4 $\pm$ 1.26	20 - 24
tail length	7.5 $\pm$ 1.78	6 - 12

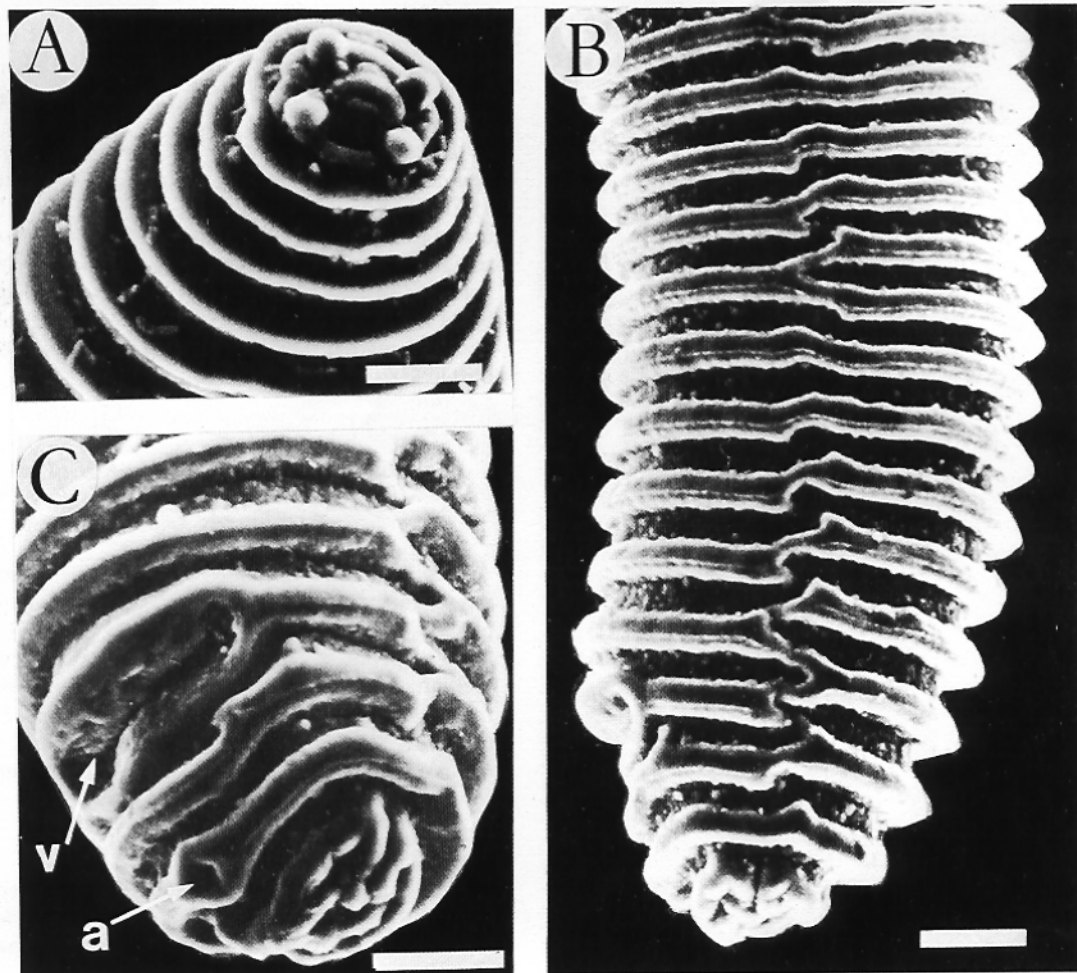


Fig. 4 - SEM micrographs of *Mesocriconeema sphaerocephalum* A, anterior body portion; B, posterior body portion; C, tail region. (V = vulva; a = anus). Scale bars = 10  $\mu\text{m}$ .

*Discussion.* In general morphology as well as measurements, these specimens fit well with previous data on *M. sphaerocephalum*, although they are in the highest range for stylet and body length. SEM observations agree well with those of Van den Berg (1980). It is a common species in Spain recorded previously by several authors (Bello, 1979; Romero *et al.*, 1970; Gomez Barcina *et al.*, 1989) from natural and cultivated habitats.

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