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SOME TYLENCHIDA (NEMATODA) FROM MALTA AND GOZO

by
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Summary. A survey carried out during 1974-1976 to determine the specific composition of plant parasitic nematodes in the Maltese Islands revealed the presence of *Ditylenchus dipsaci*, four species of *Paratylenchus* (*P. lepidus*, *P. microdorus*, *P. neoamblycephalus* and *P. tateae*) and five species of *Tylenchorhynchus* (*T. agri*, *T. badliensis*, *T. dubius*, *T. mangiferae* and *T. queirozi*).

Soil samples collected during a survey of plant parasitic nematodes in the Maltese Islands in 1974-1976 (Lamberti and Dandria, 1979; Lamberti *et al.*, 1984) revealed the presence of species belonging to the order Tylenchida. There are no published records of morphometric and morphological characters of the Maltese populations. The data presented here contribute to the knowledge of the Maltese soil nematofauna and to the morphometric variability of the species identified in the survey.

Materials and methods

Nematodes were extracted from soil, collected from the rhizosphere of plants in cultivated and natural habitats, by Cobb's wet sieve technique. Specimens were killed and fixed in hot 5% formaldehyde, dehydrated, transferred to glycerine and then mounted on slides for identification. Measurements and drawings were made with the aid of a camera lucida. Abbreviations used throughout the text are as in Siddiqi (1986).

Geographical distribution of the different species is illustrated in Fig. 1, while hosts and localities are listed in Table I.

Descriptions

DITYLENCHUS DIPSACI (Kuehn, 1857) Filipjev, 1936

7 females: L = 1.27±0.09 (1.12-1.39) mm; a = 32.3±5.58 (22.3-38.9); b = 7.8±0.59 (6.8-8.6); c = 16.1±1.62 (13.8-17.3); V% = 80.2±2.98 (74-83.8); spear = 4.9±0.38 (4.5-5.3) µm.

6 males: L = 1.14±0.06 (1.05-1.21) mm; a = 28.3±4.53 (29.5-34.8); b = 6.7±0.30 (6.2-6.9); c = 14.5±0.49 (13.8-15.01); T% = 63.3±8.5 (50.6-76.3); spear = 4.8±0.82 (4.5-5.0) µm.

Morphometrics of the Maltese population of *D. dipsaci* agree with previous descriptions. The value of its body length seems to indicate that this is a diploid population, different from the tetraploids ones found on broad beans (*Vicia faba* L.) in Gozo and studied by D'Addabbo Gallo *et al.* (1982) in their caryo-phenotype analysis. The stem nematode is a major pest of onion (*Alium cepa* L.) in Gozo (Lamberti and Dandria, 1979).

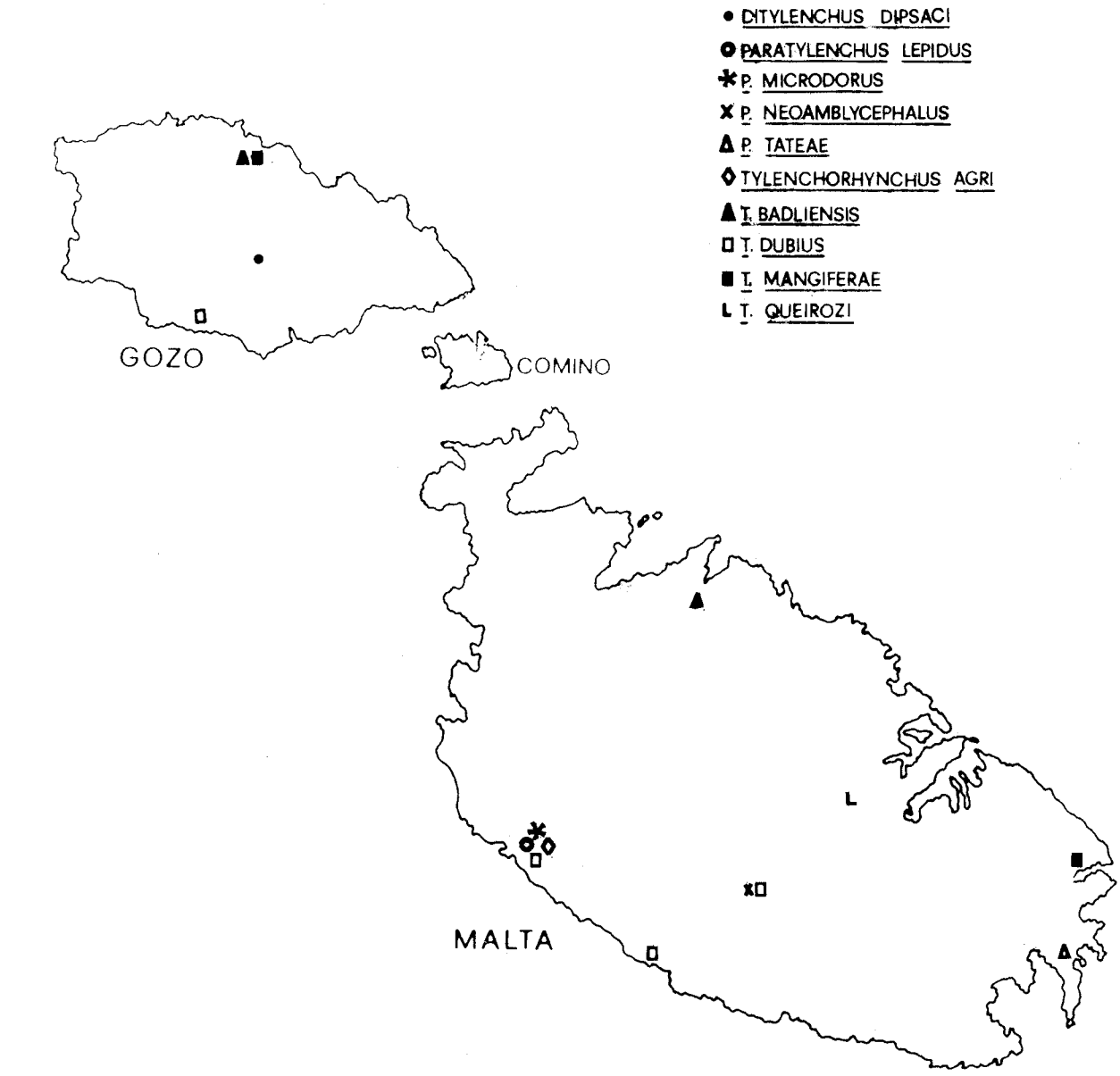

Fig. 1 - Distribution of some Tylenchida species in the Maltese Islands.

PARATYLENCHUS LEPIDUS Raski, 1985

Table II, Fig. 2 A, B

Specimens flattened.

Female: habitus an open "C", more curved in the postvulvar region. Lip region rounded, with a slight sclerotization, continuous with body contour, annules indistinct. Stylet knobs slightly sloping backwards. Dorsal oesophageal gland orifice and hemizonid not visible, excretory pore at middle basal oesophageal bulb level. Genital tract not discernible, vulva with distinct

TABLE I - *Plants in the rhizosphere of which and localities of the Maltese Islands where species of Tylenchida occurred.*

Species	Host	Locality
Ditylenchus dipsaci	onion (*Allium cepa* L.)	Ta' Hamet
Paratylenchus lepidus	barley (*Hordeum vulgare* L.)	Misrah Suffara
Paratylenchus microdorus	barley	Misrah Suffara
Paratylenchus neoamblycephalus	apple trees (*Malus sylvestris* Mill.)	Siggiewi
Paratylenchus tateae	wheat (*Triticum durum* Desf.)	Tas' Silg M'Xlokk
Tylenchorhynchus agri	barley	Misrah Suffara
Tylenchorhynchus badliensis	artichoke (*Cynara cardunculus* L. var *scolymus*)	Bur Marrad
Tylenchorhynchus badliensis	artichoke	Marsalforn
Tylenchorhynchus dubius	barley	Sannat
Tylenchorhynchus dubius	sweetvetch (*Hedysarium coronarium* L.)	Fauwara
Tylenchorhynchus dubius	barley	Misrah Suffara
Tylenchorhynchus dubius	wheat	Siggiewi
Tylenchorhynchus mangiferae	artichoke	Marsalforn
Tylenchorhynchus mangiferae	broad beans (*Vicia faba* L.)	Marsakala
Tylenchorhynchus queirozi	gladiolus (*Gladiolus* sp.)	Qormi

rounded vulvar flaps. Tail with a rounded to conoid tip.

Male: not found in our population.

Remarks

Morphometrics of *P. lepidus* from Rabat, Malta fit well with those reported in the literature, except for a (13.5 vs. 25 in Raski, 1975b and 31.2 in Bajaj, 1987) and c (9.8 vs. 14 in Raski, 1975b and 13.5 in Bajaj, 1987) values, presumably due to the poor conditions of the specimens.

This species is similar to *P. bukowinensis*, but differs in its more slender and conoid tail and for having large vulvar flaps. *P. lepidus* was originally described from Sri Lanka on tea (*Thea sinensis* L.), then reported from India from soil around the roots of pomegranate (*Punica granatum* L.) and on mango, *Mangifera indica* L. (Bajaj, 1987). This is the first record on barley (*Hordeum vulgare* L.) and in the Mediterranean region.

PARATYLENCHUS MICRODORUS
Andrássy, 1959 Table II, Fig. 2 C, D

Female: habitus ventrally curved. Lip region conoid-rounded, not offset from rest of body. Stylet with basal knobs rounded, slightly conical in some specimens. Oesophagus as in the original description; excretory pore situated at middle isthmus. Vulvar flaps well developed, vagina an oblique slit. Spermatheca rounded, empty.

Postvulvar uterine sac absent. Tail curved ventrally, tapering gradually to a rounded terminus.

Male: not present in our population.

Remarks

Measurements and morphology of *P. microdorus* from Rabat, Malta, are very similar to previous descriptions (Tarjan, 1960; Brzeski and Szcygiel, 1963; Geraert, 1965; Raski, 1975a; Andrássy, 1985; Gomez Barcina *et al.*, 1990).

This species is very common and widespread; it has often been recorded in the Mediterranean region in various soil types and from the rhizosphere of different plants, but this is the first record in association with barley. Gomez Barcina *et al.* (1990) found the first bisexual population in the Mediterranean area.

***PARATYLENCHUS NEOAMBLYCEPHALUS* Geraert, 1965** Table II, Fig. 2 E, F

P. neoamblycephalus was initially described by Reuver (1959) as *P. amblycephalus*, but Geraert (1965) showed that it was a mixture of two species; and therefore he selected and described a new holotype renaming the species as *P. neoamblicephalus*. In his description, Geraert defined the lip region shape as conical truncate, but SEM observations (Raski, 1975b) indicated that it is more rounded in outline. Actually the lip region morphology of the Maltese popula-

TABLE II - *Morphometrics of females of species of* Paratylenchus *from the Maltese Islands**.

	Paratylenchus lepidus n = 11		*Paratylenchus microdorus* n = 7		*Paratylenchus neoamblycephalus* n= 7		*Paratylenchus tateae* n = 7	
	x±s.d.	range	x±s.d.	range	x±s.d.	range	x±s.d.	range
Stylet	24.4±2.04	21.4-27.6	16.4±0.67	15.6-17.5	31.7±1.58	29.9-33.7	17.7±0.55	16.9-18.2
Total body length	347.7±29.1	286.8-384.2	337.9±20.87	317.7-358.1	375.6±40.87	317.7-423.3	357.8±18.59	335.5-380.7
Excretory pore	76.7±6.8	72.7-85.7	70.8±7.17	61.7-80.5	77.5±9.62	63.6-89.6	74.4±2.64	71.4-78.6
Oesophagus length	90.4±5.5	80.5-100.6	83.6±3.33	77.3-86.3	93.6±6.27	85.7-102.6	92.9±4.91	89.6-101.3
Maximum body width	26.1±3.3	20.8-31.2	17.8±3.3	13.0-23.4	32.1±2.16	29.2-35.7	13.8±0.53	13.0-14.3
Tail length	35.6±5.6	29.2-47.4	30.8±4.95	24.7-36.4	24.6±1.7	22.7-25.9	30.2±1.41	29.2-31.2
Body width at anus	14.6±2.7	11.0-18.8	8.5±1.49	7.1-11.0	11.7±0.60	11.1-12.3	7.5±1.34	6.5-8.4
a	13.5±1.7	11.0-15.6	19.6±3.39	15.4-24.1	11.7-0.93	10.2-13.0	25.9±1.88	23.6-28.7
b	3.8±0.2	3.6-4.2	4.1±0.16	3.9-4.3	4.0±0.28	3.7-4.3	3.9±0.11	3.7-4.0
c	9.8±1.2	7.1-11.1	11.3±0.94	10.6-12.7	15.7±1.25	14.7-17.1	12.2±1.2	11.3-13.0
V	81.8±2.7	81.0-83.5	82.3±1.4	79.7-83.5	82.3±1.75	80.3-84.3	80.2±0.99	79.1-81.4

* all measurements in µm.

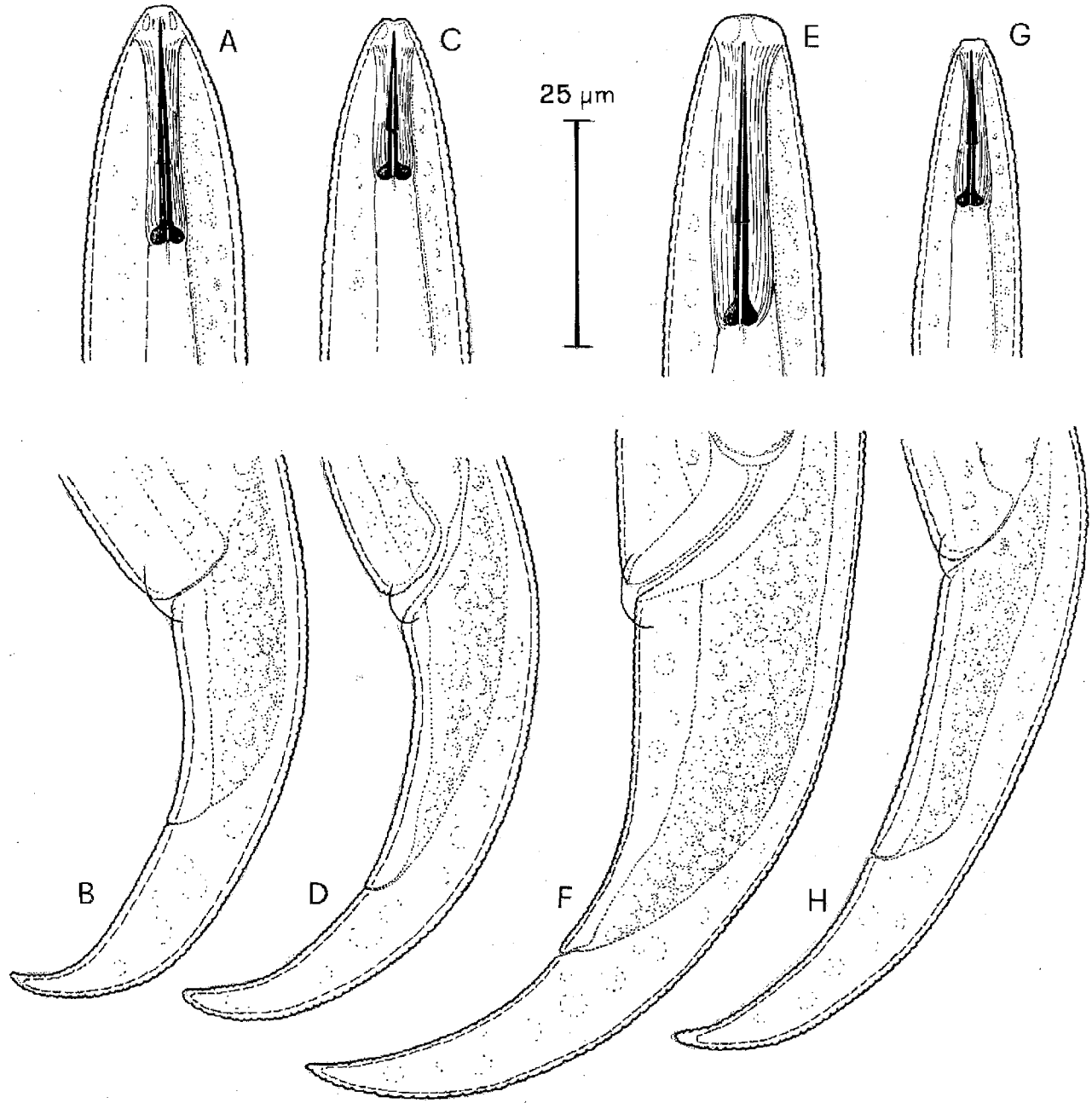

Fig. 2 - *Paratylenchus lepidus* female: A, anterior region; B, posterior region. *P. microdorus* female: C, anterior region; D, posterior region. *P. neoamblycephalus* gravid swollen female: E, anterior region; E, posterior region. *P. tateae* female: G, anterior region; H, posterior region.

tion (only females were detected) seems to fit more with Raski's description than with the original, even if the morphometrics of *P. neoamblycephalus* from apple trees (*Malus sylvestris* Mill.) in Siggiewi, Malta, overlap both the reported ranges. Moreover, some gravid females are swollen and longer, as usual in the genus (Geraert, 1965).

P. neoamblycephalus has frequently been recorded from the rhizosphere of apple trees in The Netherlands, Germany and Australia, but it also occurs in association with other crops in several regions. In Italy it has been recovered from soil samples collected around the roots of *Dianthus sp.* at various localities in Apulia (Lamberti *et al.*, 1976).

PARATYLENCHUS TATEAE Wu *et* Townshend, 1973 Table II, Fig. 2 G, H

Female: habitus ventrally curved when fixed. Lip region strongly protruding, truncate. Basal stylet knobs rounded. Excretory pore situated between middle oesophageal bulb and oesophago-intestinal junction. Oesophagus with median bulb elongate and basal bulb often pyriform, sometimes more rounded. Ovary outstretched, spermatheca empty; vulvar flaps small, vagina a transverse slit. Post uterine sac not seen. Tail tapering gradually to a subacute-rounded tip.

Male: not found in our population.

Remarks

Measurements of *P. tateae* collected from the rhizosphere of wheat (*Triticum durum* Desf.) at Tas-Silg-M'Xlokk, Malta show strong affinities with the values reported in the original description and by Raski (1975a), except for a lower minimum value of total body length. The morphology is the same, but in our specimens no postvulvar uterine sac could be seen, probably due to the excessive transparency.

P. tateae resembles *P. italiensis* in the lip region shape, but differs from it in stylet length and body length. This species was first recorded in soil samples collected from around the roots of corn, alfalfa and clover in Ontario, then from non-irrigated grassland in Canada (Raski, 1975a) and from India in soil around the roots of sugarcane (Bajaj, 1987). This is the first record of *P. tateae* in the Mediterranean region from the rhizosphere of wheat.

TYLENCHORHYNCHUS AGRI Ferris, 1963 Table III, Fig. 3 A, B

Female: body slightly curved after fixation. Lateral field with four incisures, not areolated; cuticle without longitudinal striations, marked by annules 1.0 (0.9-1.1) µm wide. Head sclerotization very faint, sometimes inconspicuous. Stylet slender, with anterior surface of basal knobs laterally inclined. Oesophagus slightly overlaps intestine, with a pyriform basal bulb. Intestine extending beyond anus with a post rectal intestinal sac occupying 50-68% of tail; fasciculi present. Vulva a transverse slit, very small vulvar lips present in some specimens. Tail sub-cylindrical, with an hemispherical smooth terminus. Phasmids not seen.

Male: not found in our population.

Remarks

Maltese specimens of *T. agri* have longer bodies (average: 825.5 vs. 670 µm in the original description) and a greater number of tail annules (30-35 vs 16-26 in the original description); other morphometrics fit well with data reported in the literature, and differences may be due to the different geographical locations. *T. agri* has previously been reported only from the United States of America as an ectoparasite of

red clover and other crops; it has not been previously recorded in the Mediterranean regions and in association with barley.

T. agri in some respects resembles *T. neoclavidatus* Mathur, Sanwal *et* Lal, 1979 in stylet length and for most of the morphometric characters, but differs essentially in the lip region shape (offset vs. continuous with body contour) and tail shape (sub-cylindrical vs. clavate).

TYLENCHORHYNCHUS BADLIENSIS Saha *et* Khan, 1981 Table III, Fig. 3 C-K

Female: habitus an open C when fixed. Lip region marked by 3 annules, offset, with lightly sclerotized cephalic framework. Stylet well developed, basal knobs with anterior surface laterally directed. Oesophagus with sacciform basal bulb, slightly overlapping the intestine. Nerve ring 89.8 µm from anterior end, hemizonid 2-2.5 annules wide, excretory pore always behind hemizonid and situated opposite to the middle of the basal oesophageal bulb. Intestinal fasciculi not seen, intestine filled with fat globules, post rectal intestinal sac absent. Tail conoid, tapering to a blunty pointed smooth terminus; phasmids located 10-12 annules from tail tip. Vulva a transverse slit, vulvar lips slightly protruding in some specimens. Spermatheca rounded, filled with sperms. Lateral field with four incisures, annules 1 µm wide at midbody.

Male: similar to the female except for sexual dimorphism. Bursa enveloping tail, with crenate margins; spicules arcuate, gubernaculum with curved proximal end, less evident than in the original description.

TABLE III - *Morphometrics of species of* Tylenchorhynchus *from the Maltese Islands**.

	Tylenchorhynçhus agri		*Tylenchorhynchus badliensis*				*Tylenchorhynchus mangiferae*				*Tylenchorhynchus queirozi*	
	females n = 7		females n = 5		males n = 5		females n = 4		males n = 4		females n = 4	
	x±s.d.	range	x±s.d.	range	x±s.d.	range	x±s.d.	range	x±s.d.	range	x±s.d.	range
Total body length	825.5±84.08	757.9-950.8	694.1±53.5	627.0-757.9	568.4±25.48	537.4-592.5	628.8±19.5	600.0-640.8	650.0±56.1	585.7-689.0	706.9±49.13	695.9-757.9
Stylet length	20.1±1.19	19.5-23.2	19.2±1.14	17.2-20.4	17.1±0.94	16.5-18.5	13.1±0.29	12.9-13.5	13.3±0.72	12.5-13.9	16.0±0.38	15.1-16.8
Excretory pore	80.5	–	108.2	–	90.4	–	106.2±10.9	93.7-113.5	106.9	–	68.0±2.2	65-72
Oesophagus length	135.0±10.1	124.2-151.2	127.5±7.8	119.5-137.7	111.5±5.09	108.0-118.8	116.1±4.35	109.6-118.8	123.4±8.92	114.2-132.0	133.2±0.85	132.3-134.0
Tail length	39.7±4.45	35.3-42.2	40.1±4.37	37-42.1	31.5±3.02	28.4-35.0	42.4±2.45	38.9-40.5	52.8±4.29	48.2-56.7	36.8±3.69	30.5-39.2
Ran	32	30-35	21	18-23	–	–	43	40-48	–	–	23	20-27
spicules	–	–	–	–	18.9±1.12	17.2-20.2	–	–	18.2±0.96	17.2-19.1	–	–
gubernaculum	–	–	–	–	8.6±0.9	7.9-10.0	–	–	5.9±0.35	6.6-7.3	–	–
a	22.9±3.2	19.2-27.1	23.4±2.47	26.7-30.0	28±1.36	27.0-30.1	35.0±2.5	33.1-39.4	37.1±3.52	33.1-38.7	32.6±0.42	32.2-33.0
b	6.1±0.4	5.5-6.6	5.45±0.29	5.0-5.8	5.1±0.13	4.9-5.2	5.5±0.06	5.4-5.5	5.23±0.15	5.1-5.4	4.4±0.26	4.2-4.7
c	21.3±2.8	18.5-24	16.7±2.43	15.5-18.8	16.2±2.0	14.0-18.8	14.5±1.01	13.4-15.4	13.3±0.5	12.9-13.9	14.2±1.23	12.8-15.1
c'	2.3±0.63	2.1-2.6	2.2±0.11	2.1-2.3	2.7±0.33	2.4-3.1	2.36±0.15	2.2-2.5	3.2±0.55	2.8-3.8	3.5±0.36	3.1-3.8
V	54.2±2.4	50.1-57.3	55.7±0.49	55.4-56.4	–	–	55.4±0.7	54.8-56.3	–	–	56.2±2.55	54.3-58.9
MB	49.1±3.07	45.6-53.6	51.5±2.6	48.9-54.1	50.3±2.1	47.2-52.3	44.1±0.50	43.4-44.5	45.6±2.19	43.1-47.3	44.13±3.03	40.9-46.9
m	–	–	49.7	–	54.5±2.75	52.1-57.5	51.6±1.74	50.0-54.1	53.0±0.4	52.5-53.3	57.4±1.13	56.6-58.2

* all measurements in µm.

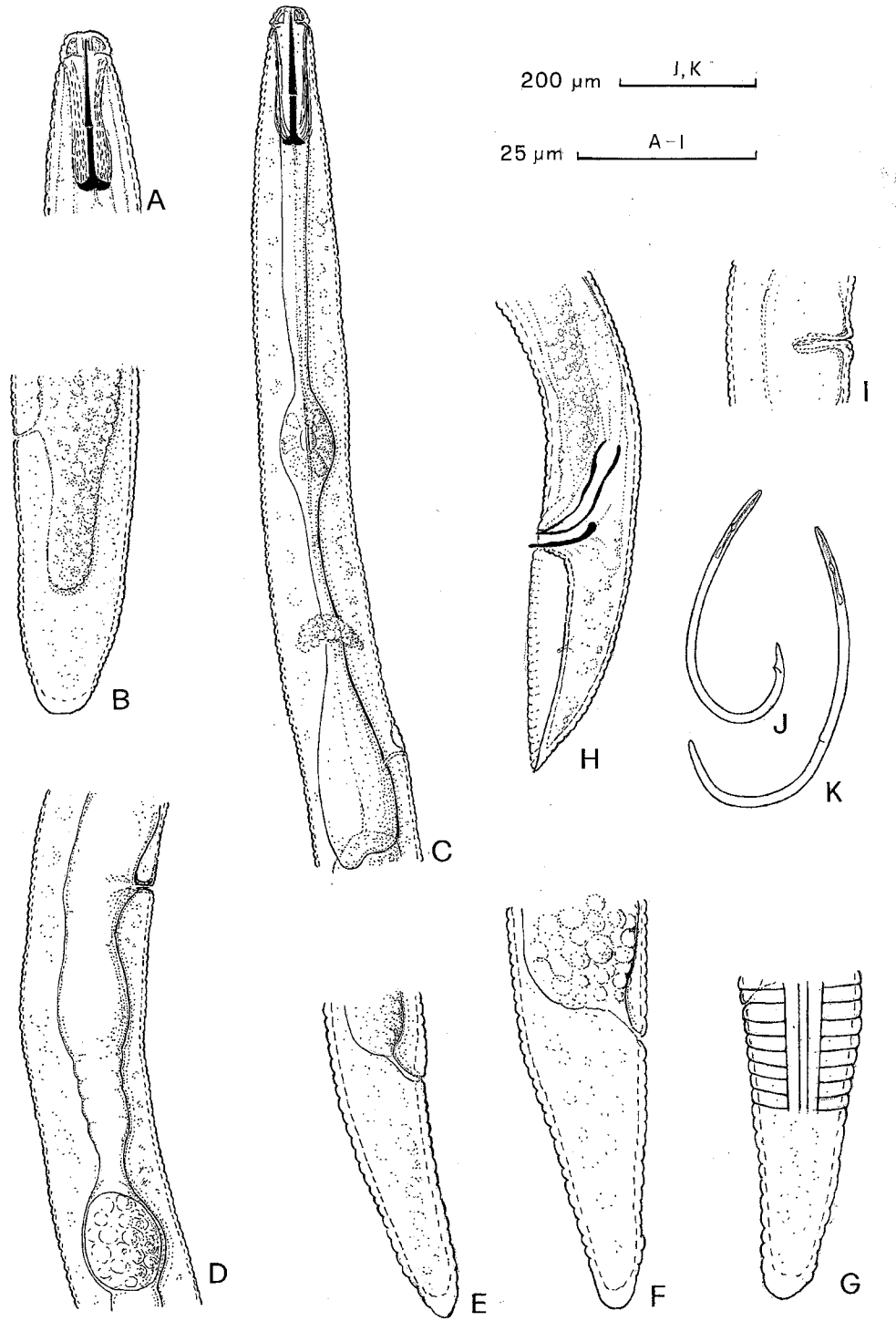

Fig. 3 - *Tylenchorhynchus agri* female: A, anterior region; B, posterior region. *T. badliensis* female: C, oesophageal region, D, vulvar region; E, F and G, different tail shape; I, vulvar area showing slightly protruding vulvar lips; H, male tail; J and K, male and female habitus respectively.

Remarks

Tylenchorhynchus badliensis was reported only from the type locality (Haryana, India, from soil around the roots of tomato), at Bur Marrad, Malta and Marsalforn, Gozo it has been recovered from the rhizosphere of artichoke (*Cynara cardunculus* L. var. *scolymus*). Morphometrics of this population fit well with the original description, extending some ranges such as a (26.7-30 vs. 28-30) and b (5.0-5.8 vs. 5.0-5.1); the width of annules at midbody is less in our specimens (average 1.0 vs. 1.7 µm).

T. badliensis is similar to *T. ancorastyletus* for stylet length, lip region shape and number of tail annules, but differs in the shape of the stylet basal knobs (anterior surface more curved in *T. ancorastyletus*), cephalic framework (more refractive in *T. ancorastyletus*) and tail shape (conoid vs. sub-cylindrical).

***TYLENCHORHYNCHUS DUBIUS* (Bütschli, 1873) Filipjev, 1936** Table IV, Fig. 4

This species is a browsing ectoparasite extremely common in the rhizosphere of various plants in Europe, rarely in the United States. In the Maltese Islands it has been recovered from soil around the roots of barley at Sannat (Gozo), Fauwara, Misrah Suffara and Siggiewi (Malta).

T. dubius has been extensively described and illustrated by several authors; specimens from Malta agree with previous descriptions, even if some populations have a smaller a value

TABLE IV - *Morphometrics of populations of* Tylenchorhynchus dubius *from the Maltese Islands*.*

Locality	*Sannat*				*Fauwara*			*Misrah Suffara and Siggiewi*		
	females n = 11		males n = 5		females n = 6		males n = 2	females n = 6		males n = 2
	x±s.d.	range	x±s.d.	range	x±s.d.	range	range	x±s.d.	range	range
Total body length	748.3±53.9	689.0-863.1	689.2±52.6	640.8-744.1	647.7±72.49	544.3-709.7	666.3-695.9	655.3±21.8	633.9-682.1	654.6-693.5
Stylet length	19.4±1.88	17.1-20.8	18.6±0.68	17.8-19.1	18.5±1.42	16.5-19.8	18.5-19.1	18.4±0.59	17.8-19.1	18.5-19.1
Excretory pore	85.4±1.7	84.8-85.9	106.9	–	90.8±9.8	83.8-97.7	108.9	103.6	–	96.4
Oesophagus length	126.1±4.89	118.8-135.0	127.3±11.17	115.5-137.7	123.5±3.8	118.8-128.0	124.1-126.9	118.1±2.59	114.8-120.8	111.5-112.2
Tail length	49.7±4.89	44.9-57.4	38.1±4.89	34.3-43.6	43.8±6.32	39.0-49.5	41.6-43.6	46.8±4.04	41.6-50.8	37.6-40.5
Ran	44	42-49	–	–	42	35-49	–	45	43-50	–
spicules	–	–	25.0±0.4	24.2-26.1	–	–	25.1-26.4	–	–	24.5-26.8
gubernaculum	–	–	11.0±2.37	9.3-12.0	–	–	12.3-12.5	–	–	12.6
a	28.3±2.22	26.1-31.5	32.1±3.6	29.9-34.3	31.9±1.70	30.6-34.3	29.8-31.6	31.3±2.61	26.9-35.1	30.1-32.3
b	5.9±0.51	5.4-6.7	5.5±0.9	4.6-6.4	5.2±0.55	4.8-5.5	5.4-5.5	5.54±0.23	5.3-5.9	5.1-5.3
c	15.3±1.35	13.7-17.3	14.4±1.22	13.1-15.5	14.3±0.55	13.7-14.7	15.0	14.1±0.98	13.2-15.2	13.2-14.8
c'	1.8±0.23	1.5-2.3	2.3±0.5	1.8-2.8	2.4±0.12	2.3-2.5	2.1-2.3	2.4±0.30	2.1-2.8	2.5-2.9
V	54.6±1.85	52.4-58.6	–	–	56.1±2.01	53.5-58.2	–	56.1±1.56	54.3-57.6	–
MB	50.4±2.29	48.0-55.6	51.5±1.65	49.7-52.9	48.9±1.43	48.9-50.6	52.1	51.8±1.17	50.2-53.0	50.8-52.7

* all measurements in µm.

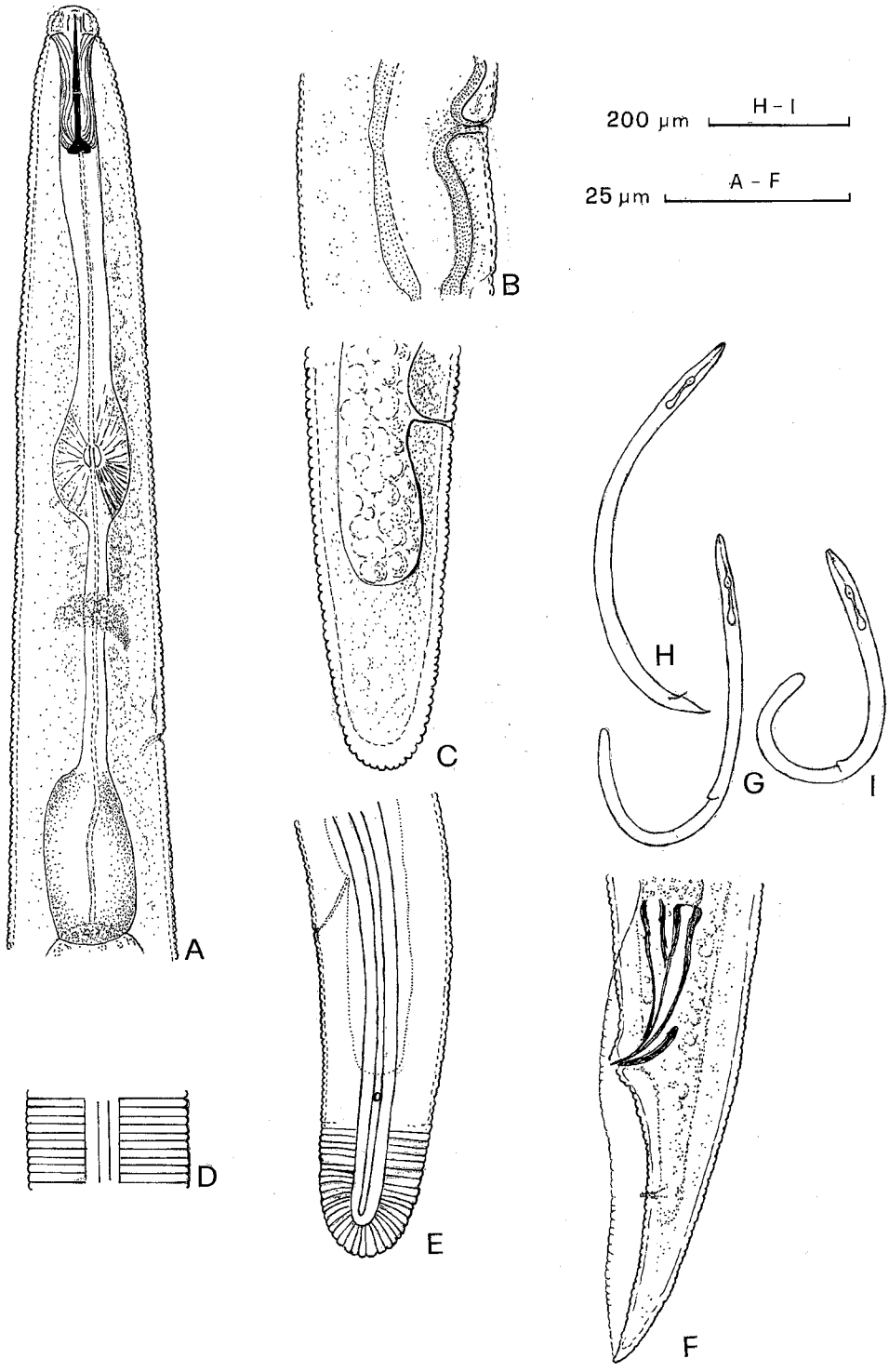

Fig. 4 - *T. dubius* female: A, oesophageal region, B, vulvar region; C and E, different tail shape; D, lateral fields at mid-body; F, male tail; H, G and I, male and female habitus respectively.

and shorter spicule length (average 24.0 vs. 26.0 µm), while the male tail is always longer (38.1 vs. 34.5 µm).

TYLENCHORHYNCHUS MANGIFERAE **Luqman *et* Khan, 1985** Table III, Fig. 5 A-D

Female: body of relaxed specimens slightly ventrally arcuate; cuticular annules distinct, averaging 1 µm wide; no longitudinal striation present. Lateral field with four incisures. Lip region clearly set off from the rest of body by a constriction and marked by 5 annules. Stylet with basal knobs moderately rounded. Median oesophageal bulb rounded to ovate, basal bulb pyriform not overlapping intestine, with evident cardia. Excretory pore located opposite to the anterior part of basal oesophageal bulb, hemizonid usually 2-3 annules anterior to excretory pore, sometimes posterior. Reproductive system amphidelphic; vulva a transverse slit, not depressed as in the original description but sometimes slightly prominent. Spermathecae rounded, filled with sperms. Tail sub-cylindrical with hemispherical, annulated terminus. Phasmids at middle tail. No post rectal sac present.

Male: general morphology similar to the female, except for the reproductive tracts and the more curved tail terminus. Spicules ventrally arcuate, gubernaculum curved with proximal end simple and distal end trough-shaped. Bursa well developed, with crenate outer margins, completely enveloping the tail.

Remarks

T. mangiferae has previously been reported only from the type locality, at Uttar Pradesh, India from the rhizosphere of *Mangifera indica* L. In the Maltese Islands it has been recovered from soil around the roots of artichoke at Bur Marrad (Malta) and Marsalforn (Gozo), and from the rhizosphere of broad beans at Marsaskala.

Morphology and most of the morphometrics of our populations fit well with the original description, except for a higher number of tail annules in the female (40-48 vs. 35-38) and for spicule (17.2-19.1 vs. 22 µm) and gubernaculum (6.6-7.3 vs. 7.4-9.5 µm) length. In a genus with many nominal species such as *Tylenchorhynchus*, *T. mangiferae* can easily be distinguished by the low value of stylet length (12-15 µm), tail sub-cylindrical to conoid with annulated terminus (characteristic not very common within the genus, a smooth terminus is usual) and absence of longitudinal cuticular striations.

TYLENCHORHYNCHUS QUEIROZI **Monteiro *et* Lordello, 1976** Table III, Fig. 5 E-G

Female: body ventrally curved after fixation, marked by fine annulation 0.8-1-0 µm wide at mid-body and without longitudinal striations. Lateral fields with four incisures, outer margins sometimes crenate. Lip region offset, with 4-5 annules; head with moderate sclerotization. Stylet slender, basal knobs rounded. Oesophagus typically tylenchoid with pyriform basal bulb. No nuclei were discernible. Intestine with globular contents, extending into almost half of the tail with a post-rectal sac. Reproductive system didelphic, with ovaries outstretched and spermathecae rounded. Vulva a transverse slit, with vulval lips protruding, leading to a muscular vagina. Tail cylindrical to sub-cylindrical, with annulated hemispherical tail terminus.

Male: similar to the female, except for sexual apparatus; spicules curved, gubernaculum simple, linear, with proximal and distal end thickened.

Remarks

Specimens of *T. queirozi* from the Maltese islands are longer (695.9-757.9 vs. 492-605 µm) than the type specimens. Other morphometric

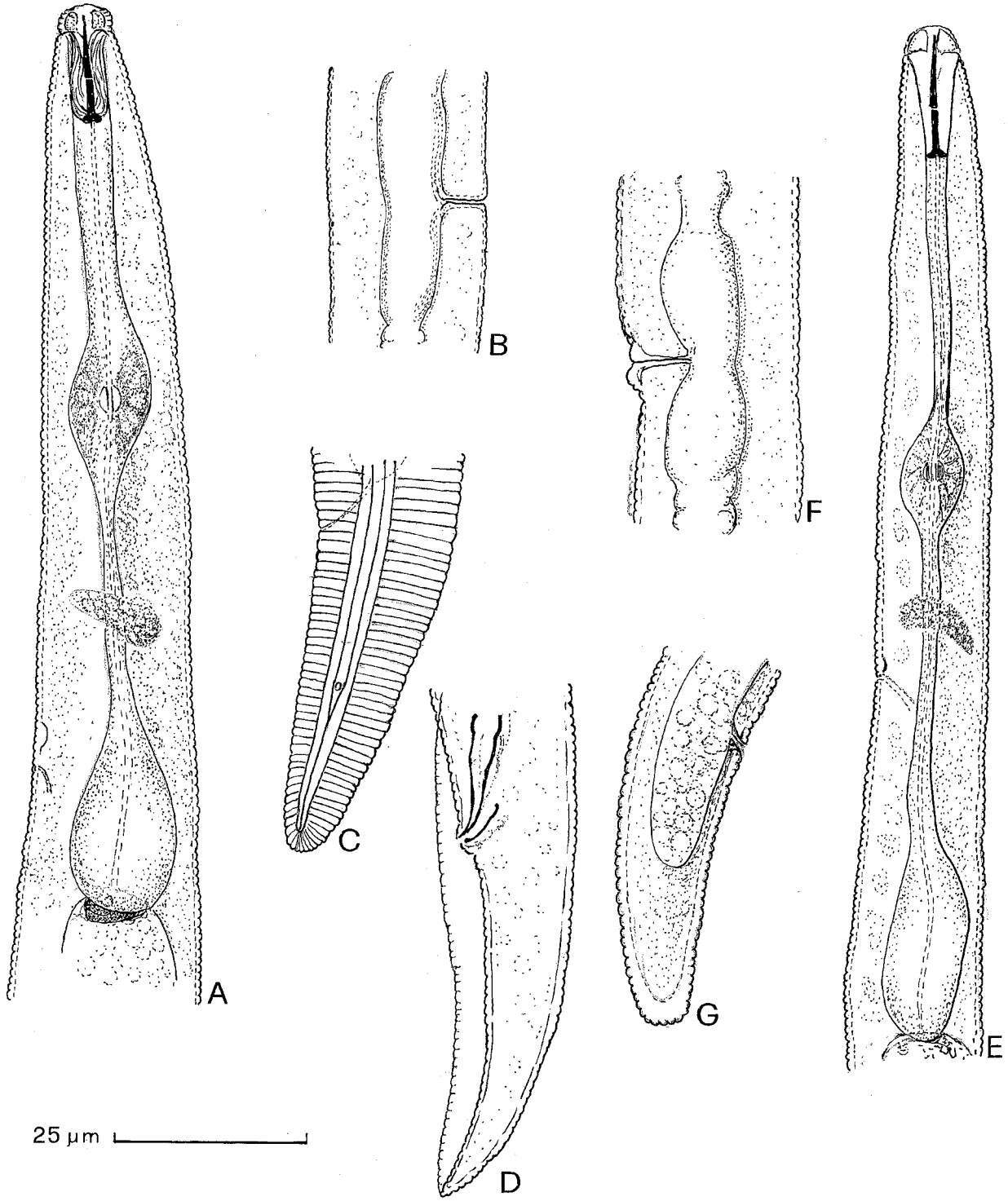

Fig. 5 - *T. mangiferae* female: A, oesophageal region, B, vulvar region; C, tail; D, male tail; *T. queirozi* female: E, oesophageal region, F, vulvar region: note the prevulvar swelling; G, tail.

and morphological characters agree well with previous descriptions. In particular, the vulvar area is elevated according to Rashid *et al.* (1987) who pointed out that the cuticle anterior to the vulva was swollen (feature not revealed in the original description).

T. queirozi has previously been recorded only from Brazil (Monteiro and Lordello, 1976; Rashid *et al.*, 1987) from light soil around the roots of *Theobroma cacao* L. This is the first record in the Mediterranean region, on *Gladiolus* sp. at Qormi.

Key to *Tylenchorhynchus* species from the Maltese Islands

1. Stylet length equal or less than 14 µm . . . . . *T. mangiferae*
   Stylet length more than 15 µm. 2
2. Tail terminus smooth 3
   Tail terminus annulated 4
3. Tail shape sub-cylindrical, Ran = 30-35 . . . . . *T. agri*
   Tail shape conoid, Ran = 18-23 . . . . . *T. badliensis*
4. Lip region marked by 6-7 annules, Ran = 35-50 . . . . . *T. dubius*
   Lip region marked by 4-5 annules, Ran = 20-27 . . . . . *T. queirozi*

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