Morphology and parasitism of the mature female of *Rotylenchulus macrosomus*(1)

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SUMMARY

The mature female of *Rotylenchulus macrosomus*, hitherto unknown, was discovered in the vicinity of the type locality, and its morphology and parasitism were studied in comparison with *R. reniformis*. Morphologically, *R. macrosomus* differed from *R. reniformis* in its greater body length, more convoluted body posture, more anteriorly situated vulva, and more pointed tail terminus. *R. macrosomus* was found to reproduce on a number of vegetable crops but, notably, did not attack cotton, which is very sensitive to *R. reniformis*. On a common host, soybean, the two species induced a similar reaction, *viz.*, an enlarged endodermal feeding cell within which a feeding tube was formed, and a syncytium comprising more or less intact hypertrophied pericyclic cells, with cell wall breakdown in the region close to the nematode head. The resemblance between the mature females of *R. macrosomus* and *R. borealis* is emphasized and the general similarity between these two species also in their male and immature female forms, host preferences, and host tissue reactions is shown.

RÉSUMÉ

Morphologie et parasitisme de la femelle mature de Rotylenchulus macrosomus

La femelle mature de *Rotylenchulus macrosomus*, non observée jusqu'à présent, a été découverte à proximité du lieu type de l'espèce. Sa morphologie et son parasitisme ont été étudiés et comparés à ceux de *R. reniformis*. Morphologiquement, *R. macrosomus* diffère de *R. reniformis* par un corps plus long et plus convoluté, la vulve située plus antérieurement et l'extrémité de la queue plus pointue. *R. macrosomus* se reproduit sur de nombreuses plantes maraîchères, mais il est à remarquer qu'il n'attaque pas le cotonnier, plante très sensible à *R. reniformis*. Chez le soja, plante-hôte commune aux deux espèces, celles-ci induisent des réactions similaires : une grande cellule nourricière endodermique dans laquelle se forme le tube nutritif et un syncytium composé de cellules péricycliques hypertrophiées plus ou moins intactes, avec des ruptures de la paroi cellulaire dans la région voisine de la tête du nématode. La ressemblance entre les femelles matures de *R. macrosomus* et de *R. borealis* est soulignée, de même que la similarité générale entre ces deux espèces, y compris mâles, femelles immatures, gamme d'hôtes et réactions de l'hôte.

Rotylenchulus macrosomus Dasgupta, Raski & Sher, 1968 was described from a population comprising males, immature females and juveniles, recovered from soil in an olive (*Olea europaea* L.) grove in Hulda, Israel; it was identified also in several additional habitats and locations in Israel (Dasgupta, Raski & Sher, 1968). Populations of the species containing mature females were detected on olive roots in two groves located within 30 km of the type locality; this provided an opportunity to describe the adult female stage, study the host-parasite relationships of the species, and reassess its relationship to other species within the genus.

Materials and methods

Soil from around infected olive trees, containing free-living stages of *R. macrosomus*, was potted, and the nematode population was allowed to build up on rooted olive cuttings in a growth chamber. After a three-month growth period males, immature and mature females were extracted from the soil and roots by standard techniques and their morphology and measurements were compared with those of a population of *R. reniformis* reared on soybean under the same conditions.

Limited host range studies of *R. macrosomus* were carried out on cotton (*Gossypium barbadense* L.) cv. Acala, tomato (*Lycopersicon esculentum* Mill.) cv. Hosen Eilon, snap bean (*Phaseolus vulgaris* L.) cv. Contender, sour orange (*Citrus aurantium* L.), corn (*Zea mays* L.) cv. N-170, soybean (*Glycine hispida* Max.) cv. Lee, sorghum (*Sorghum vulgare* Pers.) cv. D-2052, wheat (*Triticum aestivum* L.) cv. Lakhish, pepper (*Capsicum annuum* L.) cv. Maor, and potato (*Solanum tuberosum* L.). For this purpose, heat-sterilized sandy soil was placed in 750 ml containers, in which the plants were seeded. Two weeks after emergence of seedlings, suspensions of 250-300 free-living stages of *R. macrosumus* were introduced into the rhizosphere and the plants were kept in a growth chamber at 25 ± 1°. Eight weeks after inoculation, plants were carefully removed from the

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containers, roots were fixed and stained in boiling lactophenol-acid fuchsin solution, cleared in lactophenol, and scanned under a dissecting microscope for presence of mature females. A host plant was designated as one which supported mature females with egg masses on its roots.

For root histological studies, soybean plants were prepared, inoculated with *R. macrosomus*, and grown and maintained as described above. Five weeks after inoculation, plants were removed, nematode-infected segments were selected, fixed, sectioned and stained as described by Cohn and Mordechai (1977), and examined and photographed under a compound microscope. For scanning electron microscopy, roots with nematodes were fixed in glutaraldehyde and post-fixed and dehydrated by standard techniques. They were mounted on stubs, coated with gold, and viewed and photographed with a Cambridge Stereoscan S-180 electron microscope at 15 KV.

Table 1

Measurements of immature and mature females of a population of *Rotylenchulus macrosomus* (Rm) compared with *R. reniformis* (Rr)

	Immature females (n = 11)		*Mature females (n = 8)*	
	Rm	*Rr*	*Rm*	*Rr*
L (mm)	0.49 (0.47-0.51)	0.40 (0.37-0.41)	0.56 (0.52-0.59)	0.46 (0.41-0.48)
a	26.8 (24.5-29.5)	22.3 (21.4-23.1)		
b	3.5 (3-3.8)	3.1 (2.9-3.9)		
c	12.7 (11.8-14.7)	15.5 (13.9-16.4)		
o*	134.4 (122-140.1)	98.7 (91-111)		
h** (μ)	14.6 (11.5-18.2)	9.6 (6.7-17.3)		
stylet (μ)	19.7 (18.2-21.1)	18.8 (17.3-21.1)		
V	62.1 (58.9-63.3)	71 (70-72.8)	59.8 (58-62)	68.6 (64-74)

* According to the formula proposed by Perry, Darling and Thorne (1959).
** Hyaline portion of tail (Dasgupta, Raski & Sher, 1968).

Results and discussion

Morphology

Measurements of some diagnostic characters of immature females of *R. macrosomus* are presented in Table 1, along with those of individuals from a *R. reniformis* population for comparison. The average body length of the *R. macrosomus* specimens is evidently somewhat shorter than that of the type population (cf. Dasgupta, Raski & Sher, 1968), but the outstanding typical characters shown in the original description, *viz.*, relatively high " o " and " h " values — are prominent also in this population. The mature female of *R. macrosomus* (Fig. 1) differs from that of *R. reniformis* in its 20 % greater body length, and 15 % more anteriorly situated vulva (Tab. 1). In addition, the body posture of the mature female of *R. macrosomus* is more strongly curved and convoluted than that of *R. reniformis*, its tail often crossing the neck — as opposed to the relatively straight, outstretched form of *R. reniformis* (Fig. 2 A, C).

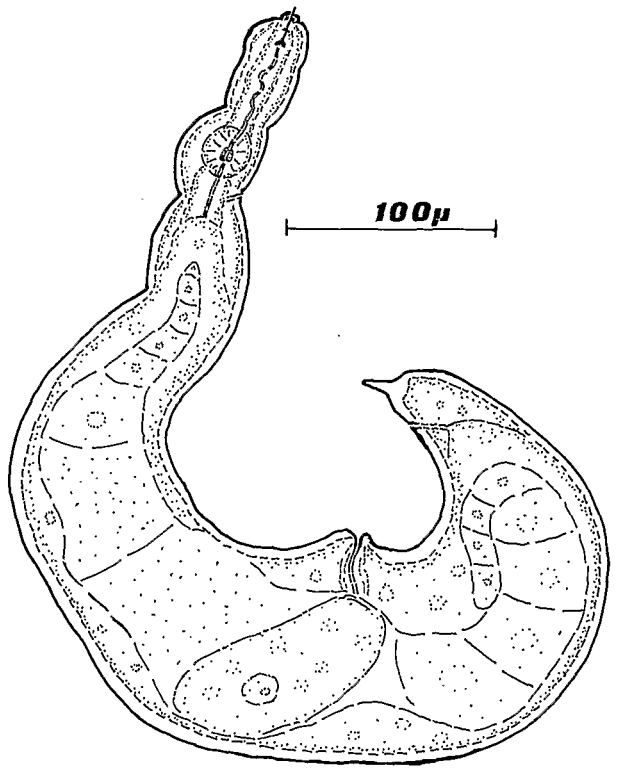

Fig. 1. *Rotylenchulus macrosomus*. Adult female.

Furthermore, the distal portion in the tail is distinctly different in the two species : rounded with a short spike-like process in *R. reniformis*, and slender with a more elongated finger-like projection in *R. macrosomus* (Fig. 2 B, D). Clearly, these two species are morphologically distinct in all life stages, including the mature female. However, the similarity between *R. macrosomus* and *R. borealis* Loof & Oostenbrink, 1962 — already observed by Dasgupta, Raski and Sher (1968) — is further accentuated by our data on the mature female of the former. In their general morphology — notably

the curved body shape and the tail terminus — as well as in body length and the V value (cf. Loof & Oostenbrink, 1962), the mature females of the two species show a remarkable resemblance. It is also noteworthy that *R. borealis* has been shown to present considerable variability in morphological and biometric characters of the migratory stages (Germani, 1978).

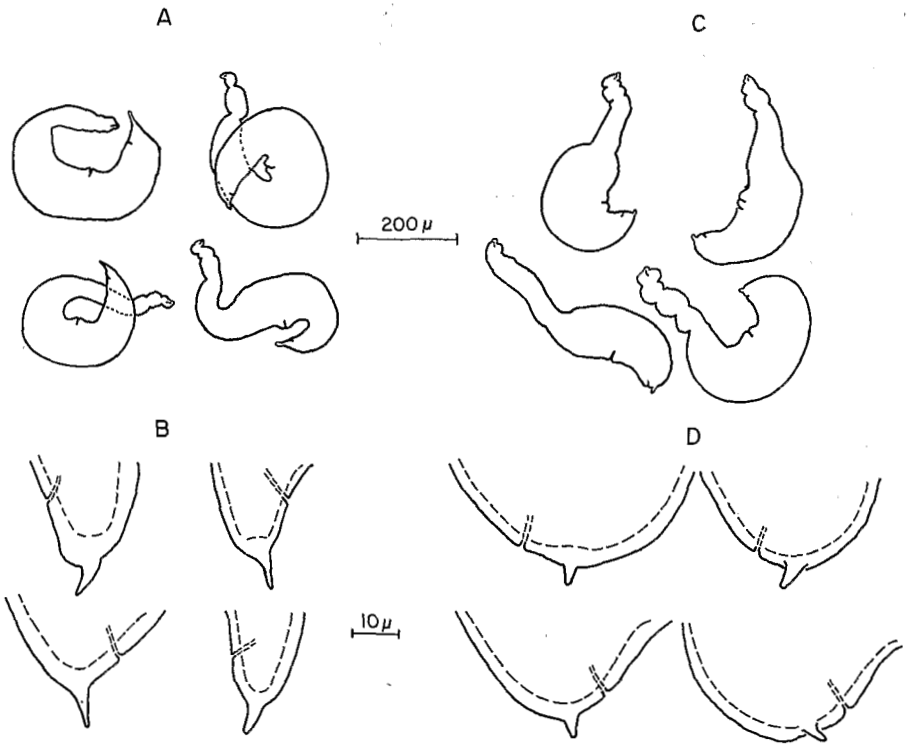

Fig. 2. *Rotylenchulus macrosomus* : A, B, Adult females. *R. reniformis* : C, D, Adult females. (A and C comparison of body postures, B and D comparison of posterior ends and tail termini.)

HOST RANGE

Besides olive, hosts of the nematode included tomato, snap bean, corn, soybean and potato. Five plant species, namely, cotton, pepper, sorghum, wheat and sour orange, were recorded as non-hosts. Evidently, therefore, *R. macrosomus* differs also in its host preference from *R. reniformis*. This difference is particularly meaningful regarding cotton, which is an important economic crop in Israel and has recently been found to be severely damaged by high populations of *R. reniformis* (Cohn & Mordechai, 1984). The general similarity in host spectrum between *R. macrosomus* and *R. borealis* (cf. Vovlas & Inserra, 1982) is also conspicuous, and may serve as another indication of proximity between the two species.

HISTOPATHOLOGY

In general, the feeding behavior of *R. macrosomus* is similar to that of *R. reniformis* (Rebois, Madden & Eldridge, 1975), *R. borealis* (Vovlas & Inserra, 1982) and *R. parvus* (Vovlas, Cohn & Inserra, 1985) on various hosts; *i.e.*, the nematode penetrates the cortical tissue of the root and comes to rest in the endodermis, where it creates a hypertrophied feeding cell (Fig. 3 B). A syncytium is formed by hypertrophy of pericyclic cells adjacent to the feeding cell, with dense granular cytoplasm and enlarged nuclei within the cells, and clearly visible partial cell wall breakdown in the region close to the nematode head (Fig. 3 C, D). A feeding tube within the enlarged feeding cell is also formed (Fig. 3 D), as has been observed in other *Rotylenchulus* species (Vovlas, Cohn & Inserra, 1985). Hence, *R. macrosomus* induces a plant reaction resembling that resulting from feeding by the three aforementioned species of *Rotylenchulus*, but differing markedly from *R. macrodoratus*, which induces a single uninucleate giant cell within the host tissue (Cohn & Mordechai, 1977). Therefore, in this respect, too, there is a clear similarity between *R. macrosomus* and *R. borealis*. It is thus possible that closer investigation of the morphological and biological characters of these two type populations in future studies may raise questions regarding the validity of their taxonomic separation.

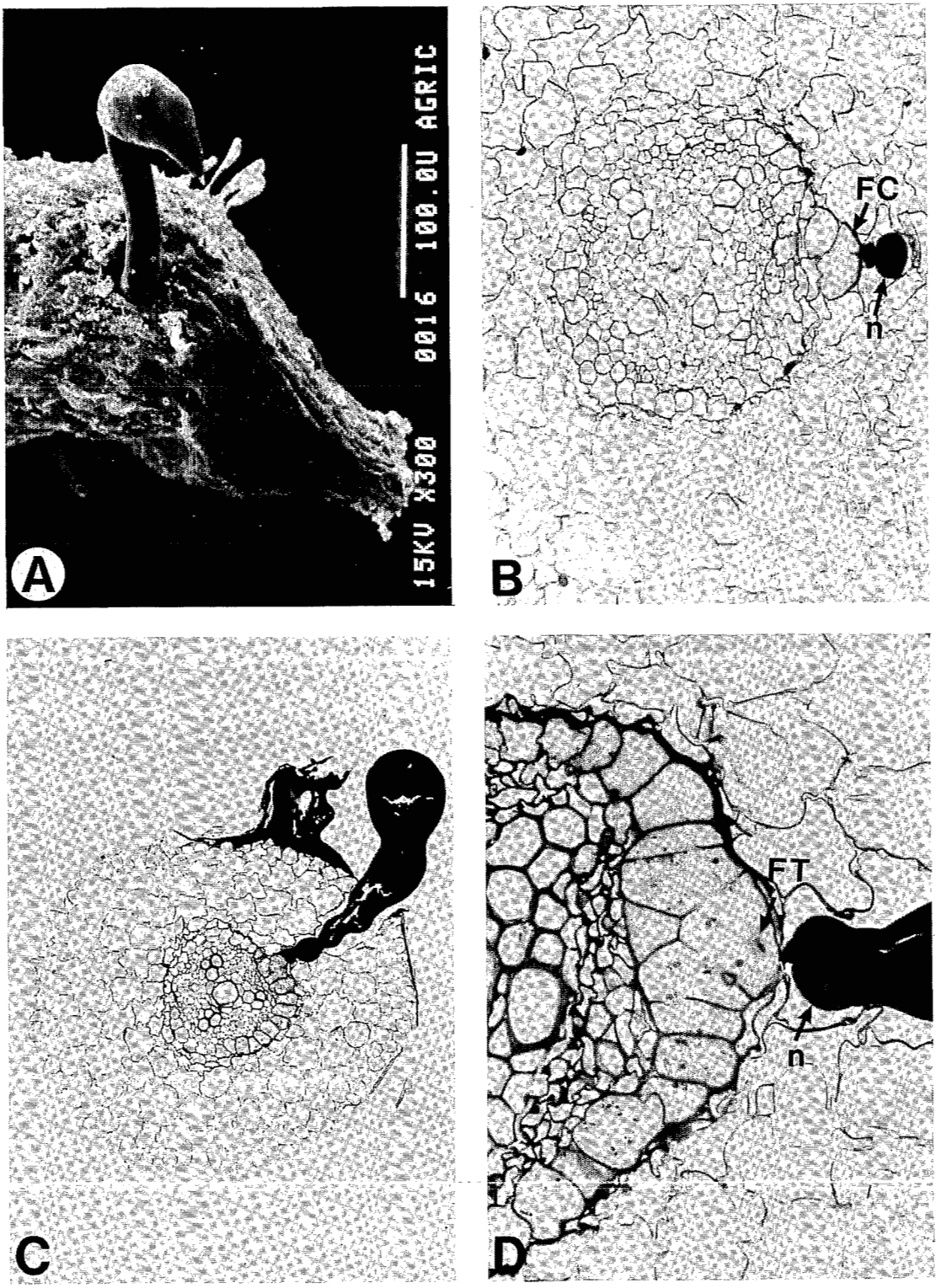

Fig. 3. *Rotylenchulus macrosomus* : Parasitism on soybean. A : Adult female attached to root; B : Formation of endodermal feeding cell (FC) by the nematode (n) in early feeding stage; C : Section of root tissue reaction in late feeding stage; D : Detail of syncytium in pericycle tissue, showing cell wall breakdown in region near the nematode head, and presence of feeding tube (FT).

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