Nematol. medit. (1978), 6: 205-212.

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SOME STUDIES ON THE PREDATORY BEHAVIOUR OF *MYLONCHULUS DENTATUS*

by

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Nematodes belonging to the order Mononchida Jairajpuri, 1969 are predacious in habit and thus are important agents in the biological control of plant-parasitic nematodes. The majority of species are large and active, possessing well developed feeding apparatus. Although the source of food of these animals has not been fully studied, it is known that some species feed upon a variety of soil microorganisms including free-living and plant-parasitic nematodes (Cobb, 1917, 1924; Thorne, 1927, 1932; Mulvey, 1961; Banage, 1963). Recently Esser (1964), Esser and Sobers, (1965) and Nelmes (1974) have reviewed the predatory habits of mononchid nematodes. The work reported here refers to a study of certain aspects of the predatory behaviour of *Mylonchulus dentatus* Jairajpuri, 1970 (Table I) which commonly occurs in Aligarh soils along with a variety of soil microorganisms, predominantly populations of free-living and phytophagous nematodes.

MATERIALS AND METHODS

To study details of the feeding apparatus of *M. dentatus*, specimens were fixed in hot 4% formalin or first stained with methyl green and then fixed in picrocarmine dissolved in ammonia. The picrocarmine fixed specimens were finally stained with a mixture of aniline blue and orange red in acetic acid; these were good for the study of musculature. The specimens were then dehydrated and finally mounted on slides in glycerine.

The food catching mechanism was studied directly under the stereoscopic binocular microscope using cavity slides with a 4 cm diameter well. Five slides were filled with 0.5% water-agar and five with tap-water. Five specimens of *M. dentatus* and about 50 individuals (adults and juveniles) of several other nematode species of varying body sizes were picked from the same suspension and transferred to the cavity slides. The slides were then covered with blue celluloid paper with a narrow air space left between the cover and the surface of the medium. The slides were then kept at 25 ± 3° C in the dark for 4 hours and afterwards were observed under the microscope. A blue filter was used to cut off direct light. All 10 slides were studied one by one at intervals of 10 minutes.

To determine the food preference and rate of predation in *M. dentatus*, 20 wells of 3 cm depth were prepared from plastic tubes of 2.5 cm diameter. The tubes were fixed to glass plates with 'Araldite'. Three ml of tap-water were poured into each well and then two specimens of *M. dentatus* were added to each. After 15 minutes prey consisting of adults and juveniles of *Aphelenchus avenae* Bastian, *Helicotylenchus indicus* Siddiqi, *Hoplolaimus indicus* Sher, *Tylenchorhynchus mashhoodi* Siddiqi *et* Basir, *Acrobeloides* sp., and *Plectus* sp. and juveniles of *Meloidogyne* sp. (120 specimens of each type) were transferred to the wells. Specimens of *M. dentatus* used in this experiment were either freshly isolated or extracted 24 hours previously, the former referred to as 'fresh predators' and the latter as 'hungry predators'. Ten of the wells received fresh and the other ten hungry predators. The prey-predator combination was kept in the dark for 12 hours at 25± 3° C. Each well was observed separately.

In another experiment 0.5% water-agar was poured into 30 cavity slides of 1 cm diameter. These slides were then divided into three equal batches. The first set received two specimens of *M. dentatus* and 10 adults of *Acrobeloides* sp. in a drop of water, the second batch the same number of predators but 10 juveniles of *Acrobeloides* sp. in a drop of water and the third set received 10 juveniles of *Hop. indicus* with two specimens of *M. dentatus*. The slides were then covered with coverslips and their edges sealed with vaseline. After 15 minutes the slides were studied directly under the microscope, each at 10 minute intervals for a one hour period.

RESULTS AND DISCUSSION

Structure of the feeding apparatus

The feeding apparatus of *M. dentatus* (Fig. 1 and Table I) resembles the stoma structure of *Anatonchus amiciae* as described by Coomans and Lima (1965) or of *Mononchus aquaticus* as described by Baqri and Jairajpuri (1974). It is made up of a tri-radiate buccal cavity and a hexa-radiate vestibule. The walls of the buccal cavity consist of two sets of strongly cuticularized plates — a set of three vertical plates with the dorsal plate bearing a large tooth and the two sub-ventrals with many denticles and a set of three oblique basal plates that are less conspicuously developed. The buccal armature consists of a large dorsal tooth with its apex directed anteriorly, and several rows of sub-ventrally arranged denticles. The anterior row of denticles are prominent and regularly arranged while the posterior rows are smaller and irregularly distributed. Behind the transverse rows of denticles a pair of fairly large sub-median teeth connect to the dorsal wall by prominent musculature. The muscles in the cephalic region are of two types: six labial muscles posteriorly attached to the oesophagus and anteriorly bifurcated, with each band connected to a different lip. Thus each labial muscle controls two adjacent lips and each lip is controlled by two different muscles. A set of stomatal muscles is attached to the vertical walls behind the region of the denticles: two subdorsal, two subventral and four sub-laterals. The stoma with its associated muscles forms the trophicosensory organ of the nematode.

THE FOOD CATCHING MECHANISM

The encounter between the prey and the predator occurred when the lip region of the latter came in contact with the former. As soon as this contact was established the predator moved its head vigorously and started probing the prey. Often it was seen to encircle the prey by making coils around its body. The contraction of labial muscles pulled the lips outwards and backwards so that the mouth and the vestibule became widely open (cf. Coomans and Lima, 1965). The dorsal tooth and the denticles became fully exposed and ready to

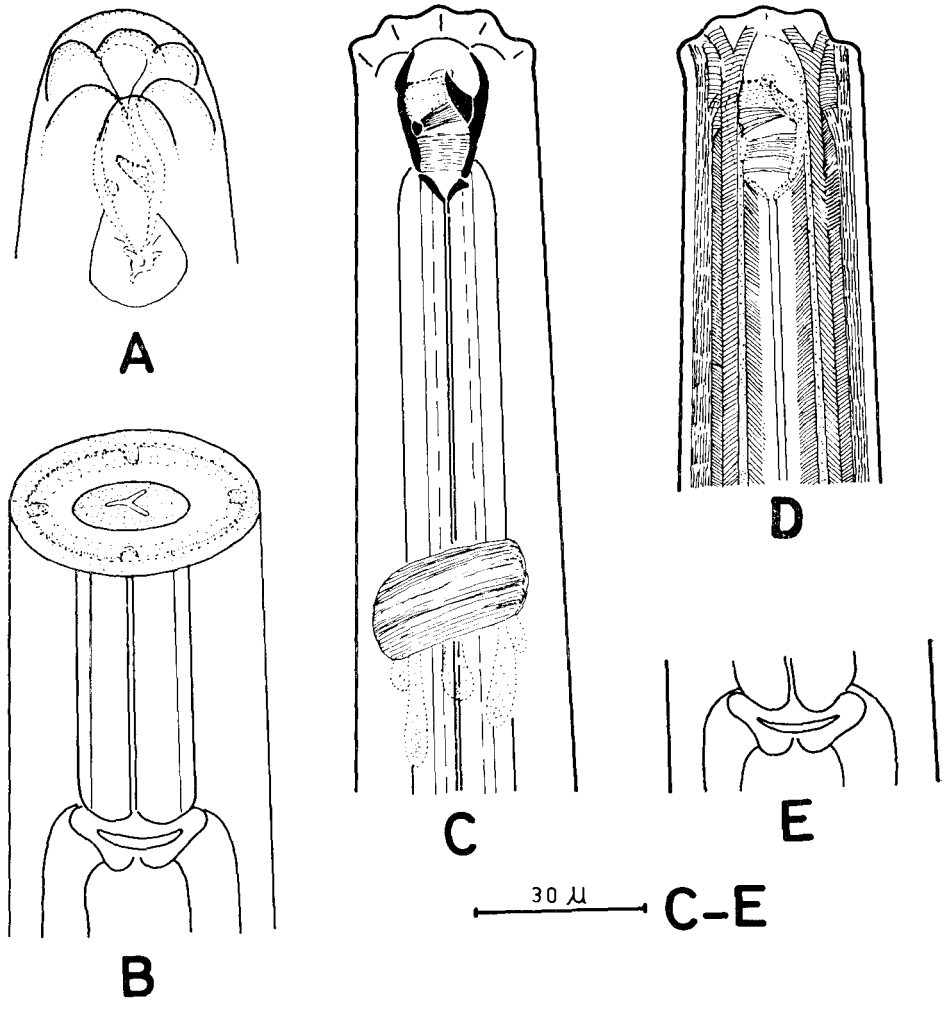

Fig. 1

Feeding apparatus and the associated structure of *Mylonchulus dentatus* Jairajpuri, 1970: A, Lip region; B, Basal part of oesophagus; C, Anterior region of body showing buccal cavity, tooth and denticles and the anterior part of oesophagus; D, Anterior region of body showing muscles associated with the feeding apparatus of the oesophagus; E, Oesophago-intestinal junction.

bite. The contraction of stomatal muscles helped to manipulate the buccal cavity. The prey became immobile and the buccal armature punctured its body, shredded it and then bit it into small pieces. The tooth and denticles as well as the lips of the predator held the prey during the act of feeding. A fluid substance was seen at the point of contact between predator and prey; if the predator discarded the prey the fluid was seen to be stuck around its oral aperture. The food, which consists of the body fluids and internal organs of the prey, was ingested by repeated actions of the feeding apparatus. According to Roggen (1973) the oesophageal muscles and the hydrostatic pressure of the body help to open and close the lumen of the oesophagus. These forces coupled with the action of the stoma are responsible for the suction of food material into the lumen of the oesophagus and its ultimate transfer to the intestine.

Table I - *Some measurements of* Mylonchulus dentatus *(n = 20).*
(All measurements in μm)

	Range	Mean
Body length	1260 - 1503	1331
Maximum body-width	34 - 38	37
Width of lip region	24 - 31	26
Height of lip region	10 - 12	11
Length of oesophagus from the lip region	333 - 387	359
Width of oesophagus	18 - 32	22
Width of oesophageal lumen	4 - 7	5
Buccal cavity	22 - 27 × 13 - 14	23 × 13
Position of dorsal tooth from the base of stoma	19 - 22	20

FOOD PREFERENCE AND THE RATE OF PREDATION

The number of prey that were hunted and killed by the predators and those where only the internal organs were sucked were counted separately. Table II shows rate of predation and the differences in the predatory activities of the fresh and hungry predators.

The fresh predators were very active towards adults and juveniles of *A. avenae* and juveniles of *Meloidogyne* sp. but did not prey much on *T. mashhoodi* and *Hel. indicus* (Table II). *M. dentatus* sucked the internal organs only of juveniles of *A. avenae, T. mashhoodi,*

Plectus sp. and *Meloidogyne* sp. and adults only of *Plectus* sp. but did not attack *Hel. indicus* or *Acrobeloides* sp.

The rate of predation of hungry *M. dentatus* was distinctly higher than fresh ones. Adults and juveniles of *A. avenae*, juveniles of *T. mashhoodi, Acrobeloides* sp., *Plectus* sp., and *Meloidogyne* sp. were actively preyed upon, but juveniles of *Hop. indicus* only little and adults not at all. The predators sucked the internal organs of juveniles of most prey species (Table II).

Table II - *Rate of predation of* M. dentatus, *(2 predator + 20 prey). (Mean of ten replicates)*

Prey / Predator	Killed		Killed and sucked the internal organs	
	Fresh	Hungry	Fresh	Hungry
Aphelenchus avenae				
Adults	10	15	0	0
Juveniles	10	12	4	6
Helicotylenchus indicus				
Adults	3	5	0	0
Juveniles	5	7	2	4
Hoplolaimus indicus				
Adults	0	0	0	0
Juveniles	0	2	0	0
Tylenchorhynchus mashhoodi				
Adults	2	5	0	0
Juveniles	6	10	3	5
Acrobeloides sp.				
Adults	0	0	0	0
Juveniles	6	10	0	0
Plectus sp.				
Adults	5	8	2	5
Juveniles	7	12	4	9
Meloidogyne sp.				
Juveniles	10	13	4	6

Differences in the rate of predation between fresh and hungry predators are significant ($p = 0.01$).

The above observations suggest that *Hop. indicus* is not a suitable prey for *M. dentatus* since only a few juveniles of this species were killed and those too by hungry predators. Adults and juveniles of *A. avenae* and second stage juveniles of *Meloidogyne* sp. were preyed on most. In general, juveniles were preferred more than adults.

Further observations have shown that two specimens of *M. dentatus* can suck in one hour the body fluid of 4 (± 2) adults or 8 (± 3) juveniles of *Acrobeloides* sp. and only 3 (± 2) juveniles of *Hop. indicus* (mean of 10 observations).

The authors thank the Indian Council of Agricultural Research, New Delhi for financial assistance.

SUMMARY

Studies on the predatory behaviour of *Mylonchulus dentatus* Jairajpuri, 1970 suggest that the stoma and its associated muscles form the trophico-sensory organs and help in the food catching and feeding mechanism. No preference was shown for *Hoplolaimus indicus* Sher as prey because only a few juveniles were killed by the starved predators. The adults and juveniles of *Aphelenchus avenae* Bastian and the larvae of *Meloidogyne* sp. were preferred most. In general, the juveniles were preferred more than the adults, perhaps because of their softer body tissues.

RIASSUNTO

Studi sul comportamento da predatore di *Mylonchulus dentatus*.

Studi sul comportamento da predatore di *Mylonchulus dentatus* Jairajpuri, 1970 indicano che lo stoma ed i muscoli, con esso associati, costituiscono gli organi trofosensori e contribuiscono alla cattura della preda ed al meccanismo di assunzione del cibo. Il nematode non ha mostrato alcuna preferenza per *Hoplolaimus indicus* Sher giacché solo pochi stadi giovanili sono stati uccisi dal predatore affamato. Molto più appetiti sono stati gli adulti e le larve di *Aphelenchus avenae* Bastian e le larve di *Meloidogyne* sp. In generale, forse per i tessuti più teneri, gli stadi larvali sono stati preferiti agli adulti.

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Accepted for publication on 12 June, 1978.