The species named above are recognized as true plant parasites, although little is known on feeding of the two species of Tylenchidae tested. Feeding of *Coslenchus costatus* on cabbage root hairs and epidermal cells was first described by Brzeski (1971), and then also observed by Wood (1973). Food source of *Aglenchus agricola* was not known, and perhaps it is the first observation of feeding of this species on plant roots. Both species are typical migratory ectoparasites.

The method may be useful for obtaining the progenies of single female, for proving parasitism and reproduction of species that are suspected parasites, for the critical study of reproduction of nematodes on plants that are poor hosts (i.e., low equilibrium density), for testing plants for resistance, and to cross nematodes. The plants that grew for a few months in the plates were easily transplanted to soil in pots and/or in the field, where they reached normal growth size.

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Evaluation of the predation abilities of the mite *Hypoaspis calcuttaensis*, predaceous on plant and soil nematodes

Anwar L. BILGRAMI*

Some species of mites can be predaceous on nematodes (Rodriguez *et al.*, 1962; Rockett & Woodring, 1965; Muraoka & Ishibishi, 1976; Inserra & Davies, 1983; Imbriani & Mankau, 1983; Bilgrami & Tahseen, 1992). In a previous paper (Bilgrami, 1994), an exhaustive study of the predaceous abilities of *Tyrophagus putrescentiae* was presented. The present article reports observations on the predation by the mite *Hypoaspis calcuttaensis* on different species of plant and soil nematodes. When cultures of many saprophagous and predaceous nematodes were heavily contaminated by *H. calcuttaensis;* the nematode populations declined significantly or even perished as a result of extensive predation.

* *Section of Nematology, Department of Zoology Aligarh Muslim University, Aligarh-202002, India.*
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The experimental process was identical to that reported earlier in similar experiments conducted with the mite *T. putrescentiae* (Bilgrami, 1994). The only difference concerns the temperature (30 ± 2 *vs* 28 ± 2 °C) and some of the species used as prey. During the present studies, the rate of predation, predatory profile, various factors influencing predation by *H. calcuttaensis :* starvation of mites, preys, agar thickness, prey density, temperature, agar concentration, age and test area (see Bilgrami, 1994) were measured. The list of prey nematodes along with the rate of predation by *H. calcuttaensis* is given in Table 1 and other results in Fig. 1.

H. calcuttaensis is predaceous. It feeds voraciously on saprophagous, plant parasitic, and predaceous nematodes (Table 1). Among saprophagous nematodes, *H. calcuttaensis* fed most on *Mesorhabditis* sp., with low variation. *Acrobeles* sp. was least preferred by the mites ($P \leq 0.05$; Table 1). Among plant-parasitic nematodes, maximum predation occurred on second stage juveniles of *Meloidogyne incognita, Anguina tritici,* and *Heterodera mothi.* Predation was most consistent on

Table 1. *Predation by* Hypoaspis calcuttaensis *on different species of nematodes belonging to different trophic groups*

Prey species	Mean* killing
SAPROPHAGOUS	
Acrobeles sp.	31 ± 2.1 (29-32)
Tobrilus sp.	32 ± 1.5 (30-34)
Rhabditis sp.	34 ± 2.1 (32-37)
Cephalobus sp.	35 ± 1.5 (33-37)
Chiloplacus symmetricus	36 ± 2.6 (33-39)
Acrobeloides sp.	37 ± 1.5 (35-39)
Mesorhabditis sp.	38 ± 1.8 (36-41)
PLANT-PARASITIC	
Paratrichodorus sp.	14 ± 5.1 (8-20)
Hemicriconemoides mangiferae	16 ± 3.8 (10-20)
Hemicycliophora dhirendri	20 ± 3.1 (16-24)
Scutellonema sp.	21 ± 3.3 (16-25)
Hoplolaimus indicus	24 ± 3.7 (18-28)
Xiphinema basiri	24 ± 3.1 (19-27)
Helicotylenchus indicus	26 ± 5.0 (20-30)
Tylenchorhynchus mashhoodi	28 ± 4.6 (22-32)
Paralongidorus citri	29 ± 4.8 (24-35)
Basiria sp.	29 ± 4.4 (25-35)
Aphelenchoides sp.	30 ± 2.3 (27-33)
Longidorus sp.	31 ± 5.1 (23-37)
Hirschmanniella oryzae	31 ± 2.9 (28-35)
Heterodera mothi	36 ± 1.5 (34-38)
Anguina tritici	36 ± 1.5 (34-38)
Meloidogyne incognita	40 ± 1.8 (38-43)
PREDACEOUS	
Dorylaimus stagnalis	8 ± 2.4 (5-11)
Mononchus aquaticus	15 ± 2.1 (12-17)
Mononchoides fortidens	16 ± 1.2 (14-17)
Mononchoides longicaudatus	18 ± 2.5 (14-21)
Aporcelaimellus nivalis	19 ± 2.4 (17-23)
Aquatides thornei	20 ± 3.0 (16-23)
Discolaimus silvicolus	21 ± 3.1 (16-24)
Mylonchulus dentatus	22 ± 3.0 (18-25)

* On 50 nematodes inoculated.

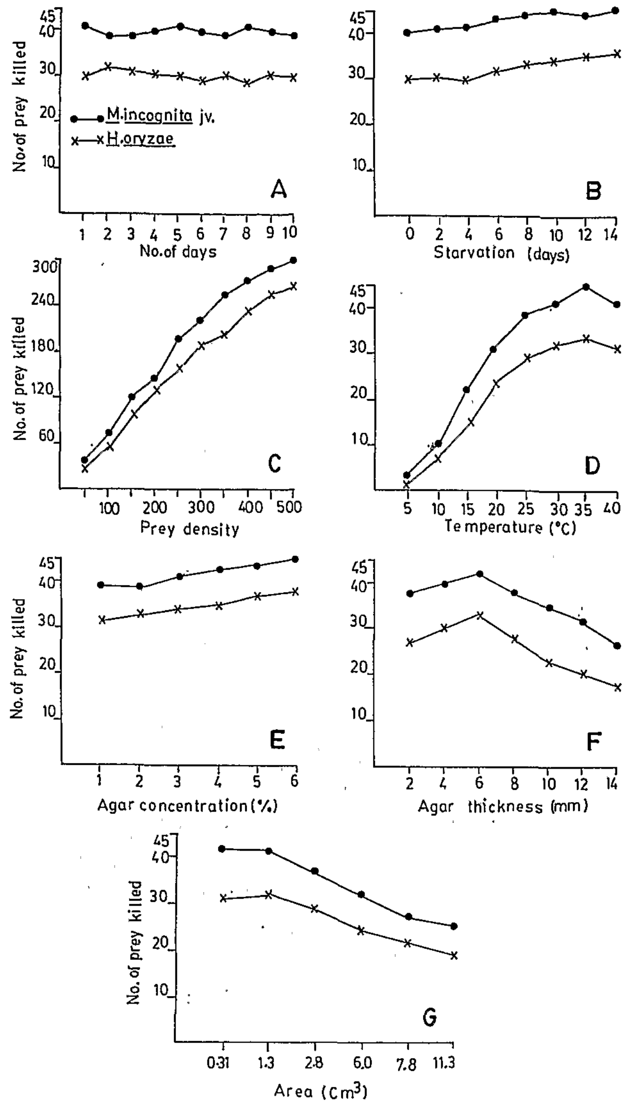

Fig. 1. *Predatory profile of* Hypoaspis calcuttaensis *over a period of 10 days (A) and effects of starvation (B), prey density (C), temperature (D), agar concentration (E), agar thickness (F) and test area (G) on its predation activity.*

these parasitic nematodes. *Hoplolaimus indicus, Helicotylenchus indicus, Hemicriconemoides mangiferae, Hemicycliophora dhirendri, Xiphinema basiri, Paralongidorus citri* and *Scutellonema* sp. were killed and eaten in small numbers. The other species were moderately predated upon by the mites ($P \leqslant 0.05$; Table 1).

Predatory nematodes resisted predation better than the other types of nematodes : 16-44 % of predatory nematodes were consumed by the mites. *Aquatides thornei* was the most killed and *Dorylaimus stagnalis* the least ($P \leqslant 0.05$; Table 1).

H. calcuttaensis consumed more individuals of *M. incognita* than of *Hirschmanniella oryzae* over a period of ten days ($P \leqslant 0.05$; Fig. 1 A). Predation by *H. calcuttaensis* on *M. incognita* juveniles and *H. oryzae* adults increased with the period of starvation (Fig. 1 B), prey density (Fig. 1 C), and temperatures up to 35 °C (Fig. 1 D). The difference in predation by fresh and 14-days-starved mites was significant ($P \leqslant 0.05$). Mites killed a maximum of individuals in a population of 500 preys and a minimum in populations of 50 preys ($P \leqslant 0.05$). At 40 °C, predation started declining. Maximum predation occurred at higher agar concentrations (5-6 %) ($P \leqslant 0.05$). Low agar concentrations (1-2 %) yielded minimum predation ($P \leqslant 0.05$; Fig. 1 E). An agar thickness of 6 mm was most suitable ($P \leqslant 0.05$; but predation declined at other agar thicknesses (Fig. 1 F). Encounters between mites and nematodes yielded maximum predation in smallest test areas (Fig. 1 G). Predation declined when test area increased. In all experiments *H. calcuttaensis* predated more upon *M. incognita* juveniles than upon *H. oryzae.*

Pergalumna sp. fed voraciously on *Pelodera lambdiense* and *Tylenchorhynchus martini* (Rockett & Woodring, 1966) whereas *T. putrescentiae* fed on a variety of nematodes in culture and experimental dishes (Bilgrami & Tahseen, 1992; Bilgrami, 1994). Present studies on *H. calcuttaensis* also suggest that these mites are predaceous and feed voraciously on plant and soil nematodes belonging to different trophic groups. More predation on *H. mothi, M. incognita,* and *A. tritici* juveniles by *H. calcuttaensis* could be attributed to physical, chemical and behavioural characteristics which are generally absent in endo-parasitic nematodes (Bilgrami, 1994). Such characters provide resistance against predation in ecto-parasitic and predaceous nematodes as is the case with present study (Bilgrami & Jairajpuri, 1989). Among saprophagous nematodes *H. calcuttaensis* preferred *Mesorhabditis* sp., while *T. putrescentiae* preferred *Acrobeloides* sp. (Bilgrami, 1994). Both species of mites, however, preferred *Acrobeles* sp. the least. *H. calcuttaensis* appeared to possess stronger predatory abilities as it killed on an average more individuals of saprophagous and plant parasitic nematodes than *T. putrescentiae* (Bilgrami, 1994). *T. putrescentiae* which killed more individuals of predaceous nematodes exhibited comparatively more consistent predation (CV = 3-27 %) than *H. calcuttaensis* (CV = 4-36 %).

Feeding by *H. calcuttaensis* on its own feacal matters (coprophagous) in the absence of prey suggests that mites undergo starvation in the absence of prey, which is supported by the fact that starvation of mites affect predation. Increased predation with starvation may thus be attributed to the apititic conditions which are governed by the duration of starvation (Bilgrami, 1994). The 10-14-days starved *T. putrescentiae* killed as many *H. oryzae* as *M. incognita* (Bilgrami, 1994) but all starving groups of *H. calcuttaensis* killed more *M. incognita* juveniles than *H. oryzae.* Mites did not show cannibalistic behaviour. Increased predation with prey number suggests density dependent predation by *H. calcuttaensis.* This may be attributed to improved probability of contacts between predators and prey (Bilgrami, 1994). Probability of contacts increases with the increase in prey density. The differential rate of predation by *H. calcuttaensis* at different temperatures and agar concentrations may be the outcome of differential activity of mites and the prey individuals. Activity of these individuals is governed by different temperatures and agar concentrations (Bilgrami, *et al.,* 1983). Agar concentration of 5 % was most suitable for *T. putrescentiae* (Bilgrami, 1994) but for *H. calcuttaensis* it was found to be 5-6 %. Thick agar layers suppressed predation, which seems to be due to decreasing probability of mites to establish contacts with prey (Bilgrami, 1994) as prey nematodes have a larger area in which they can move about and avoid predation (mites could not penetrate agar). Increased predation by *H. calcuttaensis* in small test areas suggests that small test area provided mites more nematodes per unit area to establish more contacts and initiate attacks (Bilgrami & Kulshreshtha, 1994; Bilgrami, 1994).

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