EFFECT OF MELOIDOGYNE INCOGNITA POPULATION ON BLACK PEPPER

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ABSTRACT : *Meloidogyne incognita* was found to be pathogenic to black pepper causing stunting and yellowing of the plants and reduction in root and shoot weights. Reduced growth of plants and intensity of galling was correlated with the increase in initial nematode population. An initial nematode inoculum level of 10 larvae per plant caused severe damage over a period of one year.

Koshy *et al.* (1977) reported wide spread occurrence of *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 on black pepper (*Piper nigrum* L.) from Kerala. They had screened the various species of plants used as standards for pepper and reported *Garuga pinnata* to be immune to *M. incognita*. Koshy and Sundararaju (1979) screened seven cultivars of pepper against *M. incognita* and reported the variety hybrid Panniyur I as the most susceptible. Though black pepper was reported as a host of *Meloidogyne* spp. by various workers, the pathogenic effect of the nematode on black pepper was not studied (Ayyar, 1926; Mayne and Subramaniam, 1933; Nadakal, 1964 and Kumar *et al.*, 1971).

MATERIAL AND METHODS : Fifty semi-hard pepper cuttings of the variety hybrid Panniyur I with four nodes each were planted in two kilogrammes of steam-sterilised sandy loam soil, contained in 20 cm earthen pots. On sprouting at the 3-nodes stage, they were inoculated with 10, 100, 1,000, 10,000, 100,000 freshly-hatched second stage larvae collected from egg masses from infested pepper roots in the C.P.C.R.I., farm, Kayangulam. Five replications were maintained for each inoculum level. Un-inoculated seedlings grown in sterile soil served with 25 cc each of the run out of the 500 mesh sieve of the above inoculum served as control. The plants were maintained at a place of even light in the green house. After one year, the growth characters of the plants were recorded and plants were depotted. Nematodes from 250 g of soil from each pot were extracted by finally collecting them on a 500 mesh sieve. Populations were counted under a stereoscopic binocular microscope and the total population in the whole pot, i.e. in two kilogrammes of soil, was calculated. Roots were washed free of adhering soil particles and a root-knot index rating was given. Then they were cut off from the stem base and chopped into 2 cm pieces, mixed thoroughly, and three one gram samples were drawn and stained in acid fuchsin lactophenol. Each one of them was blended separately and the volume was made upto 230 cc. Three 5 ml samples were drawn from each and eggs, different larval stages and adults were counted. The average per gram population thus determined was used in calculating the total root population in the root system of a plant. Histopathology was done according to Johansen (1940). Longitudinal and transverse sections were cut at 15 μ thickness and stained with safranin-aniline blue and mounted in DPX.

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RESULTS AND DISCUSSION : Shoot length at various inoculum levels showed, on comparison with the controls, a definite reduction. Maximum reduction of the order of 50.3 per cent was recorded on treatment receiving an inoculum level of 1,00,000 nametodes while minimum reduction of 16.0 per cent was recorded at the level of 10 nematodes per plant (Table 1). Reduction in internodal length and increase in yellowing of leaves were marked at 10,000 and 1,00,000 treatment. The same trend was seen with regard to the green weight of the shoot starting with 16.17 per cent reduction at the inoculum level of 10. There was a steady decrease in shoot weight corresponding to increase in inoculum levels, reaching a maximum of 47.6 per cent at 1,00,000 treatment (Table 1).

TABLE 1 : Effect of inoculum levels of *M. incognita* on growth of black pepper and population build up (average 5 replications)

Inoculum levels	Shoot length (cm)	Shoot weight (g)	Root length (cm)	Root weight (g)	Gall* index	Total population in (Soil & Root)
0	357.8	133.6	63.6	16.2	0	0
10	300.6 (16.0)**	112.0 (16.17)	61.4 (3.6)	17.8 (9.9)	1.6	71,755
100	249.0 (32.2)	86.0 (36.4)	60.4 (2.7)	14.2 (12.35)	2.4	44,132
1,000	211.0 (38.6)	80.0 (39.4)	52.2 (21.7)	11.8 (14.9)	3.0	69,146
10,000	279.4 (21.8)	92.4 (30.1)	44.0 (30.8)	12.4 (23.5)	3.2	1,20,409
1,00,000	178.0 (50.3)	70.0 (47.6)	59.2 (6.9)	12.6 (22.2)	3.4	1,17,175
S.Em	33.88	12.00	5.99	2.21	—	31,386
C.D.5%	69.9	24.8	—	—	—	—

**Gall index rating*

0 = No galling; 1 Light; 2 = Moderate; 3 = Severe; 4 = Very severe

**Figures in parenthesis are the percentage reduction over control.

Also, in the case of root length there was found to be increased reduction with increased inoculum dosage. The 1,00,000 treated plants stood an exception where, in two cases one or two roots which escaped initial infection got coiled at the bottom of the pot and when stretched and measured resulted in higher average value.

Increased reduction of root weight was noticed with increase in initial inoculum level. A maximum of 23.5 per cent reduction was noticed at 10,000 level and 22.2 per cent at 1,00,000 level (Fig. 1). However, significant reduction in shoot length and shoot weight occurred only with an initial inoculum level of 100 nematodes and above and differences were not significant with regard to root length and root weight. This kind of decrease in growth of plants with increasing inoculum level has been reported by Dhawan and Sethi (1976) for *M. incognita* on brinjal.

The root-knot gall index revealed a steadily increasing trend with every increase in inoculum level from 1.6 in the case of plants inoculated with 10 nematodes to 3.4 in the case of plants receiving 1,00,000 nematodes (Table 1).

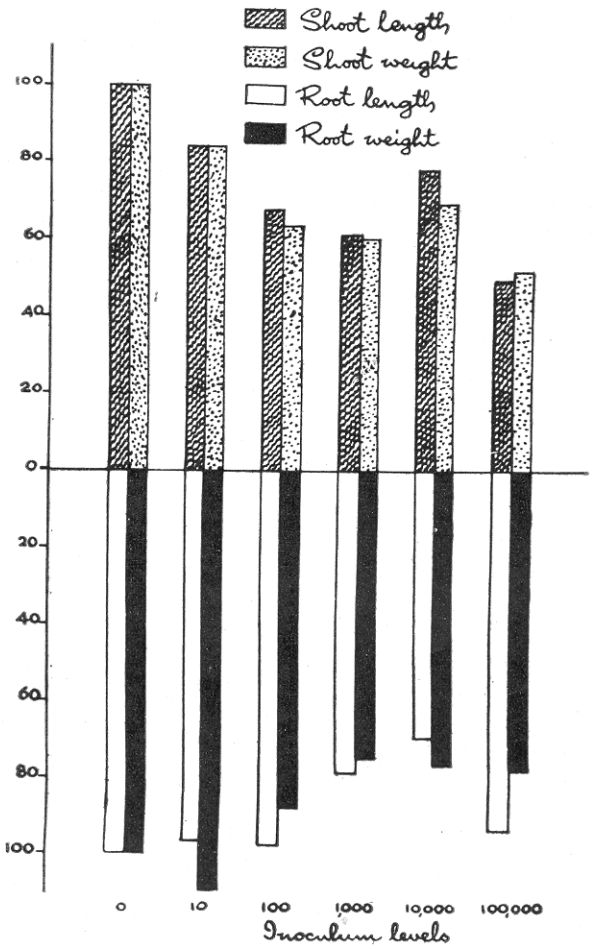

Fig. 1. Percentage reduction in growth characters of black pepper at different inoculum levels of *M. incognita*.

As for the final population (root and soil) plants at 10,000 inoculum level recorded a peak closely followed by the 1,00,000 level. The maximum multiplication occurred in the case of 10 nematodes by a factor of 7175 while in the case of 1,00,000 treatment, the factor was only 1.17 (Table 1). This clearly indicates that the rate of multiplication of nematodes is density dependent phenomenon. The decrease in rate of multiplication was perhaps due to competition for nutrition among the developing nematodes within a given root system as reported earlier by Triantaphyllou and Hirschmann (1960) in *M. incognita* and Rao and Israel (1973) in *M. graminicola*.

The average per gram root population at an initial inoculum level of 10,000 and 1,00,000 were 7685 and 7295 respectively. The reduction in growth characters varied from 22—50 per cent with the above inoculum levels which implies that an yield

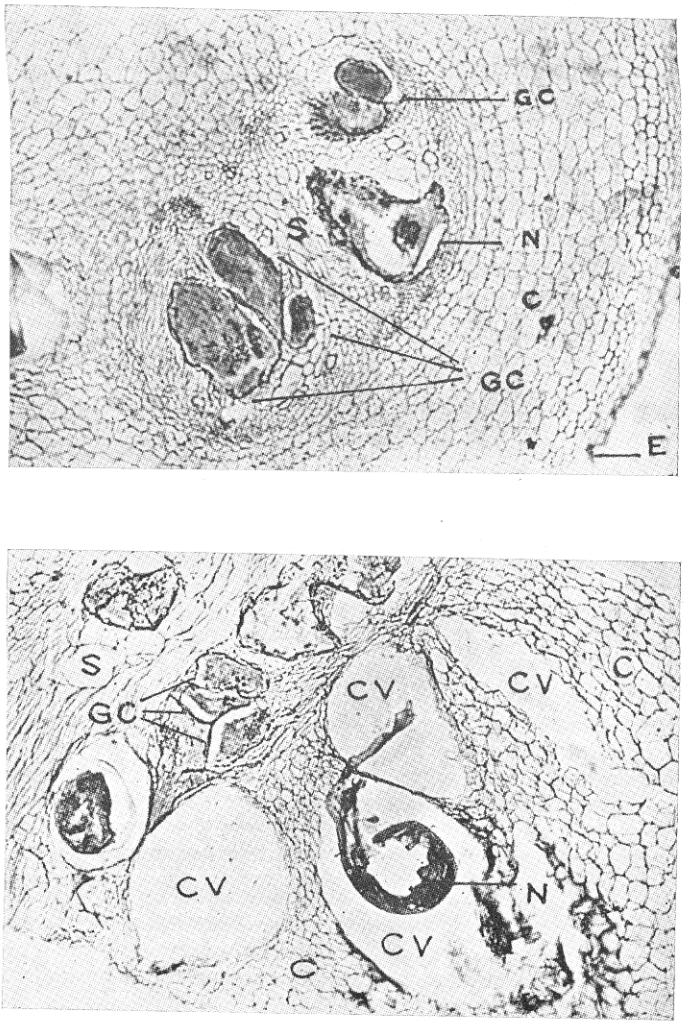

Fig. 2—3. Transverse and longitudinal sections of black pepper root infested with *M. incognita*. 2. T. S. showing nematode and giant cells in the vascular region. 3. L. S. showing multiple infection in the stele and cortex.

GC—Giant cell; N—Nematode; CV—Cavity;
S—Stele; C—Cortex; E—Epidermis.

reduction of 22—50 per cent can be expected in a plant harbouring an average per gram root population of 7,000 (eggs, different larval stages and adults) and above. Pepper being a perennial crop, it was felt that the experiment should run for a period of at least one year, unlike in annuals. The prolongation of the present study to one year has contributed to the gradual and steady build up of the population thereby causing a deleterious effect on the host even at an initial inoculum level of 10 nematodes.

Histopathology of the infested roots revealed the presence of the nematode in the stelar and cortical regions of the plant tissue. A maximum of six giant cells were recorded in the vascular region (Fig. 2 and 3). In most of the cases egg masses were found 5—10 cells below the epidermis (Fig. 2). This may be the reason for the smooth appearance of galls in the variety Hybrid Panniyur I reported by Koshy and Sundararaju (1979).

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