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EFFECT OF *RADOPHOLUS SIMILIS* ON TURMERIC

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Shallow, water soaked brownish areas of rhizomes and rotting of roots were the main symptoms of *R. similis* infestation of turmeric. Scale leaves also harboured *R. similis*. The plant growth was significantly decreased in the presence of nematode. An initial inoculum level of ten nematodes caused 35 per cent reduction of rhizome weight after four months and 46 per cent at the end of the season (8 months). With increase in inoculum levels a corresponding decrease in plant growth was recorded with a negative correlation for nematode multiplication. The nematode was found to be disseminated through infested planting materials.

Root-knot nematode was the first to be reported on turmeric (Ayyar, 1926). Later it was reported as a host for *Meloidogyne javanica* (Nirula & Kumar, 1963), *M. incognita* (Nirula & Kumar, 1963; Nadakal & Thomas, 1964) and *Radopholus similis* (Koshy & Sosamma, 1975; Vilsoni, *et al.*, 1976). The pathogenic effect of burrowing nematode, *Radopholus similis* (Cobb, 1893) Thorne, 1949 on turmeric was studied and is reported here.

MATERIALS AND METHODS

Turmeric 'finger' rhizomes, var. Ca. 70 Katergia, of 10 g each with one sound eye bud, were sown in 75 earthen pots (18 x 17 cm) containing 3 kg steam sterilised sandy loam soil during June, 1977. At three leaf stage, 48 plants of uniform growth were selected. Inoculum was collected from coconut roots using the method adopted by Koshy *et al.* (1975). The nematode suspension collected on 400 mesh sieve was placed on double-layer paper supported by an aluminium wire gauze on a petri plate containing water to obtain active nematodes. The run out water, free of nematodes or eggs, from the sieve was used for treating the control plants. Eight plants each were inoculated on or very near to the roots with nematodes suspended in water, using different levels of inoculum *viz.* 0, 10, 100, 1000, 10,000 and 1,00,000 in July, 1977. For treatments using 10 and 100

nematodes, active females and larvae were hand picked. The pots were arranged in a randomised manner in the green house with a temperature range of 27-34°C and watered daily with boiled and cooled water. After five months of inoculation, four plants each from all treatments were depotted and washed thoroughly to remove the adhering soil particles. Growth characters such as number of tillers, number of leaves, maximum width of lamina, length of lamina, shoot length, shoot weight, number of roots, maximum root length, root weight, number of rhizome branches (figures), and rhizome weight were recorded. Visual observations on rotting of rhizomes and roots were also noted. Rhizomes and roots were cut into 1-2 cm bits separately and three one gram samples, each of roots and rhizomes were drawn, stained in boiling cotton-blue-lactophenol for two minutes, cleared and churned for 30 seconds using a waring blender. The suspension was made upto 250 ml and three aliquots of 5 ml were drawn. Counts were made under a stereoscopic binocular microscope and an average per gram population was calculated. Total root and rhizome populations were worked out by multiplying the total weight of root and rhizome with per gram populations of root and rhizome. From every pot, 250 ml soil was analysed by Cobb's sieving and sifting method followed by modified Baermann's funnel method.

The remaining four replications of all treatments were retained in pots till full maturity of the rhizomes. They were depotted in March, 1978 and rhizome weights of individual plants were recorded. The rhizomes were placed in cloth bags and stored in the laboratory. Four fingers each, from all the treatments, were sown in July, 1978 in steam sterilised soil. During January, 1979 these plants were depotted and observed for nematodes and symptoms. The rhizomes and roots were cut into small pieces and left in tap water in petri plates for 72 hours and washed using a 400 mesh sieve. The roots and rhizomes were kept both in the laboratory (26-32°C) and in a BOD incubator (12-14°C).

RESULTS AND DISCUSSION

Infestation on the rhizome was evidenced by small, shallow, water soaked brownish areas. The rotting of the rhizome started initially from the leaf axils and extended further to other portions. Roots showed rotting and most of the rotten roots were found to retain only the epidermis devoid of cortex and stelar portions. Scale leaves also harboured *R. similis*. The infested rhizomes were of yolk yellow colour compared to the golden yellow colour of the healthy rhizomes (plate 10, page 43 of Maerz & Paul, 1950). Compared with the lower

TABLE I

Effect of different inoculum levels of R. similis *on growth of turmeric and population build up.* (av. of 4 replications)

Inoculum levels	No. of tillers	No. of leaves	Max. width of lamina (cm)	Length of lamina (cm)	Shoot length (cm)	Shoot weight (gm)	No. of roots	Max. root length (cm)	Root weight (g)	No. of rhizome branches	Rhizome weight after 4 mon.	Rhizome weight after 8 mon.	Total population (Soil + Root + Rhizome)	Multiplication factor
10	2.50 (9)	11.25 (12)	7.50 (0)	26.00 (8)	57.50 (1)+	43.25 (24)+	20.00 (5)	39.75 (12)+	24.25 (16)+	9.50 (36)	38.25 (35)	45.00 (46)	14328.50	1432.8
100	2.50 (9)	12.25 (0)	7.50 (0)	24.75 (12)	57.50 (1)+	34.00 (3)	22.50 (6)+	26.00 (27)	23.50 (12)+	11.50 (22)	39.25 (33)	32.50 (61)	17913.00	179.1
1000	2.25 (18)	11.50 (10)	8.00 (6)+	23.25 (18)	60.50 (6)+	28.50 (19)	19.50 (8)	29.50 (17)	15.25 (28)	10.00 (32)	41.00 (30)	37.50 (55)	36487.25	36.5
10000	3.00 (9)+	12.00 (6)	7.25 (3)	24.75 (12)	53.00 (7)	27.50 (21)	17.25 (19)	33.50 (6)	13.25 (37)	9.75 (34)	34.50 (41)	37.50 (55)	38928.50	3.9
100000	2.25 (18)	11.00 (14)	6.25 (17)	24.00 (15)	54.50 (4)	18.25 (48)	14.75 (31)	29.75 (16)	12.25 (42)	6.00 (59)	20.25 (65)	20.50 (76)	14786.50	0.1
Control (0)	2.75	12.75	7.50	28.25	56.75	35.00	21.25	35.50	21.00	14.75	58.75	84.00	0.00	0.0
C. M.	2.54	11.88	7.33	25.17	56.63	31.08	19.21	32.33	18.42	10.17	38.67	42.83	20407.29	—
S. E.	0.99	2.06	1.68	1.97	5.68	9.5	4.35	7.45	3.23	1.68	8.37	7.74	18611.31	—
C. D.	—	—	—	2.96*	—	14.43+	—	—	9.52**	3.51**	17.84**	22.81**	—	—

Figures in parenthesis are percentage reduction over control.

+Percentage increase over control.

inoculum level, the damage was more in the case of plants which had an initial inoculum of 100 or more nematodes.

The reduction in plant growth characters was directly correlated with an increase in initial inoculum levels, the least being recorded in the case of 100,000 population level. An initial level of ten nematodes per plant in 3 kg soil caused a reduction in rhizome weight by 46 per cent whereas plants inoculated with 100,000 nematodes resulted in 76 per cent reduction. All levels of populations reduced branching of rhizomes which also resulted in the yield reduction. At the inoculum level of 100,000 a reduction of 14 per cent in the case of number of leaves, 17 per cent in width of lamina, 15 per cent in length of leaf, 18 per cent in number of tillers, 31 per cent in number of roots and 16 per cent in root length was recorded (Table I). In general the inoculated plants showed a tendency to age and dry faster than the control plants.

The total population build up was not proportional to the initial inoculum used, the least being recorded at 100,000 nematodes level and the maximum at 1,000 nematodes level. However, the multiplication factor was maximum at 10 nematodes level. The maximum per gram population in root and rhizome was 5684 and 400 respectively.

An interesting feature noted was that majority of plants developed thickened tuber like nodulose root tips on contact with the pot surface, both in control as well as inoculated plants. However, the root tips of the infested plants exhibited cracking and rotting. On teasing, they yielded plenty of *R. similis* (121/g) whereas the thickenings in control plants had smooth surface and were free of nematodes.

The second generation plants depotted in January, 1979 also showed rotting of roots and rhizomes and they harboured plenty of active *R. similis*. This indicated that the nematode could survive in the seed rhizome and possibly its dissemination takes place through infested rhizomes. Vilsoni *et al.* (1976) have reported that in Fiji, *R. similis* on ginger was disseminated mainly through the planting material.

The difficulties in the extraction of *R. similis* from roots of coconut, pepper and banana (Koshy *et al.*, 1978) were not experienced in the case of turmeric. There was no scum formation on the extraction medium (water) under laboratory conditions and the total population recovery was equal in both low temperature conditions (12-14°C) as well as under laboratory conditions (26-32°C).

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