Nematol medit. (1985), 13: 127-132.

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NATURE OF RESISTANCE TO *MELOIDOGYNE INCOGNITA* IN COWPEA, *VIGNA UNGUICULATA* (1)

by
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The root-knot nematode, *Meloidogyne incognita* (Kofoid *et* White) Chitw., is a serious pathogen of cowpea, *Vigna unguiculata* (L.) Walp., in India, causing up to 28 per cent loss in pod yield (Parvatha Reddy and Singh, 1981). Cowpea lines that are resistant to the root-knot nematode would offer practical and effective means of control. However, little effort has been directed towards gaining a basic understanding of the nature of resistance.

In the present study, emphasis is given to looking at differential development patterns of *M. incognita* in susceptible and resistant lines of cowpea. Two cowpea selections (IC 9642-B and TVU 2430-P) with reported resistance to *M. incognita* (Singh and Parvatha Reddy, 1982) were chosen, along with two susceptible commercial cultivars (S-288 and S-488). Nematode penetration, development and reproduction, life history and chemical analysis (minerals and phenols) of the host in relation to *M. incognita* were observed.

Material and methods

Red sandy loam soil, sterilized in an autoclave at 14 kg pressure for one h, was used to fill the pots. Five hundred grams of soil were

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used per 10 cm diameter pot. Five grams of fertilizer mixture (17-17-17) were added for each pot and mixed thoroughly. During the experimental period the average minimum and maximum temperatures were 18.1° and 30.5°C, respectively, and there was on average 7:30 h bright sunshine per day.

Ten-day-old cowpea cultivars/selections (IC 9642-B, TVU 2430-P, S-288, S-488) raised singly in sterilized soil in 10 cm clay pots were inoculated with approximately 500 freshly hatched larvae of *M. incognita*. Each treatment was replicated eight times. Juvenile penetration in resistant and susceptible lines was investigated by harvesting the roots of four plants seven days after inoculation and staining in 0.5 per cent boiling lactophenol-acid fuchsin for one minute. Forty-five days after inoculation, the other four plants were harvested and the gall, egg mass and egg counts were made according to the methods described by Setty (1968) and Parvatha Reddy *et al.* (1975). The nematode populations in the soil remaining in pots after harvest were determined.

Randomly selected plants, grown and inoculated as described above, were uprooted every day for 40 days following inoculation, and the root systems washed in water, stained in 0.5 per cent boiling acid fuchsin in lactophenol for one minute, and observed for the developmental stages of the nematode.

Two sets of three replicates each were separately grown in 20-cm pots filled with sterilized soil. Ten days after germination, one set of each cultivar/selection was inoculated with 1,000 freshly hatched juveniles of *M. incognita*. The inoculated and non-inoculated plants were harvested 45 days later and then oven dried at 56°C for 24 hours. The dried tissues were used for estimation of mineral contents (N, P, K, Ca, Na, Mg, Zn, Cu, Fe, Mn) by the method described by Jackson (1967) and of total phenols (Horowitz, 1965).

Results and discussion

There was a significant reduction in the numbers of *M. incognita* juveniles entering the roots of resistant selections (IC 9642-B and TVU 2430-P) compared with those entering the roots of susceptible cultivars of cowpea (S-288 and S-488) (Table I). Among resistant selections, IC 9642-B exhibited significantly higher resistance to juvenile penetration. Reduced penetration by *M. incognita* juveniles was also reported by Dean and Struble (1953) and Sasser (1954) in resistant tomato varieties and by Jatala and Russell (1972) in resistant sweet potato varieties.

Fewer numbers of galls and egg masses per plant and eggs per egg mass were found on the the roots of resistant selections than on roots of susceptible cultivars (Table I). Kurian (1970) correlated low numbers of root galls with resistance in tobacco varieties. McClure *et al.* (1974) also noticed reduced numbers of galls and egg masses per plant in resistant cotton cultivars.

Juvenile populations in the soil recorded at harvest were larger in susceptible than in resistant lines (Table I). Numbers of juveniles were significantly greater on S-488 than on S-288.

Table I - *Effect of selected cultivars/selections of cowpea on juvenile infection, root galling, egg mass production and fecundity of* M. incognita *(Mean of 4 replicates).*

Cultivar/ selection	Mean No. of juveniles invaded/ plant (1)	Mean No. of galls/plant	Mean No. of egg masses/plant	Mean No. of eggs/egg mass	Mean juvenile population in soil per pot at harvest
IC 9642 - B	21	10	7	13	24
TVU 2430 - P	48	20	12	17	43
S - 288	213	184	182	142	187
S - 488	205	199	199	156	275
S. Em. ±	5.3	6.7	6.3	7.4	7.0

(1) Seven days after inoculation.

A decrease in the rate of development of various stages of *M. incognita* and a delay of 16 days in the total life cycle was observed in resistant selections compared to susceptible cultivars (Table II).

Table II - *Effect of selected cultivars/selections of cowpea on the development of* M. incognita *(Mean of 4 replicates).*

Cultivar/ selection	Mean No. of days required to attain		
	Third stage	Young ♀	Adult ♀
IC 9642 - B	20	36	39
TVU 2430 - P	20	33	39
S - 288	9	19	23
S - 488	9	19	23
S. Em. ±	0.4	0.4	0.4

Only 24 to 31 per cent of juveniles that penetrated the roots reached the adult female stage in resistant selections as compared to 96 to 97 per cent in susceptible cultivars (Table III). Hence, many of the juveniles that penetrated were unable to complete their life cycle in the roots of resistant selections. Fassuliotis (1970) also reported that in resistant cantaloupe roots, few juveniles of *M. incognita acrita* developed to adult female stage. In the present studies, the resistance in IC 9642-B and TVU 2430-P selections seems to be associated with delayed development of *M. incognita* juveniles and the fact that very few of the juveniles that penetrate developed to the adult female stage.

Table III - *Effect of selected cultivars/selections of cowpea on the development of* M. incognita *(Mean of 4 replicates).*

Cultivar/ selection	Mean No. of juveniles reachings different stages out of 500 larvae inoculated			% juveniles reaching adult stage (based on penetrated juveniles)
	% penetration	% juveniles reaching 3rd stage	% juveniles reaching adult female stage	
IC 9642 - B	4	4	1	31
TVU 2430 - P	9	8	2	24
S - 288	43	42	41	96
S - 488	42	41	40	97
S. Em. ±	1.4	0.9	1.0	5.1

Except in the case of magnesium, no direct relationship could be established between mineral contents in roots and leaves and susceptibility or resistance of the cowpea cultivars/selections. Magnesium content both in leaves and in roots of resistant selections was significantly higher than that in susceptible cultivars (Table IV). High concentration of magnesium was also reported by Sen Gupta (1964) in the root-knot resistant SL-120 tomato and by Sethi and Sharma (1976) in *M. incognita* resistant Barsati Mutant cowpea.

Total phenol content differed among the cowpea cultivars/selections studied. Some of the susceptible cultivars had total phenol contents similar to those of the resistant selections. Hence, total phenol content does not seem to have any relation to resistance or susceptibility to root-knot nematodes in the present studies.

The authors are grateful to Dr. K. L. Chadha, Director, Indian Institute of Horticultural Research, Bangalore, for providing the facilities.

Table IV - *Magnesium content in selected cultivars/selections of cowpea (Mean of 3 replicates).*

Cultivar/selection		Magnesium content (μ/1)	
		Leaves	Roots
IC 9642 - B	(Healthy)	121	82
»	(Infected)	121	80
TVU 2430 - P	(Healthy)	113	112
»	(Infected)	112	111
S - 288	(Healthy)	39	21
»	(Infected)	23	6
S - 488	(Healthy)	48	21
»	(Infected)	35	11

SUMMARY

The nature of root-knot nematode, *Meloidogyne incognita* (Kofoid *et* White) Chitw., resistance in two cowpea, *Vigna unguiculata* (L.) Walp., selections IC 9642-B and TVU 2430-P was associated with reduced juvenile penetration, root galling, egg mass production and fecundity; delayed development of juveniles to the adult female stage coupled with high concentration of magnesium.

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Accepted for publication on 14 March 1985.