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RESPONSE OF TWENTY CHICKPEA CULTIVARS TO *MELOIDOGYNE INCOGNITA* RACE 3

by
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Summary. The response of 20 chickpea cultivars to *Meloidogyne incognita* race 3 was determined by measuring the dry shoot weight of the plants and nematode reproduction. The degree of resistance to the nematode was correlated with the increase in peroxidase activity.

Meloidogyne incognita (Kofoid *et* White) Chitw. is an important pest of chickpea and causes significant yield losses. Growing resistant varieties is relatively cheap and the best method of nematode control because it requires no special equipment or extra capital investment. Different reactions of a crop variety to a particular nematode are sometimes reported but are often attributed to environmental conditions or pathotypes. Screening for resistance has been done on the basis of suppression in dry weight of the plant and nematode reproduction.

Peroxidase plays an important role in the resistant mechanism of plants. It is a key enzyme required for lignin synthesis as well as other terpenoids involved in phytoalexin production. Peroxidase catalyzes several reactions including those involved in the metabolism of phenols and indoles. On the other hand, protein content of galled roots has been used as an index of root-knot nematode infestation in lady's finger plants (*Abelmoschus esculentus* Moench). Chatterjee and Sukul, (1981) and Upadhyay and Banerjee (1986) reported that increase in protein content of chickpea (*Cicer arietinum* L.) was dependent upon the level of infection by root-knot nematodes. We determined the response of varieties on the basis of both parameters i.e total protein and peroxidase activity.

Materials and methods

Seeds of chickpea cvs were sown in 15 cm clay pots containing 1 kg of steam sterilized soil. After germination the seedlings were thinned to one per pot. One week after germination seedlings were inoculated with 2000 freshly hatched second-stage juveniles of *M. incognita* race 3. Plants were watered regularly and each set was replicated

six times (3 for peroxidase and protein, and 3 for dry shoot weight and nematode reproduction). The experiment was terminated after 90 days. Dry shoot weight, and root-knot index were recorded. The final nematode population was estimated from soil and roots.

Peroxidase activity of control and infected plants (5 days after inoculation) was determined by the method of Chance and Maehly (1955). A calibrated standard curve was prepared by graded concentration of pure purpurogallin. Specific activity of peroxidase was calculated by purpurogallin formed per mg protein per minute and total protein was estimated by the method of Lowry *et al.* (1951). The amount of protein was determined from the standard curve using serum albumin.

Resistance/susceptibility ratings were based on the suppression in dry shoot weight and nematode population according to following scale proposed by Husain (1986) with a slight modification, 0 = no galling, no nematode reproduction (RF = 0), no suppression in dry shoot weight (SDSW) = Immune; 1 = 1-10 galls, RF = < 1, SDSW up to 5% = Resistant; 2 = 11-20 galls, RF = 1.1-2.0, SDSW = 5.1-10% = Moderately resistant; 3 = 21-30 galls, RF = 2.1-4.0, SDSW = 10.1-15% = Tolerant; 4 = 31-100 galls, RF = 4.1-7.0, SDSW = 15.1-25% = Susceptible; 5 = more than 100 galls, RF = > 7.0, SDSW = > 25% = Highly Susceptible.

Rating on peroxidase activity was 0 = more than 60% increase (Immune); 1 = 50.1-60% increase (Resistant); 2 = 40.1-50% increase (Moderately resistant); 3 = 30.1-40% increase (Tolerant); 4 = 15.1-30% increase (Susceptible); 5 = 0-15% increase (Highly susceptible) with respect to the control.

Protein content was rated as 0 = no increase (Immune); 1 = 0.0-0.5% increase (Resistant); 2 = 0.6-1.0% increase (Moderately resistant); 3 = 1.1-2.0% increase (Tolerant); 4 =

2.1-4.0% increase (Susceptible); 5 = more than 4% increase in the protein content (Highly susceptible) with respect to the control.

Final rating of resistance/susceptibility was based on two similar results of the three parameters used.

Results and discussion

Data presented in Table I clearly show that none of the twenty cvs. was resistant or moderately resistant to *M. incognita*. Only one cv. (IC-4944) was found tolerant, 12 were susceptible and 7 were highly susceptible on the basis of suppression in dry shoot weight and root-knot index.

No cv. was resistant, moderately resistant or tolerant against test nematode when evaluated on the basis of increase in peroxidase activity. Eight cvs. were susceptible and 12 were highly susceptible (Table II).

Rating based on increase in protein content revealed no cv. that was resistant or moderately resistant. Three cvs. (IC-4941, IC-4942 and IC-4944) were tolerant, 9 were susceptible and 8 were highly susceptible (Table II).

Using all three parameters collectively in a final rating, only one cv. (IC-4944) was found tolerant against *M. incognita*. Eleven were susceptible and 8 were highly susceptible (Table III).

Positive correlation was observed in the degree of resistance to nematode and the increase in peroxidase activity. Moreover, measurement of protein content is a must for determination of peroxidase activity. Increase in protein content may also be used as an index for resistance susceptibility ratings. Use of these three parameters together appears to be more reliable criteria for resistance/susceptibility ratings. Moreover, increase in peroxidase activity may also be used as single criteria for early (5 days after inoculation) ratings.

TABLE I - Response of 20 chickpea cvs. against *Meloidogyne incognita* race-3 based on dry shoot weight suppression, nematode reproduction and root-knot index

Cultivar	Dry shoot weight (g)	Suppression in dry shoot weight with respect to control	Nematode Reproduction (RF)	Root knot index	Reaction ^{a)}
IC-4928	9.8	25.8	9.2	5	HS
IC-4929	8.5	25.5	8.5	5	HS
IC-4930	9.0	20.2	6.5	4	S
IC-4931	12.2	25.1	11.0	5	HS
IC-4932	12.5	16.0	4.7	4	S
IC-4933	9.6	38.7	17.2	5	HS
IC-4934	8.6	26.7	9.7	5	HS
IC-4935	8.7	35.5	16.0	5	HS
IC-4937	14.0	18.5	4.0	4	S
IC-4938	8.6	18.9	5.2	4	S
IC-4939	1.7	27.4	12.0	5	HS
IC-4940	2.4	16.1	6.2	4	S
IC-4941	2.9	18.0	5.3	4	S
IC-4942	2.1	15.4	4.5	4	S
IC-4943	2.9	21.8	6.5	4	S
IC-4944	3.2	13.8	3.8	3	T
IC-4945	1.9	20.0	4.9	4	S
IC-4946	3.0	19.1	4.5	4	S
IC-4947	4.2	18.2	6.6	4	S
IC-4948	1.9	18.3	4.5	4	S

^{a)} HS = highly susceptible; S = susceptible; T = tolerant.

TABLE II - Response of 20 chickpea cvs against *M. incognita* race-3 based on peroxidase activity and protein content

Cultivar	Peroxidase activity			Total protein content		
	Peroxidase activity per mg protein per minute	% increase with respect to control	Reaction ^{a)}	Protein in one gm fresh shoot wt. (mg)	% increase with respect to control	Reaction ^{a)}
IC-4928	0.174	14.4	HS	42.17	4.7	HS
IC-4929	0.206	14.6	HS	37.75	4.1	HS
IC-4930	0.207	9.2	HS	39.43	4.6	HS
IC-4931	0.204	12.8	HS	41.45	4.4	HS
IC-4932	0.206	21.8	S	35.54	2.1	S
IC-4933	0.179	4.5	HS	36.16	6.9	HS
IC-4934	0.195	11.3	HS	41.26	4.9	HS
IC-4935	0.165	1.8	HS	36.29	4.0	HS
IC-4937	0.236	26.7	S	38.50	2.1	S
IC-4938	0.245	16.3	S	35.09	3.0	S
IC-4939	0.207	9.2	HS	33.86	4.3	HS
IC-4940	0.163	13.5	HS	40.71	3.1	S
IC-4941	0.194	15.5	S	42.27	1.2	T
IC-4942	0.230	15.2	S	34.74	1.1	T
IC-4943	0.184	11.4	HS	40.23	3.7	S
IC-4944	0.177	18.1	S	38.81	1.1	T
IC-4945	0.191	18.3	S	33.17	2.7	S
IC-4946	0.190	11.6	HS	37.93	2.9	S
IC-4947	0.175	8.0	HS	43.36	3.3	S
IC-4948	0.178	15.7	S	42.30	3.1	S

^{a)} HS = highly susceptible; S = susceptible; T = tolerant.

TABLE III - Final response of 20 chickpea cvs based on three parameters used

Cultivar	Reaction based on dry shoot weight and root-knot index	Reaction based on peroxidase activity	Reaction based on protein content	Final ^{a)} reaction
IC-4928	HS	HS	HS	HS
IC-4929	HS	HS	HS	HS
IC-4930	S	HS	HS	HS
IC-4931	HS	HS	HS	HS
IC-4932	S	S	S	S
IC-4933	HS	HS	HS	HS
IC-4934	HS	HS	HS	HS
IC-4935	HS	HS	HS	HS
IC-4937	S	S	S	S
IC-4938	S	S	S	S
IC-4939	HS	HS	HS	HS
IC-4940	S	HS	S	S
IC-4941	S	S	T	S
IC-4942	S	S	T	S
IC-4943	S	HS	S	S
IC-4944	T	S	T	T
IC-4945	S	S	S	S
IC-4946	S	HS	S	S
IC-4947	S	HS	S	S
IC-4948	S	S	S	S

^{a)} HS = highly susceptible; S = susceptible; T = tolerant.

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