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INFLUENCE OF *MELOIDOGYNE INCOGNITA* INFESTATION
ON *RHIZOBIUM* NODULE FORMATION IN FRENCH BEAN⁽¹⁾

by

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French bean (*Phaseolus vulgaris* L.) is an important vegetable crop in India and is very susceptible to root-knot nematodes, *Meloidogyne* spp. (Singh *et al.*, 1979). Infested plants are stunted, and generally unthrifty and the yellowish foliage suggests they may be deficient in nitrogen. Several workers have reported that root-knot nematodes cause reduced nodulation in leguminous plants; but there is no published information on french bean. The object of the present investigation was to ascertain the extent to which the root-knot nematode, *Meloidogyne incognita* (Kofoid *et* White) Chitwood interferes with nodulation and growth of this crop.

Materials and Methods

The original inoculum of *Rhizobium* sp. was obtained from nodules of french bean and was maintained in the glasshouse on the same host grown in sterilized soil. The inoculum was prepared by grinding some nodules in a mortar with water to make a heavy suspension as suggested by Taha and Raski (1969). Ten ml of suspension were added to each pot when required.

Egg masses from a pure culture of *M. incognita* maintained on tomato were isolated carefully and transferred to petri dishes partially

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filled with sterile water and incubated at room temperature. The larvae which hatched within two days after incubation were used for inoculation by pipetting 1000 larvae suspended in 10 ml water into four holes punched close to the root zone of each plant.

Each of the treatments was replicated five times, using 10 day old seedlings of french bean (CV. Premier) in 15 cm clay pots. The various treatments were: 1) nematodes alone (N), 2) rhizobia alone (R), 3) nematodes and rhizobia inoculated simultaneously (N + R), 4) rhizobial inoculation two weeks after nematode inoculation (N → R), 5) nematode inoculation two weeks after rhizobial inoculation (R → N), 6) control (without nematodes and rhizobia). Observations on plant growth and nodulation were recorded 40 days after the first inoculation.

Results and Discussion

There were significant differences in plant height between the nematode inoculated and uninoculated plants (Table I). Nematode inoculation either simultaneously with rhizobia or two weeks prior to or after rhizobial inoculation decreased the plant height indicating that the nematode infestation was a limiting factor irrespective of the sequence of its inoculation in relation to the rhizobium. Simultaneous inoculation of nematode larvae and rhizobia caused significant ($P = 0.01$) reduction (47%) in plant height compared to rhizobium infected plants. However, maximum reduction in plant height (52%) compared to rhizobium infected plants was observed when nematodes alone were inoculated. Nematode inoculation two weeks prior

Table I - *Effect of M. incognita and Rhizobium sp. on plant growth and nodulation in french bean (mean of five replications).*

Treatment	Plant height cm)	Fresh shoot weight (g)	Root length (cm)	Fresh root weight (g)	No. of nodules per plant
Nematode (N)	31.0	9.30	18.4	4.10	53.4
Rhizobium (R)	65.0	21.32	32.6	6.66	162.0
N + R	34.4	13.72	24.2	5.16	56.0
N → R	38.8	15.12	27.8	5.22	61.6
R → N	40.6	17.16	31.0	5.70	108.8
Control	52.8	17.80	31.6	6.44	64.6
C.D. at 5%	2.19	1.19	2.30	1.26	17.47
1%	2.98	1.62	3.14	1.72	23.83

to or after rhizobial inoculation had no significant effect on plant height.

Fresh shoot weight was reduced by 35% in simultaneous inoculations, and 20 and 30% respectively when rhizobia were inoculated prior to or after nematodes compared to rhizobium inoculated plants. When nematodes alone were inoculated reduction in shoot weight was 56%. Similar trends in relation to treatments occurred with regard to root length.

There was no significant difference in the maximum fresh root weight between the treatments rhizobium alone, rhizobial inoculation prior to nematodes, and the untreated control. Inoculation of nematodes alone resulted in the least root weight which was similar to that with nematodes and rhizobia inoculated simultaneously or nematode inoculation prior to rhizobia.

Similar reduction in shoot and root growth have previously been noted in white clover by *M. javanica* (Taha and Raski, 1969), in mung bean by *M. incognita* (Hussaini and Seshadri, 1975) and *M. javanica* (Bopaiah *et al.*, 1976) and in cowpea by *M. incognita* (Sharma and Sethi, 1976). The significant reduction in plant growth might be due to the heavy nematode damage to the french bean roots.

Nematode infestation significantly reduced the number of nodules on french bean roots. A greater nodule reduction was observed when the bacterium and the nematode were inoculated simultaneously (63%) or when the nematode was established before the inoculation of the bacterium (62%) than when the bacterium was established before the introduction of the nematode (33%). Significant reduction in nodulation due to root-knot nematode infestation reported here on french bean is in accordance with the findings of earlier workers on various other leguminous crops (Balasubramanian, 1970; Bopaiah *et al.*, 1976; Hussaini and Seshadri, 1975; Nigh, 1966; Sharma and Sethi, 1976). Nutrient deficiency caused by nematodes in the host plant (Masfield, 1958; Malek and Jenkins, 1964), competition between nematode larvae and root nodule bacteria (Epps and Chambers, 1962; Malek and Jenkins, 1964), antagonistic effect of root-rot organisms upon root nodule bacteria (Epps and Chambers, 1962) and overall reduction of the root system due to the root-knot nematode infection (Taha and Raski, 1969) may account for reduced nodulation.

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S U M M A R Y

The effect of *Meloidogyne incognita* (Kofoid et White) Chitwood on plant growth and nodulation was investigated in french bean plants (*Phaseolus vulgaris* L.). Inoculation experiment showed that the nematode caused reduction in plant height, fresh weight of shoot and root, root length and number of nodules in the root system. A greater nodule reduction was noticed when rhizobia and nematodes were inoculated simultaneously or when nematodes were established before the inoculation of rhizobia than when rhizobia were established before the introduction of nematodes.

R I A S S U N T O

Influenza delle infestazioni di Meloidogyne incognita sulla formazione dei noduli da Rhizobium su radici di Fagiolo.

È stato studiato l'effetto delle infestazioni di *Meloidogyne incognita* (Kofoid et White) Chitw. sulla formazione di noduli da *Rhizobium* su radici di Fagiolo (*Phaseolus vulgaris* L.). I risultati indicano che l'inoculazione del nematode ha causato riduzioni sull'altezza delle piante, sul peso fresco della parte epigea e delle radici, sulla lunghezza delle radici e sul numero di noduli su di esse presenti. Una maggior riduzione della nodulazione è stata osservata quando *Rhizobium* e nematodi sono stati inoculati simultaneamente o quando l'inoculazione dei nematodi ha preceduto quella del *Rhizobium* che non nel caso in cui i nematodi sono stati inoculati posteriormente al *Rhizobium*.

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