PATHOGENICITY OF *MELOIDOGYNE INCOGNITA* ON *DIANTHUS CARYOPHILLUS*

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Summary. Studies were undertaken to assess the pathogenic potential of *Meloidogyne incognita* on carnation. Nematodes were inoculated on thirty-day-old carnation (*Dianthus caryophillus*) plant roots at population levels of 10, 100, 1,000 and 1,0000 second stage juveniles. Plant growth was reduced at the level of 1,000 and 10,000 juveniles compared to the control. Plant growth, root length, root weight, time taken to first bloom and floral diameter were all adversely affected and stalk sturdiness was reduced, thus reducing the commercial value of the flowers.

Carnations are highly sensitive to pathogenic nematodes and infected plants suffer decline in quality and yield of flowers (Esser *et al.*, 1988; Fawzy *et al.*, 1991). Surveys conducted in the state of Himachal Pradesh (India), to study the association of carnation with plant parasitic nematodes, showed heavy infestation by many nematode genera (Khanna and Khan, 1990; Khanna and Jyot, 1999). Among them, *Meloidogyne incognita* (Kofoid *et* White) Chitw. was recorded in 61 out of 99 samples. In some root samples, root-knot nematodes were encountered in such high numbers to warrant an experiment to assess the pathogenic effect on carnation.

MATERAL AND METHODS

The experiment was conducted at Solan in a glasshouse where temperatures ranged between 16 and 26.5 °C. Thirty-day-old carnation (*Dianthus caryophillus* L.) cv. Red Corso seedlings, each grown singly in sterilized pots filled with 600 g of autoclaved soil mixture (fine soil, sand and FYM in a ratio of 1:1:1), were inoculated with four nematode levels, i.e. 10, 100, 1,000 and 1,0000 freshly hatched second stage juvenile (J_2) of *Meloidogyne incognita*. For inoculation, young feeder roots of the potted plants were exposed by carefully removing a little soil from the top of the pot. Nematode inoculum, in a water suspension, was poured on the exposed roots, which were immediately re-covered with the sterilized soil mixture. Light watering followed the inoculation. For uninoculated check plants, only water was added. An additional control, using the extraction water after the removal of nematodes from the suspension, was used to ascertain if any factor other than nematodes may limit plant growth. Each treatment was replicated five times and the pots were arranged in a completely randomized design.

The information recorded included days to first flowering, floral diameter, stem length, stem sturdiness, root weight, root length, root-knot gall index and final nematode population. All data were statistically analyzed.

RESULTS AND DISCUSSION

Clear symptoms of attack did not appear until 45 days after inoculation, except for those plants inoculated with 10,000 nematodes which were smaller. At the end of the experiment, plant height was less as inoculum increased. Root length and root weight were adversely affected at densities >100 juvenile per pot. Adverse root effects with increasing nematode population were observed: root length decreased from 9 cm to 3.4 cm and root weight from 4.3 g to 3 g as the nematode population increased from 1,000 to 10,000 juveniles (Table I). A significant delay in appearance of the first flower and a reduction of floral diameter were observed in the plants receiving 1,000 and 10,000 juveniles (Table I). Nematode reproduction (Pf/Pi) decreased as inoculum level increased (Table II). The root-knot index was not statistically different from the control at 100 juveniles/pot but was significantly greater at the high initial population densities. However, only small sized galls were produced by *M. incognita* on carnation.

Plants infested with *M. incognita* were smaller and showed leaf chlorosis. Initially, the lower leaves turned yellow followed by the upper leaves and, in rare cases of severe infestation, the stalk started turning yellow at the base. The stalk became weak and unable to stand erect. Flowers were rated as 'B' grade commercially. Flowering was delayed by more than a month and some nematode infested plants never bore flowers.

The results showed that carnation cv. Red Corso is highly susceptible to *M. incognita*. The nematode not only causes quantitative losses, it also delays yield and affects the quality of the flowers - flower size is reduced significantly and this leads to poor commercial grading.

Table I. Effect of *Meloidogyne incognita* on carnation growth parameters and yield.

Initial nematode inoculum (J_2/pot)	Stem length (cm)	Stem sturdiness (°)	Root length (cm)	Root weight (g)	Days to first flowering	Floral diameter (cm)
0 (water only)	49.8	9.4 (3.217)*	17.9	7.7	148	6.2
0 (associated water)	48.6	11.6 (3.520)	17.4	7.4	148	6.3
10	48.6	8.8 (3.125)	17.2	7.5	147	6.2
100	41.8	14.8 (3.953)	16.0	6.5	153	6.2
1,000	35.6	21.6 (4.742)	9.0	4.3	163	5.6
10,000	28.1	29.2 (5.491)	3.4	3.0	186	5.2
C.D. (at 5%)	4.78	(0.477)	2.98	1.3	9.3	0.53

* Values in parentheses are square root. Means flanked by the same letters in a column do not differ significantly. Factorial CRD analysis.

Table II. Reproduction potential of *M. incognita* on carnation.

Initial nematode inoculum (J_2/pot)	Final nematode population (J_2/pot)	Rf = Pf / Pi**	Gall index (1-5 scale)***
0 (water only)	0 (0.000)*	0	1.0 (47.5)[a]
0 (Associated water)	0 (0.000)	0	1.0 47.5)[a]
10	450 (2.578)[c]	45.0	1.0 47.5)[a]
100	1320 (3.070)[b]	13.2	1.4 (69.5)[a]
1,000	2573 (3.362)[a]	2.6	2.6 (117.5)[b]
10,000	1414 (3.126)[ab]	0.1	3.4 (135.5)[b]
C.D. (at 5%)	(0.267)		H = (25.8)

* Values in parentheses are log (x+1); Means followed by the same letters in a column do not differ significantly.
** Rf = Reproduction factor; Pf/Pi = Final nematode population/Initial nematode population.
*** Root-knot gall index on 1-5 scale; 1 = no galls, 2 = 1-10 galls, 3 = 11-30 galls, 4 = 31-100 galls, 5 = >100 galls Factorial CRD analysis.

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