Nematol. medit. (1998), 26: 13-17

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PATHOGENIC POTENTIAL OF *PRATYLENCHUS THORNEI* ON *MENTHA CITRATA* AS INFLUENCED BY SOIL TYPE

by
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Summary. In a glasshouse experiment *Pratylenchus thornei* reproduced best (Rf=8.49) in sandy clay loam soil followed by loamy sand (Rf=7.80) and sandy loam (Rf=6.41) respectively in *Mentha citrata* suckers/roots inoculated with 12,500 nematodes per pot. The greatest reduction in growth and oil yield of *M. citrata* occurred in sandy clay loam followed by loamy sand and sandy loam at initial inoculum (Pi) levels of 12,500 and 25,000 nematodes/pot. In the absence of nematodes the greatest plant growth and oil yields were in sandy loam soil followed by sandy clay loam and loamy sand.

The cultivation of Bergamot mint *Mentha citrata* Ehrh (family Labiatae) is affected by several species of plant parasitic nematodes (Haseeb, 1993), among which *Pratylenchus* species are of greatest importance (Haseeb and Shukla, 1995). The incidence and occurrence of *P. thornei* Sher *et* Allen in the rhizosphere of this crop varies from area to area (Haseeb, 1993) in India but the factors responsible for these differences are unknown. Soil type is considered to affect reproduction and pathogenicity of some nematodes (Norton, 1978; Mittal and Dhawan, 1989). The present work investigated the effect of three soil types on the reproduction and pathogenic potential of *P. thornei* and on growth and oil yield of *M. citrata*.

Matyerials and methods

Soil was collected from various fields at the Central Institute of Medicinal and Aromatic Plants Experimental Farm and cultivated land in the Lucknow district. After the analysis by International pepette Method (Piper, 1966), three major soil types, viz. loamy sand (81% sand, 7% silt, 12% clay, 41% water holding capacity (WHC), 1.2% organic matter (OM), pH 7.8), sandy loam (66% sand, 14% silt, 20% clay, 43% WHC, 1.9% OM, pH 7.6) and sandy clay loam (54% sand, 22% silt, 24% clay, 49% WHC, 3.2% OM, pH 7.2) were selected for the experiment.

Uniform healthy suckers (5 cm long) of *M. citrata* cv. Kiran were transplanted singly into 30 cm diameter clay pots containing 7.5 kg of a steam sterilized soil-compost (9:1) mixture of each soil type. At the 4th leaf stage, the pots were inoculated with 12,500 and 25,000 specimens of *P. thornei* (Pi) from a pure culture maintained on ornamental *Chrysanthemum* in a glasshouse. Five pots of each soil type were left uninoculated to serve as controls. There were five replicates for each treatment.

At 100 days after inoculation, plant growth was determined by measuring length, fresh and dry weight of root and shoot; chlorophyll content was estimated according to the method of Arnon (1949); CO_2 gas exchange rate of the third leaf (from apex) was mesured in a closed system using a portable photosynthesis model Li 6000 (LiCOR, U.S.A.); total sugar in leaves was estimated by the method of Yemm and Willis (1954); total phenol content in the third leaf was estimated by the method of Swain and Hill (1959); essential oil content was determined by hydrodistillation of 100 g fresh shoot tissue using Clevenger apparatus (Clevenger, 1928); the final nematode population (Pf) in 250 g soil from each replicate was determined by Cobb's sieving and decanting technique with final separation in a Baermann funnel (Southey, 1986); the density of nematodes in the roots of each replicate was determined by comminuting 5 g root/sucker tissues in a Waring blender (Pinochet *et al.*, 1995).

The experiment was a split plot design. Data were subjected to analysis of variance (Cochran and Cox, 1957). Statistically significant differences among the treatments were tested by critical difference (CD) test at 5% and 1% probability (P) level.

Result and discussion

Effect of soil type on shoot growth and oil yield of *M. citrata* was significantly ($P \leq 0.05$) high in sandy loam (SL) followed by sandy clay loam (SCL) and loamy sand (LS) respectively in nematode free plants (Table I). Influence of soil types on other growth parameters viz. root length, fresh/dry weight, shoot height, photosynthetic rate, total chlorophyll, sugar and phenol content in leaves in the absence of nematodes was almost similar to shoot growth but several variations were evident (Table I and II). Reproduction of *P. thornei* was significantly ($P<0.05$) high in SCL followed by LS and SL, respectively, at a Pi level of 12,500 but at 25,000 nematodes per pot, Rf was highest in LS and lowest in SCL (Table II). Effect of *P. thornei* on the growth and oil yield of *M. citrata* was always significant ($P<0.05$) irrespective of soil type and Pi levels as compared to nematode free plants. However, extent of reduction in plant growth and oil yield was influenced by soil types. Suppression of various growth parameters and oil yield due to nematode damage was highest in SCL followed by LS and SL, respectively, as compared to uninoculated control (Table I and II).

Interaction effect of soil types and initial population densities of *P. thornei* on plant growth and oil yield was always significant ($P<0.05$) except for root length and shoot height (Table I and II). Shoot growth and oil yield of *M. citrata* were greater in SL and SCL than in LS which is in general agreement with other workers (Mittal and Dhawan, 1989; Nakasono *et al.*, 1990). Similarly, reproduction of *P. thornei* was highest in SCL than in LS or SL, particularly at lower inoculum densities as also found by Kable and Mai (1968) and Riggs *et al.* (1956).

The studies ravealed that Bergamot mint grew best in sandy loam soil in which *P. thornei* reproduced least.

Acknowledgement. The authors are grateful to Dr. Sushil. Kumar, Director, Central Institute of Medicinal and Aromatic Plants, Lucknow, for encouragement and critical suggestions during this investingation. We also thank Dr. N. K. Srivastava and Dr. Saudan Singh for their help in studies on physiological/biochemical changes in plants and analysis of physical properties of the soil.

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TABLE I - *Effect of soil type and initial population density (Pi) of* Pratylenchus thornei *on plant height, weight and oil yield of* Mentha citrata.

Soil types (MF)	Pi (SF)			Interaction (MF X SF)	L.S.D. (P<0.05)	
	0	12,500	25,000		[x]SF	[y]MF
Root length (cm)						
S_1	97.8	65.2	53.2			
S_2	108.4	82.2	65.4	NS	5.58*	5.13
S_3	96.4	57.6	48.0			
Shoot heigth (cm)						
S_1	109.2	66.4	56.4			
S_2	117.2	79.6	65.0	NS	8.46*	7.51
S_3	101.8	64.2	51.2			
Root fresh weight (g)						
S_1	176.2	75.0	60.2			
S_2	172.0	87.4	68.0	*	5.87*	7.03
S_3	156.8	66.4	48.4			
Shoot fresh weight (g)						
S_1	248.8	124.6	100.2			
S_2	317.6	166.2	146.4	*	7.18*	8.87
S_3	293.0	122.2	92.8			
Root dry weight (g)						
S_1	33.8	15.4	12.2			
S_2	33.0	16.6	14.2	*	1.47*	1.30
S_3	31.2	12.8	9.4			
Shoot dry weight (g)						
S_1	51.5	25.4	20.4			
S_2	65.6	33.2	28.2	*	1.79*	1.65
S_3	63.4	24.8	19.6			
Oil yield (ml/100 g fresh herb)						
S_1	0.55	0.28	0.23			
S_2	0.63	0.34	0.29	*	0.011*	0.015
S_3	0.60	0.28	0.23			

[x] Sub factor (SF) at fix level of main factor (MF).
[y] MF at fix level of SF.
* Significant ($P \leq 0.05$).
S_1 - Loamy sand, S_2 - Sandy loam, S_3 - Sandy clay loam.

TABLE II - *Effect of soil type and initial population density (Pi) of* P. thornei *on CO_2 exchange rate, total chlorophyll, sugar and phenol content in leaves of* M. citrata *and on nematode reproduction.*

Soil types (MF)	Pi (SF)			Interaction (MF X SF)	L.S.D. (P<0.05)	
	0	12,500	25,000		[x]SF	[y]MF
Total chlorophyll (mg/g fresh weight)						
S_1	1.14	0.51	0.42			
S_2	1.40	0.68	0.57	*	0.022*	0.022*
S_3	1.23	0.48	0.38			
CO_2 exchange rate (mg CO_2/dm^2/hour)						
S_1	11.93	6.16	5.25			
S_2	12.63	7.22	5.92	*	0.051*	0.055*
S_3	12.21	5.59	4.74			
Total sugar (mg/g fresh weight)						
S_1	16.80	7.76	5.91			
S_2	20.00	10.84	9.16	*	0.088*	0.084
S_3	25.50	10.89	8.26			
Total phenol (mg/g fresh weight)						
S_1	22.50	14.82	12.36			
S_2	26.25	18.17	15.96	*	0.060*	0.055*
S_3	20.25	11.34	8.63			
Final nematode population (Total root)						
S_1	0	33900	32267			
S_2	0	28492	24480	*	145.1*	468.3*
S_3	0	38910	29814			
Final nematode population (7.5 kg soil)						
S_1	0	63600	71400			
S_2	0	51600	67800	*	514.3*	634.1*
S_3	0	67200	59400			
Reproduction factor (Rf = Pf/Pi)						
S_1	0	7.80	4.15			
S_2	0	6.41	3.69	*	0.031*	0.028*
S_3	0	8.49	3.57			

[x] Sub factor (SF) at fix level of main factor (MF).
[y] MF at fix level of SF.
* Significant ($P \leq 0.05$).
S_1 - Loamy sand, S_2 - Sandy loam, S_3 - Sandy clay loam.

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Accepted for publication on 4 November 1997.