EVALUATION OF DIFFERENT SOIL TYPES ON MULTIPLICATION OF *PRATYLENCHUS COFFEAE* AND GROWTH OF BANANA SEEDLINGS VAR. NENDRAN

P. Sundararaju and K.J. Jeyabaskaran

National Research Centre for Banana (ICAR), Thogamalai Road,Thayanur post, Tiruchirappalli – 620 102, India.

Summary. The effect of different soil types (alluvial, sandy loam, silty clay, black soil, laterite and red soil) on the multiplication of *Pratylenchus coffeae* and growth of banana plants was studied. The results revealed that maximum shoot length, girth at collar, number of leaves, number of roots, root length and root weight were evident in alluvial soil followed by sandy loam soil, whereas minimum plant growth parameters was recorded in red soil. Maximum root-lesion index was observed in silty clay soil (4.4) and alluvial soil (4.2) whereas minimum infestation was observed in red soil (3.2). The reproduction factor of nematode population based upon root-lesions and final root and soil population was maximum in silty clay soil followed by alluvial while minimum nematode population was recorded in red soil. The multiple regression equations pertaining to the soil physico-chemical properties versus nematode populations in both soils and roots were derived.

The root-lesion nematode, *Pratylenchus coffeae* is considered to be one of the most economically important nematode pests of banana. Surveys carried out in banana growing regions in different parts of India having different soil types indicated variations in population level and percentage of infestation of *P. coffeae* (Rajendran *et al.*, 1979; Sundararaju, 1996). An attempt was made to investigate the influence of different soils on the nematode host interactions.

MATERIALS AND METHODS

Six different soils, namely alluvial, sandy loam, silty clay, black soil, laterite and red soil (Table I) were collected from different banana growing regions in Tamil Nadu and sterilised with 2 per cent formaldehyde solution. Sixty cement pots (45 x 40 cm) each were filled with the different sterilised soils. The soils used in this trial were analysed for physico-chemical properties like pH, exchangeable cations (i.e, Ca, Mg, K and Na) clay content, particle density, bulk density and porosity by following standard procedures (Jackson, 1965). Banana (*Musa* AAB) suckers cv. Nendran of uniform size extracted from banana gardens were pared to a depth of one cm to remove any superficial infestation and immersed in hot water at 55 °C for 10 minutes. The treated suckers were planted individually in each of the 60 cement pots. Five replications of each soil were arranged in a completely randomised block design on glasshouse benches and watered daily. A culture of *P. coffeae* (Zimmerman) Filipjev *et* Schuurmans Stekhoven was maintained on carrot discs as a source of inoculum. One month after planting the soil in each pot was inoculated with 1000 *P. coffeae* through four holes made at different depths around the base of the plant. The remaining five plants, in each soil, which were not inoculated with nematodes, served as untreated control.

After six months, the plants were removed from the pots with the root system intact. Roots were washed thoroughly to remove the adhering soil particles. Growth characters such as plant height, pseudostem girth, number of leaves, leaf area, root length, number of roots and root weight were recorded together with visual observation of lesions and rotting of roots based on a 1-5 rating index (Pinochet, 1988). After indexing, the roots were cut into small pieces, mixed thoroughly and three aliquots of 10 g each were stained in boiling acid fuchsin lactophenol for population counts (Sundararaju and Ratnakaran, 2002). Nematodes from 250 g soil from each pot were extracted by Cobb's sieving method for estimating total soil population (Sosamma and Koshy, 1985).

Regression analysis was done between these soil parameters and nematode populations in soils and roots (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Nematode inoculated plants exhibited stunted growth with reduced vigour compared to uninoculated plants (Table I). In general, plant growth as measured by plant height, pseudostem girth, number of leaves and laminar length in nematode inoculated plants was greater in alluvial soil followed by sandy loam. A similar trend was observed in uninoculated plants of alluvial soil having the maximum value of 95 cm, 28.6 cm, 7 and 72.6 cm with respect to plant height, pseudostem girth, number of leaves and laminar length. Minimum plant growth parameters of 50.4 cm, 15.6 cm, 4 and 40.2 cm was recorded with respect to plant height, pseudostem girth, number of leaves and laminar length in red soil of nematode inoculated plants. A similar trend was noticed in uninoculated plants showing the

Table I. Effect of *Pratylenchus coffeae* on growth of banana plants in different soil types.

Soil type	Plant height (cm)		Pseudostem girth (cm)		No. of leaves		Lamina length (cm)		No. of roots		Root length (cm)	
	Inoc.	Uninoc.	Inoc.	Uninoc.	Inoc.	Uninoc.	Inoc.	Uninoc.	Inoc.	Uninoc.	Inoc.	Uninoc.
Alluvial	83.4 (11.4)	95.0	24.0 (14.0)	28.6	5.6 (21.4)	7.0	60.8 (16.1)	72.6	62.0 (15.0)	73.0	63.6 (25.1)	85.0
Sandy loam	79.4 (9.9)	88.2	22.6 (16.0)	26.8	5.0 (23.0)	6.6	61.6 (14.0)	71.6	65.6 (25.4)	88.0	63.8 (18.2)	78.0
Silty loam	77.6 (1.8)	79.0	21.4 (7.0)	23.0	5.2 (7.1)	5.6	61.0 (5.5)	64.6	63.2 (3.7)	65.6	56.0 (11.1)	63.0
Black soil	74.2 (3.6)	77.0	22.8 (3.0)	23.6	5.0 (3.8)	5.2	60.8 (2.7)	62.6	56.0 (2.1)	57.2	69.2 (13.0)	79.6
Laterite	72.5 (3.9)	75.6	20.0 (8.3)	21.8	5.0 (7.4)	5.4	56.2 (5.5)	59.6	55.0 (11.3)	62.0	83.2 (4.6)	87.2
Red soil	50.4 (5.6)	53.4	15.6 (6.0)	16.6	4.0 (9.1)	4.4	40.2 (6.5)	43.0	47.0 (9.9)	52.2	60.2 (10.4)	67.2
CD (P = 0.05 %)	4.25	6.08	2.90	3.64	0.84	1.12	2.89	4.28	3.69	3.87	3.24	4.68

Figures in parenthesis are the percentage reduction over uninoculated control plants.

Table II. Physico-chemical properties of the different soils studied.

Soil type	pH	Ca	Mg	K	Na	Clay (%)	Particle density	Bulk density	Porosity (%)
		(meq/100g)					(g/cc)		
Alluvial	7.2	13.73	3.73	2.10	1.25	22.16	2.55	1.48	47.16
Sandy loam	7.5	5.23	2.08	0.86	2.81	19.56	2.59	1.31	49.42
Silty loam	8.6	6.56	3.71	1.64	1.94	41.26	2.27	1.34	40.97
Black soil	8.1	42.37	10.32	3.06	2.43	62.03	2.20	1.39	55.75
Laterite soil	6.2	7.72	2.80	1.19	2.61	34.83	2.48	1.31	46.40
Red soil	5.9	9.54	3.68	1.98	2.32	38.71	2.56	1.65	35.80
CD (P= 0.05)	1.82	20.14	2.31	1.01	0.96	15.37	0.21	0.20	10.38

Table III. Regression of nematode population on soil factors.

Soil factor (X)	Nematode population in soil	Nematode population in root	Total nematode population
pH	Y= 106 X + 1865 (R^2=0.37**)	Y= 650 X – 1206 (R^2=0.37**)	Y= 756 X + 658 (R^2=0.44**)
Ca	Y= - 12 X + 2809 (R^2=0.17)	Y= -30 X + 3941 (R^2=0.15)	Y= - 42 X + 6751 (R^2=0.17)
Mg	Y= - 58 X +2895 (R^2=0.18)	Y= - 146 X + 4151 (R^2=0.15)	Y= - 205 X + 7046 (R^2=0.19)
K	Y= - 151 X +2909 (R^2=0.28*)	Y= -674 X + 4725 (R^2=0.22**)	Y= - 825 X + 7046 (R^2=0.19)
Na	Y= -506 X + 3763 (R^2=0.47**)	Y= - 572 X + 4781 (R^2=0.08)	Y= - 1078 X + 8545 (R^2=0.17)
Clay	Y= - 13 X +3121 (R^2=0.24*)	Y= - 36 X + 4844 (R^2=0.25*)	Y= - 50 X + 7965 (R^2=0.27*)
Particle density	Y= 184 X + 2187 (R^2=0.01)	Y= - 117 X + 3793 (R^2=0.01)	Y= 66 X + 5981 (R^2=0.01)
Bulk density	Y= - 1050 X + 4120 (R^2=0.11)	Y= - 5767 X + 11658 (R^2=0.46**)	Y= - 6817 X + 15779 (R^2=0.38)
Porosity	Y= - 3 X +2794 (R^2=0.01)	Y= 32 X + 2009 (R^2=0.04)	Y= 29 X + 4803 (R^2=0.02)

** Significant for P = 0.01. *Significant for P = 0.05.

maximum value of 53.4 cm, 16.6 cm, 4.4 and 43 cm with respect to plant height, pseudostem girth, number of leaves and laminar length. Plant growth was at par in silty loam, black soil and laterite soil .

Total number of roots, root length and root weight was statistically significant between nematode-inoculated and uninoculated plants for all six soil types tested (Table I). Maximum number of roots was recorded in sandy loam soil (88) of uninoculated control plants followed by alluvial soil (73). In the case of nematode-inoculated plants, the maximum number of roots was recorded in sandy loam (65.6) followed by silty loam (63.2) while the minimum number of roots was recorded in red soil of both uninoculated (52.2) and inoculated (47) plants. The percentage reduction over control was greater in sandy loam (25.4) followed by alluvial soil (15) whereas the minimum reduction was observed in black soil (2.1).

In the case of root length, maximum growth was detected in laterite soil (87.2 cm) of uninoculated control plants followed by alluvial soil (85 cm), black soil (79.6 cm), sandy loam (78 cm), red soil (67.2 cm) and silty loam (63 cm). A similar trend was observed in nematode-inoculated plants (Table I). However, the percentage reduction over control was maximum in alluvial soil (25.1) followed by sandy loam (18.2), whereas the least was observed in laterite soil (4.6). Maximum root weight was recorded in alluvial soil (550 g) followed by sandy loam soil (545 g) of uninoculated control plants, while minimum root weight was recorded in red soil (322 g). In the case of inoculated plants, maximum root weight was recorded in sandy loam soil (460 g) followed by alluvial soil (435 g). The percentage reduction over control was maximum in alluvial soil (20.9) followed by sandy loam (15.6), while minimum reduction was recorded in laterite soil (4.8). Irrespective of the soils used, production of lateral roots and rootlets was considerably reduced in *P. coffeae* inoculated plants compared to the uninoculated control plants.

A perusal of the data in Table I shows that the maximum root-lesion index was recorded in silty loam (4.4) followed by alluvial soil (4.2) and sandy loam (4.0) of nematode inoculated plants and minimum was recorded in red soil (3.2), whereas the lesion index was at par in all the soils of uninoculated control plants.

The maximum number of nematodes from soil and roots was recorded from silty loam followed in order by alluvial soil, sandy loam, laterite and black soil (Table I). Nematode multiplication was least in red soil. Furthermore, the red soil did not support either the multiplication of nematodes or the growth of banana plants, suggesting that the red soil may not be suitable for banana cultivation. The alluvial and sandy loam soils produced maximum plant growth, compared with other soils of both inoculated and uninoculated control plants. However, maximum reduction in plant growth was obtained in inoculated plants compared with the control. Whereas the inoculated plants in silty loam, black soil and laterite soil recorded the minimum reduction in plant growth over the control.

Physico-chemical properties of all test soils used in this trial are given in Table II. Soil pH and soil porosity showed no significant regression with nematode population in soils and roots (Table III). However, exchangeable cations (Ca, Mg, K, Na) showed negative correlation with nematode population in both soils and roots. Among these cations, Na showed significant negative correlation with nematode population in soils and roots.

These results indicate that multiplication of the root lesion nematode and growth of banana plants were influenced by soil types. Based on the various growth parameters, maximum per cent reduction was recorded in red soil followed by laterite, black soil and silty loam. Though silty loam soil supported maximum multiplication of *P. coffeae*, plant growth was moderately better than laterite, black and red soil. The present investigations are in agreement with the findings of Sosamma and Koshy (1985) who studied the effect of different soils on multiplication of *Radopholus similis* and growth of coconut seedlings.

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