

Effects of Sand and Clay Mixture on Root-Knot Nematode in Sugarcane

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ABSTRACT

A pot experiment was conducted to find out the effect of mixture of sand and clay soils on the development of root-knot disease and female of *Meloidogyne* spp. in sugarcane roots. Maximum of 18.1 galls/g root were found in soil having 100% sand. The numbers of gall in soils having sand and clay ratios of 10:1, 9:2, 8:3, 7:4, 6:5, 5:6 and 4:7 ranged from 4.1-6.4/g root. The numbers of galls recorded from above seven mixtures of sand and clay was statistically similar but significantly lower as compared to only sand. The lowest gall number of 1.2/g root was recorded in pure clay soil, which was statistically similar to the number of galls found in soils having 1:10, 2:9, 3:8, 4:7, 5:6, 6:5, 7:4 and 8:3 sand and clay. The highest population of mature female of *Meloidogyne* spp. was also recorded in pure sand. The lowest population of 1.1 female nematode per gram root of sugarcane was found in pure clay. The range of female nematode was 2.1 – 13.1/g roots in sand and clay mixtures of 1:10 to 10:1. The differences in population of nematodes in roots of sugarcane grown in eleven different mixtures of sand and clay were not significant. The average number of galls per gram of sugarcane roots was 6.2 in the month of October and November which was significantly higher as compared to September. The prevalence of mature female in September to November was statistically similar but significantly lower as compared to August.

Key words: *Meloidogyne* spp., sand and clay mixture, root-knot nematode, sugarcane.

INTRODUCTION

Soil type and climate affect the overall population density and composition of nematodes (Williams, 1969). Hatmosoewarno (1974) reported that highest nematode populations were found in regosol soil followed by heavy alluvial soil, "Kabongan" latosol soil, "Klawing" alluvial soil, "Kabongan" Podsollic soil, light "Kabongan" latosol soil and heavy "Kabongan" latosol soil successively in Indonesia. Spaul (1981) reported that the density of *Meloidogyne* and *Pratylenchus* in roots was greatest in sandy soils. Siswojo (1981) reported that nematode populations were higher in light soils than heavier soils. Ami and Sabie (1989) reported that larval density of *Meloidogyne* spp. was higher in coarse textured soil than in fine textured soil. Nematode reproduction was affected by soil temperature. The population density peaked in September and was lowest in January in most tomato field surveyed. Root-knot and stubby-root nematodes were more abundant in sand (<95% silica). Sheath, sheathoid, awl and lance nematodes were only observed in sand. Stunt nematodes were abundant in muck soil (<45% organic matter).

Spiral, ring and lesion nematodes were generally as prevalent in muck as in sandy soils. More than 2000 parasitic nematodes (all genera in a complex) per 100 ml of soil were sometimes present (Hall and Irey, 1992). Hence the experiment was undertaken to find out the effect of sand and clay mixture producing artificial soil texture on root-knot nematode in sugarcane.

MATERIALS AND METHODS

A pot experiment was conducted to find out the effect of mixture of sand and clay soils on the development of root-knot disease and female of *Meloidogyne* spp. in sugarcane roots. Pure river

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bed sand and heavy clay soil were collected and dried in the hot sun on a concrete floor. Both sand and clay soils were sterilized with formalin at the rate of 30 ml formalin (40% formaldehyde) dissolved in 1000 ml water for per cubic feet of soil. The treated soil was covered with polythene sheets and kept for 72 hours. Then the polythene sheets were removed and the soil was spread in thin layer on the concrete floor for 7 days. After sterilization sand and clay were mixed at the ratios of 0:11, 1:10, 2:9, 3:8, 4:7, 5:6, 6:5, 7:4, 8:3, 9:2, 10:1 and 11:0. Then earthen pots (40 cm diameter) were filled-up with mixed soils at the rate of 12 kg/pot.

Seedlings of sugarcane (Isd 16) were grown in nematode free soil and transplanted in the pots. After 45 days of transplanting, the sugarcane seedlings were inoculated with 20 eggmasses of *Meloidogyne* spp. To enhance the growth and root development, the settlings were fertilized into three installments viz. 20 days after plantation, during tillering stage and during May/June. Each pot received 3.5 g urea, 2.25 g TSP and 1.5 g MP at the rate of 280, 180 and 120 kg/ha of urea, TSP and MP, respectively (Ali *et al.*, 1989). Necessary intercultural operations were done as and when necessary.

Each mixture of sand and clay represented a treatment and each treatment was replicated four times (four pots). There were 12 treatments and 4 replications. The pots were arranged in the pot house of BSRI following randomized complete block design. Data were taken on the incidence of gall and mature female in the months of August, September, October and November.

RESULTS AND DISCUSSION

The severity of root-knot disease was the highest in the soil having only sand. Its severity decreased gradually with the decrease of ratio of sand in soil mixtures having the lowest severity in pure clay. In soil having higher proportion of sand than clay, root tips of sugarcane were severely galled and gall size was large. On the other hand, growth of root tips and production of rootlets discontinued. The mixtures having higher population of clay than sand showed small gall and root growth and rootlet development continued (Fig. 1, 2 & 3). Maximum of 18.1 galls/g root were found in soil having 100% sand. The numbers of gall in soils having sand and clay ratios of 10:1, 9:2, 8:3, 7:4, 6:5, 5:6 and 4:7 ranged from 4.1-6.4/g root. The number of galls recorded from above seven mixtures of sand and clay was statistically similar but significantly lower as compared to only sand. The lowest gall number of 1.2/g root was recorded in pure clay soil, which was statistically similar to the number of galls found in soils having 1:10, 2:9, 3:8, 4:7, 5:6, 6:5, 7:4 and 8:3 sand and clay (Table 1). The significantly highest population of mature female of *Meloidogyne* spp. was also recorded in pure sand. The lowest population of 1.1 female nematode per gram root of sugarcane was found in pure clay. The range of female nematode was 2.1-13.1/g roots in sand and clay mixtures of 1:10 to 10:1. The number of population of nematodes in roots of sugarcane grown in different mixtures of sand and clay were not significant except pure sand (Table 1).

The average number of galls per gram of sugarcane roots was 6.2 in the month of October and November which was significantly higher as compared to September. Significant differences in gall number were not found in the month of August, October and November. The highest population of 13.3 female nematodes/g root was found in August which was followed by November, September and October having 10.5, 9.4 and 8.9 female nematodes/g root. However, the differences in populations of female nematodes in four different months were not significant (Table 2). The ranges in gall number per gram of root recorded in August, September, October and November in the sand and clay mixtures of 0:11, 1:10, 2:9, 3:8, 4:7, 5:6, 6:5, 7:4, 8:3, 9:2, 10:1 and 11:0, respectively were 0.0-3.3, 0.5-4.8, 0.8-2.8, 1.0-5.3, 0.3-10.8, 2.0-7.0, 3.5-6.5, 0.3-11.0, 2.8-5.8, 3.3-10.0, 2.5-7.8 and 16.3-22.5. The effect of the sand and clay mixture in four different months of data collection on gall development was statistically similar (Table 3).

In pure sand, maximum population of 32.8-113.3 females per gram of roots was recorded in all four months. Their population in September to November was statistically similar but significantly lower as compared to August. In sand and clay mixtures of 0:11 to 5:6, the populations of females in four different months ranged from 0.0 to 10.3/g root and were not significantly different. The soil having 6.5 ratios of sand and clay yielded 31.0 females/g root in September, which was significantly different from only August when the population was 3.5/g root. In other four mixtures of sand and clay (7:4, 8:3, 9:2, 10:1), their populations ranged 0.5-20.3/g root and were not significantly different (Table 4). There are many findings that sandy soil is more favourable and clay soil is less favourable for the growth of root-knot and other plant parasitic nematodes as reported by Spaul (1981), Siswojo (1981) and Reddy (1987). Similar observations are also made by Hall and Irey (1992) who reported that root-knot and stubby-root nematodes were more abundant in sand (<95% silica). It was further supported by Ami and Sabie (1989) that larval density of *Meloidogyne* spp. was higher in coarse textured soil than in fine textured soil.



Fig. 1: Severely galled roots of sugarcane grown in 11:0 of sand clay mixture.



Fig. 2: Lower galled roots of sugarcane grown in 6:5 of sand and clay mixture.



Fig 3: Lowest galled roots of sugarcane grown in 0:11 of sand and clay mixture.

Table 1: Number of galls and population of mature females of *Meloidogyne* spp. in roots of sugarcane grown in sand and clay mixtures at different ratios

Sand:Clay mixture	Number of galls/g root	Population of mature female/g root
0:11	1.2 d	1.1 b
1:10	1.8 cd	2.1 b
2:9	1.8 cd	2.1 b
3:8	3.3 bcd	3.4 b
4:7	4.8 bcd	3.7 b
5:6	4.6 bcd	6.8 b
6:5	4.6 bcd	13.1 b
7:4	4.3 bcd	6.4 b
8:3	4.1 bcd	10.0 b
9:2	6.4 b	7.6 b
10:1	5.6 bc	7.9 b
11:0	18.1 a	62.0 a

Values are average of 16 observations and those within the same column with a common letter (s) do not differ significantly ($P=0.05$) by DMRT.

Table 2: Number of galls and population of mature females of *Meloidogyne* spp. in roots of sugarcane grown in sand and clay mixtures at different ratios during different months of observation

Month of observation	Number of galls/g root	Population of mature females/g root
August	4.7 ab	13.3
September	3.0 b	9.4
October	6.2 a	8.9
November	6.2 a	10.5

Values are average of 32 observations and those within the same column with a common letter (s) do not differ significantly ($P=0.05$) by DMRT.

Table3: Number of galls caused by *Meloidogyne* spp. recorded in four different months from roots of sugarcane grown in different sand and clay mixtures

Sand:Clay mixture	Number of galls/g root in four different month of observation			
	August	September	October	November
0:11	0.8	0.0	3.3	0.8
1:10	4.8	0.5	0.8	1.3
2:9	2.8	1.8	0.8	1.3
3:8	5.3	1.0	5.3	1.8
4:7	1.8	0.3	6.3	10.8
5:6	3.0	2.0	6.3	7.0
6:5	3.5	3.8	6.5	4.5
7:4	0.3	1.0	4.8	11.0
8:3	2.8	3.5	5.8	4.5
9:2	10.0	3.3	5.8	6.8
10:1	5.5	2.5	6.8	7.8
11:0	16.5	16.3	22.5	17.3

Values are average of four observations.

Table 4: Population of mature females of *Meloidogyne* spp. recorded in four different months and collected from galled roots of sugarcane grown in sand and clay mixtures

Sand : Clay mixture	Number of galls/g root in four different month of data collection			
	August	September	October	November
0.0 e	1.3 e		3.0 e	0.0 e
0.5 e	5.8 de		0.0 e	2.0 e
2.0 e	3.3 e		0.0 e	3.0 e
1.5 e	5.8 de		4.0 e	2.3 e
0.5 e	2.0 e		4.0 e	8.3 cde
10.3 cde	4.0 e		5.8 de	7.3 cde
31.0 bcd	3.5 e		7.5 cde	10.3 cde
7.0 cde	0.5 e		8.0 cde	10.3 cde
20.3 cde	3.8 e		7.3 cde	8.8 cde
4.3 e	11.3 cde		7.3 cde	7.8 cde
2.8 e	5.8 de		10.3 cde	12.8 cde
32.8 bc	113.3 a		49.0 b	53.0 b

Values are average of four observations and those within the same column and row with a common letter (s) do not differ significantly ($P=0.05$) by DMRT.

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