Bangladesh J. Sugarcane, 31: 82-88 *July, 2009*

Effect of Soil Amendment with Pressmud and Bagasse on Root-Knot Disease (*Meloidogyne*), Growth and Some Yield Parameters of Sugarcane.

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ABSTRACT

A pot experiment was conducted to find out the effect of soil amendment with pressmud and bagasse on root-knot disease (*Meloidogyne spp.*), plant growth, some yield contributing parameters and recovery of sugarcane. The soil of the experiment was amended with pressmud at 10, 20, 30 and 40 t/ha and with bagasse at 20, 25 and 30 t/ha. Before amendment the soil was inoculated with eggmasses of root-knot nematode. To determine the effect of root infection with the nematode on growth and yield parameters of sugarcane both inoculated and non inoculated soils were used for each treatment. The highest number of galls (10.8/g root) and maximum population of females (18.4 /g root) were found in plants which were grown in soil received no pressmud or bagasse (control). All treatments with the two materials gave significant reduction in gall and female development. However, the efficacy of all treatments with pressmud to reduce number of galls and females was not significantly different. Efficacy of all treatments with bagasse was also not significantly different. Improvement in stalk height, stalk girth, length of internode, number, length and dry weight of roots, number of tillers, number and weight of millable cane and recovery percent were achieved with most of the treatments with the amendments. Due to inoculation of soil with *Meloidogyne* eggmasses, average reduction in stalk height, stalk girth, length of internode, number, length and dry weight of roots, number of tillers, number and weight of millable canes and recovery percent were 4.08, 2.15, 5.23, 10.69, 11.97, 22.48, 16.11, 7.26, 4.88 and 15.27 % , respectively.

Key words : Effect, pressmud, bagasse, root-knot, sugarcane

INTRODUCTION

Pressmud and bagasse are two important by products of sugar industry. The materials may be used as organic soil amendment to control nematode diseases of sugarcane. Rosenfeld (1955) reported that pressmud reduced nemic disease of sugarcane through its effect on the increase of root-area, surface, improvement of soil texture, correction of pH and manipulation of temperature. Roman (1961) observed control of nematodes parasitic on sugarcane through the use of pressmud as organic soil amendments. Elgindi (1967) studied the mortality of larvae of *Meloidogyne javanica* by applying sugarcane bagasse and molasses as organic amendments to soil and observed that both of the materials reduced the number of nematode larvae in sugarcane fields. Pressmud (25t/ha^{-1}), farm yard manure (20t/ha^{-1}), poultry manure (20 t/ha^{-1}), neem cake

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(2 t/ha^{-1}), and sugarcane bagasse(25 t/ha^{-1}) were tested and found effective to reduce population of sugarcane photosphere nematodes such as *Meloidogyne incognita, Pratylenchus coffeae and Helicotylenchus dihystera (Jonathan et al.*,1991). It was found that neem cake and pressmud were the most effective, giving populations 81-82 % lower (than control) after 90 days and 60-62% lower after 180 days. Cane yield and recovery were 104.85 t/ha. and 14.15% with pressmud,104.23 t/ha and 14.25% with neem cake, 92.68-99.28 t/ha and 13.80-14.18% with other treatments. Pre plant application of sugarcane bagasse as a soil amendment was found to be effective to reduce root galling in tomato caused by *M. javanica* (Sikora *et al.*, 1973). The above discussion indicates that the pressmud and bagasse may be effective to control sugarcane nematodes and to increase cane yield.

Considering the above facts the present experiment was conducted to find out the effect of pressmud and sugarcane bagasse on root-knot nematode development and some yield parameters of sugarcane.

MATERIALS AND METHODS

A pot experiment was conducted to find out the effect of pressmud and bagasse amendments and nematode inoculum on root-knot development, plant growth and yield parameters of sugarcane during 1999-2000 and 2000-2001. The soil of the experiment was sterilized with 3% formalin. The treated soil was covered with polythene sheets and kept for 72 hours. Then the polythene sheets were removed and the soil was air dried for 7 days. Each earthen pot (40 cm diameter) was filled with 12 kg sterilized soil. An earthen plate was placed below each pot pot to retain excess fluids. Pot soil was amended with 125, 250, 375 and 500 grams pressmud per pot (equivalent to 10, 20, 30 and 40 tons/ha) and 250, 312.5 and 375 grams of bagasse per pot (equivalent to 20, 25 and 30 tons /ha). Both the materials were thoroughly mixed with the soil and allowed to decompose for 20 days providing necessary soil moisture. There were altogether eight treatments including control, where no amendment was used. Twenty days after decomposition, sugarcane settlings, grown in polyethylene bag containing formalin sterilized soil, were transplanted in the pot in the month of January. Each pot received one settling. Forty five days after transplanting, settlings were inoculated with eggmasses of *Meloidogyne spp.* at two eggmasses per kg soil. A set of 32 pots (four for each treatment) was inoculated to record data on galling incidence and population of root-knot nematodes. Another set of 32 pots (four for each treatment) was inoculated in the similar way to record data on growth and yield parameters. Additional 32 pots (four for each treatment) were used as control, which did not receive nematode eggmasses. Number of galls and mature females developed in the sugarcane roots were recorded in the months of August, September, October and November. Data on number of tillers, stalk growth, yield, number of galls and eggmass, population of nematode, number and length of leaves per plant, number of millable canes, height of cane, length of internode, weight of millable canes, length and weight of roots and recovery of sugar were recorded.

RESULTS AND DISCUSSION

Effect of inoculation with *Meloidogyne* on plant growth and yield

Inoculation of soil with *Meloidogyne* eggmasses caused reduction in all parameters related to plant growth, sugarcane yield and recovery percentage. Due to infection of the nematode stalk height, stalk girth, length of internode, number, length and dry weight of roots,number of tillers, number and weight of millable canes per clump were reduced by 4.08, 2.15, 5.23, 10.69, 11.97, 22.48, 16.11, 7.26 4.88 and 15.27%, respectively. The reduction parcentage was significant (P=0.05) in case of internode length, number, length and dry weight of roots, number of tiller, and recovery percent (Table 1).

Results of the present study reveal that infestation of root-knot caused severe reduction in some of the yield contributing parameters(Table 1). Similar reduction in growth and yield parameters of sugarcane in terms of length and weight of shoot as well as root and sugar content due to inoculation with *M. javanica* was recorded by Islam *et al.*, (1994). Rao and Gopal Swarup (1974) found that *Helicotylenchus dihystera* is pathogenic to sugarcane causing stunting of the plants and reduction in fresh and dry weight of shoot and root system. Anwar and Azad (1988) recorded that plant parasitic nematodes including root-knot *(M. incognita*) strongly reduced root and shoot growth while investigating the influence of nematode on root and shoot of gram. Haider and Sen (1990) also found adverse effect of nematode infection on sugarcane such as stunted growth,poor stand, poorly developed roots and rot of root. They also reported that increase in nematode levels tended to enhance the pith and cavity in sugarcane plant most likely through related disturbances in the nutrient status of the plant.

Effect of pressmud and bagasse on nematode development, plant growth and cane yield.

Gall and nematode development : Maximum of 10.8 galls/gram of sugarcane root was recorded under control, where soil was not amended with pressmud or bagasse (Table 2). Significant (P= 0.05) reduction in gall number over control was achieved with all seven treatments with two materials.The best treatment to reduce root galling was 20 t/ha. of bagasse, which was followed by 30 and 25 t/ha.of the material and 30 and 40 t/ha. of pressmud.Gall number under the above five treatments ranged 0.8-4.0/g root and was not significantly different. The least effective treatment was the lowest dose of pressmud which was followed by second lowest dose of the material (Table 2). In absence of the amendments the root systems showed severe root galling (Fig.1).

Like gall number, the highest population of 18.4 female/g root was recorded under control. All treatments with pressmud as well as bagasse caused significant reduction in their population. Average number of female reduced to 0.6/g root at 20 t/ha of bagasse. Their population under other six treatments with the two materials ranged 2.1-9.2/g root. However, differences in their population under those six treatments were not significant (Table 2)

Growth of stalk and root : Stalk growth in terms of height, girth and internode length was positively influenced by different doses of pressmud as well as bagasse. However,

all doses of pressmud and only 25 t/ha of bagasse gave significant increase in stalk height as compared to control. The maximum stalk height was obtained from the treatment with 20 t/ha pressmud, which was statistically similar to 30 and 40 t/ha of the material. Only the pressmud at 20 t/ha gave significant increase in stalk girth as compared to control. Significant increase in internode length was achieved with three higher doses of pressmud over control (Table 3)

Number, length and dry weight of sugarcane roots ranged 193.8-261.8,17.77-31.77 m, and 20.20 -34.50g per clump under different treatments including control, respectively. Pressmud at all levels did not influence the root growth of sugarcane significantly as compared to control. Significant increase in root number over control was achieved with 25 and 30 t/ha of bagasse. Only the lowest dose of the material gave significant increase in root length and dry root weight over control (Table 3)

Yield and yield contributing parameter : Number of tiller and millable cane per clump recorded at all four levels of pressmud was statistically similar but significantly higher over control. It indicated that the pressmud positively influenced the yield contributing patameters of sugarcane. The treatments were also effective to increase weight of millable cane per clump over control. However, the increase was not significant at 20 t/ha. Recovery percentage was significantly higher over control only when soil was amended with bagasse at 20 and 30 t/ha (Table 4).

The findings of the present study clearly reveal that soil amendment with sugarcane bagasse and pressmud gave appreciable reduction in nematode development and increase in plant growth and yield of sugarcane (Table 2 and 3). The findings are in agreement with the findings of *Sikora et al.(1973)*. They found that sugarcane bagasse caused reduction in number of *Meloidogyne* and gall in tomato roots. In another study, Sikora *et al.* (1973) applied rice husk alone, rice husk + sugarcane bagasse (at 3 and 6 t/ha, and 2 and 4 t/ha, respectively) to field plots 5 weeks before planting of tomato and found that rice husk did not show appreciable effect on root-knot development caused by *Meloidogyne javanica* but decreased tomato yield. Sugarcane bagasse at 2 t/ha also did not show any effect on root galling but the treatment increased yield. At 4 t/ha of bagasse gave 22% reduction in root galling but no increase in yield. Fifty days after addition of the amendments there was more than 70 % reduction in population of *M. javanica* in rice husks amended plots and 100 to 150 days after planting, the reduction was 90%. Sugarcane bagasse caused a greater reduction in nematode numbers of *Meloidogyne*. Soil amendments with sugarcane bagasse and molasses reduced population of *M. javanica* larvae (Elgindi, 1967). Effectiveness of pressmud and bagasse as soil amendments to suppress nematodes of sugarcane rhizosphere was demonstrated by Jonathan *et al.* (1991) . They amended soil with the materials at 25 t/ha and found that pressmud suppressed populations of *M. incognita, Pratylenchus coffeae* and *Helicotylenchus dihystera* over control by 81-82% after 90 days and 60-62% after 180 days of planting. Other worker also achieved control of nematodes parasitic on sugarcane using pressmud as pre-plant soil amendment (Roman, 1961)

The principles of nematode control with organic amendments were not studied in the present study. However, many other researchers demonstrated that organic amendments reduced nematode populations due to release of decomposition products like organic

acids, H_2 S, phenolic compounds and ammonia from the materials. These are directly toxic to the nematodes (Johnston, 1957; Mankau, 1963, Badra *et al.*, 1979 and Mian and Rodriguez- Kabana, 1982).

Results of the present study clearly showed that infection of sugarcane root systems with *Meloidogyne* caused appreciably reduction in shoot and root growth of sugarcane over control. The reduction was significant in case of length of internode, number, length and dry weight of roots, number of tillers and recovery percentage as compared to control. Preplant amendment of soil with pressmud and bagasse may be effective to reduce nematode development and to increase yield.

Table 1. Effect of *Meloidogyne* infestation on different parameters related to growth and yield of sugarcane

Parameters	Non-Inoculated	Inoculated	Reduction (%)
Stalk height/cane (cm)	147.10	141.10	4.08ns
Stalk girth/cane (cm)	1.86	1.82	2.15ns
Length/internode (cm)	8.60	8.15	5.23*
Number of root/clump	235.80	210.60	10.69*
Length of roots/clump(m)	26.78	20.73	11.97*
Dry root weight/clump (g)	29.94	23.21	22.48*
Number of tiller/clump	3.91	3.28	16.11*
Number of millable cane/clump	3.03	2.81	7.26ns
Weight of millable cane/clump(kg)	1.23	1.17	4.88ns
Recovery%	12.05	10.21	15.27*

*= The differences are significant (P=0.05); ns= The differences are not significant (P=0.05)

Table 2. Effect of pre-plant amendment with pressmud and bagasse to soil on the development of root gall and females of *Meloidogyne spp.* in sugarcane under inoculated condition

Amendment with dose (t/ha^{-1})	Number of galls/g root	Population of female/g root
Pressmud :		
10	6.3 b	9.2 b
20	5.2 bc	7.3 bc
30	3.5 bcd	3.8 bc
40	4.0 bcd	5.1 bc
Bagasse :		
20	0.8 d	0.6 c
25	2.3 cd	2.1 bc
30	1.9 cd	2.8 bc
Control(no pressmud or bagasse)	10.8 a	18.4 a

Values within the same column with a common letter (s) do not differ significantly (P=0.05)

Table 3. Effect of pre-plant amendment with pressmud and bagasse to soil on the growth of stalk and root of sugarcane growth in *Meloidogyne* spp. inoculated soil

Amendment with dose (t/ha)	Stalk height/cane (cm)	Stalk girth/cane (cm)	Length per Internode(cm)	Number of root per clump	Length of root per clump(m)	Dry weight of root per clump(g)
Pressmud :						
10	147.5 bc	1.76 ab	8.73 abc	212.5 ab	22.50 b	25.13 b
20	178.0 a	1.96 a	8.74 a	195.6 b	18.66 b	21.50 b
30	156.0 ab	1.89 ab	8.72 ab	225.3 ab	23.19 ab	26.50 ab
40	176.0 a	1.85 ab	8.94 a	229.1 ab	26.81 ab	29.25 ab
Bagasse :						
20	124.1 cd	1.83 ab	7.86 bc	215.9 ab	31.77 a	34.50 a
25	146.0 bc	1.91 ab	8.49 abc	252.0 a	25.80 ab	29.00 ab
30	115.1 d	1.77 ab	8.18 abc	261.8 a	23.54 ab	26.50 ab
Control(no Pressmud or Bagasse)	110.1 d	1.75 b	7.69 c	193.8 b	17.77 b	20.20 b

Values within the same column with a common letter(s) do not differ significantly (P=0.05)

Table 4. Effect of pre-plant amendment with pressmud and bagasse to soil on yield contributing parameters of sugarcane grown in *Meloidogyne* spp. inoculated soil

Amendment with Dose(t/ha^{-1})	Number of tiller/clump	Number of millable Cane/clump	Weight of millable cane/clump(kg)	Sugar recovery (%)
Pressmud :				
10	4.13 abc	3.13 abc	1.45 a	10.70 ab
20	4.38 ab	3.25 ab	1.29 ab	10.88 ab
30	4.63 a	3.63 a	1.54 a	10.85 ab
40	4.13 ab	3.50 a	1.58a	11.47 ab
Bagasse :				
10	3.63 bc	2.50 bcd	0.95 b	11.66 a
20	2.63 d	2.25 cd	0.91 b	11.44 ab
30	2.88 cd	3.0 abcd	0.98 b	11.87 a
Control(no Pressmud or bagasse)	2.38 d	2.13 d	0.87 b	10.20 b

Values within the same column with a common letter(s) do not differ significantly(P=0.05).

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