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Comparative efficacies of soil amendments and a synthetic nematicide on growth, yield and food components of a root-knot nematodes-infected soyabean (Glycine max L. Merill)

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ABSTRACT: A study carried out to compare the effects of organic soil amendments (Cocoa pods, Poultry dropping and Neem leaf) and a synthetic nematicide (Vertimec) on growth, yield and food components of a root-knot nematodes-susceptible variety of soyabean (TGX 923-2E).

The organic soil amendments and Vertimec were significantly effective in decreasing nematode multiplication rate and root-knot development with a resuktant increase in plant growth and yield as compared with the control. It was observed that the soyabean plants treated with poultry droppings had the highest growth (number of leaves/plant) and yield (number of pods/plant) parameters. The food components of soyabean were however not significantly affected by the treatments.

Key Words: Soil amendments; Nematicides; Root-knot nematodes; Soyabean (*Glycine max*).

Introduction

Soil amendments augment soil nutrients, improve soil physical condition, increase crop performance, and activities of soil microorganisms (Wade and Sanchez, 1983). Soil amendments decompose easily, are less toxic than synthetic pesticides and are easily available to farmers.

The presence of soil amendments in soils brought about considerable decrease in the population build-up of plant parasitic nematodes (Saifullah and Gul, 1990; Stirling, 1991; Akhtar and Mahmood, 1997; D'Addabbo, 1995; D'Addabbo and Sasanelli, 1996). This might be as a result of the development of mononchids and many other nematophagus fungi which are antagonistic to parasitic nematodes.

Studies on the compoarative efficacies of soil amendments and synthetic nematicides in the control of parasitic nematodes attacking soyabeans and resultant effects on the food components of soyabeans still remain in its infancy, hence this study.

Materials and Methods

Collection of Materials

The materials (Cocoa pods, poultry droppings, and neem leaves) which were sued as organic amendments were obtained, dried properly, and ground into powdery form. Vertimec, a synthetic nematicide was obtained from the Ciba Geigy Chemical Company. Soyabean variety TGX 923-2E was obtained from International Institute for Tropical Agriculture (IITA), Ibadan.

Potted Experiment

Fifty 5-litre plastic pots were filled with steam sterilized sandy-loam soil. These pots were arranged randomly on stands. There were 5 treatments (Cocoa pods, poultry droppingd, neem leaves, Vertimec, and control) while each treatment was replicated 10 times. A solution of the synthetic nematicide (Vertimec) was prepared according to the manufacturer's recommendation by mixing 0.75 litres of Vertimec in 1000 litres of water. Two hundred grammes (200g) of each of the ground materials were added separately to the pots and thoroughly mixed with the soil in the pot. Also, 200ml of the Vertimec solution was applied per soil content of pots where necessary. Pots where-in neither soil amendment nor Vertimec was applied served as control experiment.

A week after treatment application, three seeds of soyabeans were planted but later tinned down to one per pot. Two weeks after planting (2 WAP), inoculation of soyabean plants was done using 3,000 freshly extracted root-knot nematode eggs per pot. Data were collected on plant height and number of leaves per plant, at 10 WAP. Number of flowers per plant, number of pods per plant, and number of seeds per pod were also observed and recorded.

Fifteen weeks later after planting, when the final harvest was done, the soyabean plants were uprooted and roots were assessed for root-gall index using the rating scale of 0-5 (Sasser et al., 1984), where 0 = no infection; 1 = 1-5% of roots galled; 2 = 6-25% of roots galled; 3 = 26-50% of roots galled; 4 = 51-75% of roots galled; and 5 = 76-100% of roots galled. Also, nematode populations after termination of experiment was determined by sieving and decanting method along with Baermann's technique (Southey, 1986) and assessed.

Proximate analysis

Biochemical tests (Proximate analysis) were carried out on the soyabean seeds collected from each of the treatments. Crude protein, fats and ash of soyabean from each of the 5 treatments were determined in the laboratory using standard procedures. All data were subjected to analysis of variance and where appropriate means were separated using Duncan's Multiple Range Test.

Results and Discussion

Table 1 shows that root-knot nematodes significantly reduced the growth and yield of soyabean while the organic soil amendments and Vertimec significantly reduced the adverse effect of root-knot nematodes on the growth and yield potential of soyabean. Earlier workers including Verma and Anwar (1999) and Akhtar and Mahmood (1997) have reported the importance of various organic soil amendments in reducing nematode population build-up in soils and consequently increases in crop yield were observed. The nematode population reduction is usually as a result of organic acids and alkaloids which are released into the soil by the amendments. Population of microorganisms such as monochids and nematophagus fungi might also be enhanced in the soil as a result of the use of organic soil amendments (Akhtar and Mahmood 1997; D'Addabbo and Sasanelli, 1996).

There were significant differences in soyabean plant height, number of leaves, pods and seeds per pod due to the different treatments. There were no significant differences between plant height, number of flowers and seed/pod in soyabean plants treated with all the organic soil amendments and those treated with synthetic nematicide (Vertimec), though the treated plants performed significantly better than the control.

Table 1: Effect of soil amendments and a syhthetic nematicide (Vertimec) on some growth and yield parameters of soyabean.

Treatment	Average plant height at 10 WAP	Average number of leaves/plant at 10 WAP	Average number of flower/plant	Average number of pods/plant	Average number of seeds/pod
Cocoa Pod	39.10a	64.80b	16.70a	27.20b	2.93a
Poultry droppings	46.06a	86.00a	20.90a	38.30a	2.86a
Neem leaf	41.60a	62.70b	14.60a	22.00b	2.73a
Nematicide (Vertimec)	42.61a	60.40b	12.20a	20.70b	2.96a
Control	29.39b	50.50c	8.20b	14.30c	1.75b

Means followed by the same alphabet along the same column are not significantly different at P = 0.05 according to Duncan's Multiple Range Test.

However, the soyabean treated with poultry droppings had the significantly highest number of leaves and pods/plant. The observed superior performance of poultry droppings may partly be due to the high nitrogenous protein and total crude protein as well as essential salts of poultry droppings (Belewu and Adeneye, 1996; Belewu, 1996).

The above-mentioned components of poultry droppings may enhance better vegetative growth of the treated soyabean plants.

Table 2 shows that the organic soil amendments and the synthetic nematicide significantly suppressed the nematode multiplication rate in the soil, and also significantly reduced gallings on soyabean roots. The less-galled the roots, the better they are at absorbing water and nutrients from the soil. These materials are transported to other parts of the plant for good growth and yield.

Table 2: Effects of soil amendments and a synthetic nematicide (Vertimec) on root-knot nematode multiplication rate and gall index.

Treatments	Initial root-knot nematode count (pi)	Final root-knot nematode count (pf)	Multiplication rate pf/pi x 100/1 %	Gall index
Cocoa pod	3000 eggs	1,087b	36.2b	0.9a
Poultry droppings	3000 eggs	869ab	29.0a	0.8a
Neem leaf	3000 eggs	982b	32.7b	1.0a
Nematicide (Vertimec)	3000 eggs	608a	20.3a	0.6a
Control	3000 eggs	9.296c	309.9c	4.2b

Means followed by the same letter(s) along the same column are not statistically different according to Duncan's Multiple Range Test at P = 0.05; N. S. = Not Significant.

The root-knot nematode multiplication rate was 309.9% in the untreated control whereas in the treated pots, the multiplication rate varied between 20.3 – 36.2%. The reduction in the multiplication rate will result in lower nematode population build up and less crop damage. This supports the findings of Abadir et al. (1996) and D'Addabbo and Sasanelli (1997).

Table 3 reveals that there was no significant difference in the food components of soyabeans as a result of the different treatments. This implies that the organic soil amendments and Vertimec did not significantly affect the food components of soyabean. Thus the tested organic soil amendments and Vertimec can be used for nematode control on soyabeans without fear of any adverse effect on the food components.

Table 3: Effects of some amendments and a synthetic nematicide (Vertimec) on some components of soyabean.

TREATMENT	CRUDE PROTEIN	FAT	ASH
Cocoa pod	48.2	5.4	17.9
Poultry droppings	51.7	5.4	16.9
Neem leaf	49.9	5.4	17.0
Vertimec	52.3	5.6	18.6
Control	46.4	5.3	15.0
	N. S.	N. S.	N. S.

N. S. = Not Significant

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