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Full Length Research Paper

Studies on *Meloidogyne javanica* infestation on roma tomato (*Lycopersicon esculentum* Mill) under different soil amendments

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The effect of different soil amendments on infestation of *Meloidogyne javanica* on roma tomato (*Lycopersicon esculentum)* was investigated at the Federal College of Agriculture, Ishiagu, Nigeria using pot experiment. Completely randomized design was used for experiment and data collected were subjected to analysis of variance (ANOVA). All significant differences observed were separated using Fisher's least significant difference (F-LSD). The parameters measured were plant height (cm) at 50% flowering, number of leaves at 50% flowering, number of fruits per plant at harvest, weight (g) of fresh fruit at harvest, number of galled roots per plant and number of galls per root per plant. The study revealed that there exist significant ($P < 0.05$) differences among the amendments in the height of plant at 50% flowering, leaf number, number of fruit per plant and number of galls per root per plant. There was no significant ($P > 0.05$) effect on weight of fresh fruit at harvest and number of galled roots per plant. Results further showed that soil amended with organic materials (poultry droppings, grass ash and Rice husk ash) at the range of 10 to 20 t/ha were good for optimum growth, performance and control of root-knot nematode of tomato. Therefore, farmers are advised to use 20 t/ha for optimum growth and control of root knot nematode on roma tomato.

Key words: Soil amendments, *Meloidogyne javanica*, roma tomato, control.

INTRODUCTION

The commercial tomatoes belong to the family of *Solanaceae* which is an important source of vegetables and desert crops. The tomato belongs to species most frequently referred to as *Lycopersicon esculentum.* It is a native to the Andes region of South America. Tomato as one of the vegetable crops and fruits are very important in human nutrition (Abubakar, 1999).

Tomato growing on a garden basis has been practiced in Nigeria for a long period of time mainly for domestic consumption such as soup, stew and vegetables salads (Poysa, 2000). This crop is now being grown in form of paste, purree, ketchups and as fruit drinks.

The fruit is known to contain high level of vitamins A, B and C (Janes, 1994). More than a hundred different pest species have been recorded world wide on tomato crops (Peet, 2001). Some of the major ones however, include nematodes mites, thrips aphids, moths, white flies, beetle and flies (Kessel, 2003).

Over sixty species of plant parasitic nematodes attack tomato but the most destructive nematodes responsible for enormous losses of tomato are the root-knot nematode belonging to the genus *Meloidogyne* (Udo, 2004).

The most wide spread and devastating species on tomato in the tropics on tomato are *Meloidogyne javanica*. About 29 - 50% yield reduction of tomato in the tropics is attributed to root- knot nematodes (Udo, 2004). They cause formation of galls on roots of affected plants and this generally results in varied symptoms on the crops (Khan and Khan, 1987).

Developed nematicides are water soluble non- fumigants. On the whole, many different classes of chemical have been effectively used to control plant pathogenic nematodes in the nurseries and fields. The use of pre-plant treatments may not eradicate nematode completely from

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the soil. This method of application is preformed to treat the soil around the living plant which may result in phototoxicity which in turn decreases the beneficial effect of the chemicals.

Soil amendments of different kinds used as nutrient source for crop production have been found effective in the control of root disease of plant. Remarkable reductions have been achieved in nematode population in both green house and field conditions with concomitant increase in growth and yield (Majeed and Abubakar, 2000). Such increase in growth have been attributed to either improvement in soil condition resulting in greater root-growth thereby enhancing the utilization of soil nutrients or to changes in the biotic and abiotic environment of the plant.

This work is aimed at determining the effects of different soil amendment materials (rice husk ash, grass ash and poultry dropping) on root-knot nematodes on tomato.

MATERIALS AND METHODS

The experiment was conducted at the research and teaching farm of Federal College of Agriculture Ishagu Ebonyi State, Nigeria. The area is located at latitude 06º 25″N and longitude 08º 31″E. The vegetation of the area is within the derived savannah zone of south-eastern Nigeria.

Variety of tomato used

The variety of tomato used was roma which was bought from the Department of Crop Science, University of Nigeria Nsukka (UNN), Enugu State. The soil amendment materials used were well cured poultry droppings, grass ash, and rice husk ash.

Preparation of ash

Guinea grass (*Panicum maximum*) was cut from the vicinity of the Federal College of Agriculture Ishiagu, Nigeria and dried under the sun and rice husk was also collected from the mill at Eke market Ishiagu and burned to ash.

Soil sterilization

Top soil, 0 - 30 cm depth, was collected from the students project site, Federal College of Agriculture Ishiagu, Nigeria. The soil was sterilized in the laboratory using electric soil sterilizer at 50℃ for two hours to ensure that no micro-organism is left alive.

Nursery preparation

The roma seedlings were raised in a wooden tray measuring 100 cm by 50 cm by 30 cm using sterilized top soil. This was watered every other day depending on the intensity of the sun.

Transplanting

Polythene bags (29 by 30 cm) were used for the transplanting of young tomato seedlings. Each bag contained one seedling. The seedlings were transplanted three weeks after germination. 1 kg of sterilized soil were amended with various soil amendments at the rate of 10, 20 and 30 t/ha and filled into polythene bags. The unamended soil served as control.

Preparation of inoculum

An infected Indian spinach (*Spinache oleraceae*) root already maintained in an inoculum bucket was used as inoculum source. The roots was thoroughly washed with distilled water and cut into pieces and put into a 1000 ml measuring cylinder. 200 ml of 0.5% sodium hyprochlorite solution (house-hold bleach) at the ratio 1:40 was poured into a measuring cylinder tightly capped and shook vigorously for about three minutes to dissolve the gelatinous matrix. The eggs were collected through sieving and washed with distilled water. Using a counting dish, the number of eggs was estimated.

Inoculation of nematodes

Each of the tomato stands contained in the plots was inoculated with 1000 root-knot nematode (*Meloidogyne incognita)* eggs two weeks after transplanting with the use of syringe. The soil around the roots was opened 2 cm deep and 3 cm from the root. The eggs were inoculated into the hole and slightly covered with soil.

Experimental design

The experimental design used for this research work was completely randomized design (CRD), with four replications. Data were collected on plant height at 50% flowering, number of leaves at 50% flowering, number of fruits per plant at harvest, weight (g) of fresh fruit at harvest, number of galled roots per plant and number of galls per root per plant. Number of galls was scaled according to Taylor and Sasser (1978) as follows: 0 = No galls, 1 = 1 - 2 galls, 2 = 3 - 10 galls, 3 = 11 - 30 galls, 4 = 31 - 100 galls and 5 = > 100 galls.

Data analysis

The data collected were subjected to analysis of variance (ANOVA) and the significant means were separated using Fisher's least significant difference (F-LSD) at 5% level of probability according to Obi (2002).

RESULTS

Table 1 shows the effect of soil amendments on mean plant height and number of leaves at 50% flowering. The amendments produced a significant effect ($P < 0.05$) on plant height. 10 t/ha of poultry droppings differed significantly ($P < 0.05$) from other levels of amendments except poultry droppings 20 t/ha and grass ash 10 t/ha. The highest plant height was obtained from poultry droppings at 10 t/ha. Poultry droppings at 20 t/ha differed significantly ($P < 0.05$) from other levels of amendment. On the number of leaves produced by the plant, the treatments had significant ($P < 0.05$) effect. The highest leaf number was obtained from 20 t/ha of poultry droppings.

Table 2 shows that the amendments affect the mean number of fruits per plant significantly ($P < 0.05$). Poultry droppings at 20 t/ha differed from other amendments

Table 1. Effect of soil amendments on mean plant height (cm) and number of leaves at 50% flowering.

Amendments (t/ha)	Plant height (cm)	Number of leaves
Control	38.1	10.0
PD 10	60.6	15.5
PD 20	55.7	16.3
PD 30	29.9	8.3
GA 10	52.4	9.3
GA 20	36.2	6.0
GA 30	11.8	5.3
RHA 10	39.1	10.0
RHA 20	33.7	10.0
RHA 30	39.8	9.3
F-$LSD_{0.05}$	17.87	5.28

PD = Poultry droppings; GA = grass ash; RHA = rice husk ash.

Table 2. Effect of mean number of fruits per plant and weight (g) of fresh fruit at harvest.

Amendments (t/ha)	Number of fruits	Weight (g)
Control	1.3	10.3
PD 10	5.3	15.9
PD 20	6.5	16.9
PD 30	2.3	14.8
GA 10	1.3	22.2
GA 20	1.8	21.1
GA 30	1.8	16.5
RHA 10	1.8	15.1
RHA 20	1.3	14.2
RHA 30	2.3	11.7
F- $LSD_{0.05}$	2.29	NS

NS= Not significant.

except poultry droppings 10 t/ha. Poultry droppings at 20 t/ha obtained the highest mean number of fruits per plant. 0 t/ha, grass ash 10 t/ha and rice husk ash 20 t/ha had the least mean number of fruits per plant. On the other hand, there was no significant effect ($P > 0.05$) observed on weight of fresh fruit at harvest.

Result produced in Table 3 indicates that the treatments had no significant ($P > 0.05$) effect on the number of galled roots per plant and number of gall per root per plant. All the amendments were similar statistically.

DISCUSSION

The study on root-knot nematode on tomato showed that poultry droppings produced significant ($P < 0.0$) effect on the mean height and leaf number at 50% flowering. At 10 t/ha of poultry droppings, the highest mean height was 60.6 cm and the least being controlled with 11.8 cm. The highest mean leaves were obtained from 20 t/ha of poultry droppings. This result is in line with the findings of Kemper and Nurwira (1999) which inferred that optimal growth and yield performance of groundnut was obtained from poultry droppings at the rate of 10 t/ha. The result in Table 1 shows that the optimal height and leaf number of tomato is obtained from the range of 10 to 20 t/ha of poultry droppings.

The results contained in Table 2 shows that number of fruits per plant had significant ($P < 0.05$) effect. The rate at 20 t/ha of poultry droppings produced the highest mean fruit per plant with 6.5 and the least was obtained from control with 1.3. On the other side of weight of fresh fruit at harvest, there was no significant ($P > 0.05$) effect. This result showed that the optimal number of fruits per plant is obtained from poultry droppings at 20 t/ha and weight of fresh fruit at harvest is obtained from grass ash at 10 t/ha. Therefore, application of organic manure (poultry droppings and grass ash) is encouraged for fruit

Table 3. Effect of soil amendments on the mean number of galled roots per plant and number of galls per root per plant.

Amendments (t/ha)	Number of galled root/plant	Number of galls/root/plant
Control	3.3	4.8
PD 10	3.0	1.5
PD 20	3.0	1.5
PD 30	3.0	1.5
GA 10	3.0	1.5
GA 20	3.0	1.5
GA 30	3.0	1.5
RHA 10	3.0	1.5
RHA 20	3.5	1.8
RHA 30	3.8	1.5
F-LSD$_{0.05}$	NS	NS

number and weight of fresh fruits at harvest.

In Table 3, results show that the number of galled root per plant had no significant ($P > 0.05$) effect. Since no amendments were added to the control pots, the roots were affected with galls. At 30 t/ha of rice husk ash, the lowest mean number of galls per root per plant was obtained. This result is in line with Nair (2006), his research work shows that the use of rice hush ash is applicable where other organic manure is not available. This result showed that the application of rice husk ash is advisable where there is no organic manure.

Conclusion and recommendation

The importance of tomato as a vegetable crop cannot be over emphasized. It is important that due attention be given to its production and cultivation of the best use pesticide in controlling pest especially the root-knot nematode. Following the results of this study, the indications are that organic manure be counted as one of the materials used in the prevention and control of root-knot nematode.

Conclusively, it is evident that the highest performance was achieved by the plots with amendment materials than those without amendment. However, the poor performance observed from the control plot shows that there was a great effect of root-knot nematode, though it affect others but not as much compared to control experiment.

Based on the research findings of this study, the following recommendations were made. It is beneficial to use organic manures (poultry droppings, grass ash and rice hush ash) as means of controlling the effect of root-knot nematode in the soil. Strict attention should be paid to the best control measures on the use of organic manures if a good result is to be obtained.

Farmers should be encouraged to promote the use of organic manures (poultry droppings, grass ash and rice husk ash) since the use of chemical has adverse environmental effects and health hazards.

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