

Control of Nematode Disease of Eggplant (*Solanum aethiopicum* L.) Using Manure

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Summary

Pot experiment was conducted in the year 2010 and repeated in 2011 to examine the effects of organic manure (poultry, cow dung, domestic waste) and inorganic manure (NPK 15:15:15) on the yield, soil and root population of *Meloidogyne incognita* that infected Ethiopian eggplant *Solanum aethiopicum* in a greenhouse at Kabba College of Agriculture, Ahmadu Bello University, Kabba, Nigeria. Each of the organic manure was applied as soil amendment at the rate of 5 t/ha and the inorganic fertilizer (NPK) was applied at the rate of 200 kg/ha while there was an untreated control that acted as standard check. The experimental design was a completely randomized design comprising of five treatments including control and each of the treatments was replicated four times. The results of the experiment showed that all the organic manures considered and NPK fertilizer were effective in suppressing nematode negative effects on the plant as manifested in improved yield, reduced soil and root population as well as in reduced gall index of the organic and inorganic manure treated plants compared with the control. The mean fruit yield of the manure treated plant was 18±1, of NPK fertilizer treated ones was 17, while the average fruit number in untreated control was 6.5. The organic and inorganic manures treated plants had bigger fruit size compared with control and were significantly different from the control. The soil and root population as well as root gall index were reduced in all the manure treatments compared with the control and they were significantly different from the control. The results of this experiment confirmed that organic manure can be utilized to manage root-knot nematode (*M. incognita*) in soil.

Key words

Ethiopian eggplant, fruit number, fruit size, inorganic manures, *Meloidogyne incognita*, organic manure

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Introduction

Solanum aethiopicum L. (Ethiopian eggplant) belongs to family *Solanaceae* that has been described as one of the most intriguing and largest plant families in the world (Bonsu et al., 2000). The family comprises of well-known edible plants such as potato, tomato eggplant and pepper; ornamental plants such as nireMBERGIA (*Nierembergia utenscence*), and poisonous species such as Jimson weed (*Datura* spp.), mandrake (*Mandragora officinarum* L.) and bitter-sweet night shade (*Solanum dulcamara*) (Bonsu et al., 2002).

S. aethiopicum is a traditional food plant in Africa, a vegetable that has potential to improve nutrition, boost food security, foster rural development and support sustainable food production, and it is more nutritive than the fruit. The highly variable fruit is eaten both raw and cooked and it is becoming more popular as cultivated crop.

This plant is affected by wide range of pests, prominent among them is root-knot nematode *Meloidogyne incognita* (Kofoid and White, 1919; Chitwood, 1949) which is responsible for serious root damage leading to stunting, chlorosis and drastic yield reduction. The best method of managing the pest is through the use of synthetic chemicals known as nematicide. These synthetic chemicals are highly toxic to humans and very expensive and do not guarantee the safety of the environment.

Application of soil amendment in form of organic manure and plant extracts and other biocides into the soil is an attempt to supplement soil nutrient and to control or suppress plant diseases and insect pests under the nascent organic agriculture in Nigeria, and it is used as a vibrant area of research interest. The agricultural sector in Nigeria is facing a new challenge that the conventional farming system is transitioning to organic farming system.

Scarcity, high cost, environmental safety and global restriction on the importation of chemical nematicide have spurred scientist to search alternative control measures against nematode pests of economic food crops (Anonymous, 2004). Application of organic manures not only improves plant growth and productivity, but also is a useful tool for pest management. It also guarantees environmental safety (Pakeerathun et al., 2009). Organic manures have been reported to suppress nematode pest in various experiments conducted across the world. The incorporation of organic amendment (with other bio control agents) have an important role in the management of target nematodes via reduction of its population to a low and safe level (Abubakar et al., 2004; El-Sherriff et al., 2008; Ullah et al., 2008; Mohammed and Alan, 2003; Jatak, 2002; Kaskavala, 2007; Summer, 2011; Adesiyun et al., 1990). Dickson and Lucas (2007) observed similar trend in their various experiments. The study was conducted to evaluate the effects of organic and inorganic manures on the yield attributes of *M. incognita* infected Ethiopian eggplant.

Materials and methods

The pot experiment was conducted at College of Agriculture, Ahmadu Bello University, Kabba in Nigeria. The experiment was carried out twice (2010 and 2011) and the data generated were pooled together for analysis.

Soil sterilization and experimental design

Top soil (1-10 cm) was mixed, sieved and sterilized for about 10 hours at a temperature range of 90-100°C. Ten kilograms of sterilized soil was filled into a 15 litre capacity perforated plastic pot and arranged on the concrete floor of the screen house. The PH of the soil was determined with PH meter to be 6.2. The experimental design was a complete randomization comprising of five treatments, control inclusive, and each treatment was replicated four times.

Soil amendment: The pots except the one set aside for inorganic manure treatment (NPK 15:15:15 fertilizer) were separately amended with three types of organic manures (poultry, cowdung, and domestic waste manure) at the rate of 5 t/ha a week before planting, while the inorganic fertilizer was applied at the rate of 200 kg/ha, three weeks after planting.

Crop establishment: The seeds of *S. aethiopicum* were collected from Institute of Agricultural Research (IAR) Zaria, Nigeria. The seeds were confirmed to be susceptible to nematode pest in previous experiment (Abolusoro, 2006). Three seeds were introduced into each of the experimental pot and thinned to one healthy thrifty crop three weeks after planting (3WAP).

Extraction and inoculation of plant with nematode: Plant parasitic nematode *M. incognita* juveniles were extracted from previously infected tomato grown in pure culture of *M. incognita* in previous pot experiment using the method stated by Whitehead (1965). Total of 1000 juveniles were introduced into each pot at the base of the standing plant. This was done three weeks after planting (3WAP).

Data collection and analysis: In both experiments, data were collected on yield components, (number of fruits per plant and average fruit weight). Data were also collected on number of juvenile in root, soil and gall index from all the treatments. All the data were pooled together and means were analysed. Means separation was done using Duncan's multiple range test at 5% probability level.

Results

The number of fruits per eggplant was higher in both organic and inorganic manure treated plants compared with the untreated control. Poultry manure treated plants recorded the highest number of fruit among the organic manure followed by cowdung, while domestic waste manure treated plants recorded the least number of fruit among the organic manure treatment. The fruit productions among the manure treatments were not significantly different from each other but were different from the control. The average number of fruits of the organic manure treated eggplant was 18±1; of NPK fertilizer treated plants was 17, while in the untreated control there was an average of 6.5 fruits (Table 1).

Eggplants that were treated with organic manure and NPK fertilizer had higher fruit weight compared with the untreated control. The average fruit weight of the eggplants that were treated with organic manure was 27±2 g and those with NPK fertilizer treatment had an average weight of 28.7 g, while the untreated control had the least average weight of 12 g (Table 1).

Table 1. Effects of organic manures and NPK fertilizer on fruit production of *M. incognita* infected eggplant

| Treatments | Average number of fruit/plant | Average fruit weight/plant |
|--------------------|-------------------------------|----------------------------|
| A (Control) | 6.5a | 15.3a |
| B (Poultry manure) | 19.3b | 29.3b |
| C (Cowdung) | 18.7b | 27.8b |
| D (Domestic waste) | 16.9b | 25.9b |
| E (NPK fertilizer) | 17.0b | 28.7b |
| SEM | 2.3381 | 3.4110 |

Means followed by the same letter(s) along the same column are not significant different according to Duncan's Multiple range test at $p=0.05$.

At harvest, the final *M. incognita* population for each of the treatment was counted. All the organic and inorganic manure treated plants had reduced number of nematodes, compared with the control treatment. The population of *M. incognita* was the lowest in poultry manures compared to other manure utilized in the experiment. The reduction in population of *M. incognita* in all the organic and inorganic manure treatments was significantly different from the control (Table 2).

The number of *M. incognita* in 5 g of root of infected eggplant is shown in Table 2. Organic and inorganic manure significantly reduced nematode number. The organic manure treated eggplant had population range 15 ± 1 and NPK fertilizer treatment had an average of 17, while the untreated control had an average of 35 nematodes (Table 2).

The root damage expressed as gall index of root - knot nematode infected eggplant due to treatment with organic and inorganic manure is shown in Table 2.

More damages were recorded on the root of untreated egg plants. The organic manure treated plants had a root damage range of 2.2 ± 0.2 and NPK fertilizer treated eggplant recorded a gall index of 2.4, while the untreated control had 4.2 (Table 2).

Discussion

The results of this research work show that nematicidal components are available in manures as indicated in the result of this work. Application of organic and inorganic manure caused a significant declines in population of *M. incognita*, both in the

root and soil, hence reducing the root damage (gall index) of manure treated plant, compared with the untreated control, and sub-sequently improved the yield attributes (fruit number and fruit weight of Ethiopian eggplant). Similarly, it has been demonstrated by researchers that organic manure is a useful tool for nematode control. For example, Summer (2011) reported that organic manure amendment stimulates the multiplication of micro-organisms like fungi and bacteria. Some of the microorganisms are parasites of nematodes. The microorganisms cause the suppressions of parasitic nematodes in the soil and promote growth and development of the plant. Mohammed and Alan (2003) reported that organic manures incorporated into the soil improved the performance of nematode infected plant. This improvement is due to direct stimulation of predators and parasitic nematodes, leading to reduction in soil pathogen and consequent increase in the fruit yield. Adesiyan et al. (1990) reported the efficiency of organic manures such as poultry domestic waste and cowdung in suppressing nematode population, hence accelerating the fruit yield. Jatak (2002) reported that manure amendment reduced the population of soil and root-knot nematode (*M. incognita*) by populating predatory microorganism on nematode. This microorganism competes with root-knot nematode for space, water, food etc. The toxin produced by the microorganism has adverse effect on the root knot nematode's speed of activities, nematode survival and population density hence increasing plant yield. Poultry and other organic and inorganic manures are effective in bringing down nematode population with consequent yield improvement.

Conclusion

The result of this study showed that poultry manure, domestic waste, cow dung and inorganic fertilizer (NPK 15:15:15) have the potential to suppress nematode population with a resultant increase in yield output. Inorganic fertilizer is equally effective in this direction but emphasis is not on inorganic manure since the focus of the research work is to promote organic farming because of its associated merits. The present study confirms the potency of organic manures as root knot nematode suppressant with resultant yield improvement. Domestic waste and other types of manure may easily be disposed by recycling them into the soil as organic manure hence converting waste to wealth. This practice will assist in reducing environmental pollution.

Table 2. Effects of organic manure and NPK fertilizer on the soil, root population and gall index of *M. incognita* infected plant

| Treatments | Initial nematode population | Nematode population after harvest | Nematode population/5 g of root | Root gall index |
|--------------------|-----------------------------|-----------------------------------|---------------------------------|-----------------|
| A (Control) | 1000 | 2842b | 35.3a | 4.2 |
| B (Poultry manure) | 1000 | 359a | 14.2b | 2.0 |
| C (Cow dung) | 1000 | 412a | 15.4b | 2.4 |
| D (Domestic waste) | 1000 | 4290a | 16.0b | 2.3 |
| E (NPK fertilizer) | 1000 | 450a | 17.1b | 2.4 |
| SEM | | 63.371 | 3.4512 | |

Means followed in the same letter along the same column are not significantly different according to Duncan's multiple range test at $p=0.05$.

Recommendation

The result of this study shows that organic manures (poultry cowdung domestic) is endowed with potential to suppress the root and soil population of *M. incognita* hence reducing the root damage level and other negative effects on infected plant with resultant yield increase. The author intends to repeat the experiment under field condition.

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