THE EFFECT OF COW-DUNG AND CHICKEN DROPPINGS IN THE CONTROL OF ROOT-KNOT NEMATODES (*Meloidogyne incognita*) OF TOMATO (*Solanum Lycopersicum* L.)

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ABSTRACT

Tomato (*Solanum lycopersicum*) is one of the most widely grown vegetables in the world. It belongs to the family Solanaceae also called night shade family. It grows well in the tropics, especially in humid lowland regions. Over sixty species of plant parasitic nematodes attack tomato but the most destructive nematodes responsible for enormous yield loss are the root-knot nematodes, belonging to the genus *Meloidogyne*. In the present study, the nematicidal potentials of cow dung and chicken droppings on root-knot nematode of tomato (*Meloidogyne incognita*) were assessed. Greenhouse experiment was conducted to test the efficacy of cow dung and chicken droppings in controlling the effects of root-knot nematode on tomato individually and in combination in sterilized soils. Three weeks old tomato seedlings raised in sterilized soil were inoculated with 10 egg masses of *Meloidogyne incognita* each. The treatments were arranged in a Randomized Complete Block Design (RCBD). Plant height, number of leaves, stem diameter, root length, number of galls and number of nematodes in soil and roots were determined. The results obtained revealed that chicken droppings significantly improved the growth parameters of tomato and effectively reduced the population of nematode compared to cow dung treatment or their combination. Plants treated with cow dung also had better growth parameters than those with combined treatments, but recorded more nematode population than the combined treatment. Combined treatments of cow dung and chicken droppings had a synergetic effect in reducing nematode population even though they had an antagonistic effect on growth parameters of the plant. It could be deduced that chicken droppings has a controlling effect on the root-knot nematode of tomato and hence could be utilized by farmers to avert yield losses in tomato farms.

Keywords: *Solanum lycopersicum*, *Meloidogyne incognita*, Cow dung, Chicken dropping,

INTRODUCTION

Tomato (*Solanum lycopersicum*) is one of the most widely grown vegetables in the world. It belongs to the family *Solanaceae* or night shade family. It grows well in the tropics, especially in humid lowland regions. Due to its high demand, it is cultivated all year round in most parts of the world (Shankara *et al.,* 2005). In Nigeria, tomato is by far the most cultivated among vegetable crops (Ramalan *et al.,* 1994).

Nigeria is the second largest producer of tomatoes in Africa, and the 13th largest producer of the commodity in the world

(FAO, 2010). Tomato production in Nigeria has been facing many biotic and environmental constraints. The world's average tomato yield in 2001 was 27 Mt/ha but in tropical Africa, only 8 Mt/ha of the fruit were harvested from field production (Fanjimi and Fanjimi, 2010). Poor yield of tomato in Nigeria however, aside other biotic constraints, has been attributed in many parts to nematode diseases (Agbenin *et al.,* 2004). Over sixty species of plant parasitic nematodes attack tomato but the most destructive nematodes responsible for enormous yield loss are the root-knot nematodes belonging to the genus *Meloidogyne*, accounting for about 29-50% yield reduction of tomato in the tropics (Udo, 2004).

Tomato plants infected with root-knot nematodes (*Meloidogyne* spp.) have been reported to show stunted growth, conspicuous root galls and yield losses. In Nigeria reports indicate that high population of nematodes are associated with almost all types of crops throughout the country, and thus pose a serious problem to Nigerian agricultural economy. Among all the known methods of nematode control, chemical control stands supreme because of its quick action and effectiveness. Nevertheless, the problems of high cost, unavailability and hazards associated with its use cannot be overlooked (Chindo *et al*., 2012).

Many of the soil amendments used as nutrient sources for crop production have been found to control plant parasitic nematodes. Such materials include green manure, cow dung, poultry droppings, dried crop residues, botanicals, camel dung and composted agro-industrial wastes (Hassan *et al*., 2010). The present trend in non-chemical pest management strategies has encouraged the use of organic materials otherwise considered as waste, first to sanitize the environment, and second, as cheap, effective, and efficient for pest control (Atungwu and Kehinde, 2008). Hence, the present study was set out to assess the efficacy of using cow dung and poultry manure individually and in combination, in controlling the root-knot nematode *Meloidogyne incognita* of tomato as an alternative to synthetic pesticides.

MATERIALS AND METHODS

Study Area

The experiment was conducted at the greenhouse, Department of Biology Faculty of Life Science Ahmadu Bello University, Zaria.

Sample Collection

Roma VF tomato seeds which is susceptible to *Meloidogyne incognita* was obtained from an agrochemical shop in Sabongari Local Government Area, Kaduna state. The nematode inoculum used was obtained from a previously infected tomato farm in Pambeguwa, Kubau Local Government, Kaduna State. Cow dung and chicken droppings were obtained from Department of Animal Science farm, Faculty of Agricultural Sciences, Ahmadu Bello University, Zaria.

Soil Sterilization

Top soil was obtained near the screen house at the Department of Crop Protection Ahmadu Bello University, Zaria at a depth of 0-30cm with the aid of a soil auger. The soil was sterilized in an autoclave at 120°C for 3 hours.

Nursery Preparation, Transplanting and Inoculation

Roma-VF tomato seeds were raised to seedlings for three weeks in a nursery tray containing heat-sterilized soil and watered on daily basis. The tomato seedlings were then transplanted three (3) weeks after sowing. Inoculation of the tomato seedling was done 3 weeks after transplanting.

Greenhouse Experiment

A total of thirty 18cm mouth wide plastic pots were used in the study. These were arranged in a Randomized Complete Block Design (RCBD), divided into 5 groups of six in the following pattern:
Group 1: Sterilized soil
Group 2: Sterilized soil + nematode inoculum
Group 3: Sterilized soil + nematode inoculum + cow dung
Group 4: Sterilized soil + nematode inoculum + chicken dropping
Group 5: Sterilized soil + nematode inoculum + cow dung + chicken dropping
Seedlings in groups 2-5 were inoculated with 10 egg masses (1000 larvae) of *M. incognita* each. These were carefully covered with soil and watered regularly for a period of 5 weeks.

Termination of the Experiment and Harvesting

The experiment was terminated 5 weeks after inoculation. To ensure easy removal of the plant from the soil, the side of the pot was pressed to loosen the soil. The soil was removed from the root by gently shaking the plants.

Determination of Root-knot Index

The number of galls formed on the roots of each plant was counted after harvesting. Root-knot index was determined using the scale: 0 = no galling; 1 = 1-10 galls; 2 = 11-20 galls; 3 = 21-30 galls; 4 = 31-100 galls and 5 = more than 100 galls (Sasser *et al*., 1984).

Extraction of Nematode

Extraction of the nematode from soil was done using the modified sieving and decanting method as described by Coyne *et al*. (2007).Tissue maceration was employed to extract nematodes from the root as described by Viaene and Bert (2015).

Counting of Nematodes

Ten (10) milliliters of the bubbled suspension was pipetted into the Don Caster's counting dish and the nematode populations were counted under a stereoscopic microscope. Counting and identification was done twice for each sample and the average obtained.

Data Collection and Analyses

Growth parameters such as plant height, number of leaves, stem diameter, root length, number of galls, number of nematodes in the soil and root were determined at the end of the experiment. Data obtained from the study were subjected to Analysis of Variance (ANOVA), at 5% level of significance. Where significant differences were observed, Duncan's Multiple Range Test (DMRT) was used to separate the means.

RESULTS

The effect of some organic manure in controlling the effect of the root-knot nematode (*M. incognita*) of tomato, as seen in the growth parameters and some root-knot nematode indices is shown table 1.

Table 1: Growth parameters and some root-knot nematode indices in tomato treated with organic manures.

Parameter	Treatments				
	T1	T2	T3	T4	T5
Plant Height (cm)	52.33 ± 2.19^{a}	34.67 ± 4.18^{b}	40.00 ± 4.16^{b}	41.67 ±4.48^{ab}	31.67 ± 1.76^{b}
Number of Leaves	12.67 ± 0.88^{a}	7.67 ± 0.33^{c}	10.00 ± 0.58^{bc}	10.67 ± 0.33^{ab}	7.67 ± 1.20^{c}
Stem Diameter (cm)	0.60 ± 0.05^{a}	0.43 ± 0.03^{b}	0.50 ± 0.05^{ab}	0.50 ± 0.00^{ab}	0.47 ± 0.03^{ab}
Root Length	14.33 ± 0.33^{a}	8.67 ± 0.33^{c}	11.67 ± 0.33^{b}	12.33 ± 0.33^{b}	11.33 ± 0.33^{b}
Number of Galls	0.00 ± 0.00^{d}	26.33 ± 1.45^{a}	8.67 ± 0.67^{bc}	6.33 ± 0.88^{c}	10.67 ± 0.88^{b}
Root-Knot Index	0.00 ± 0.00^{c}	3.00 ± 0.00^{a}	1.00 ± 0.00^{b}	1.00 ± 0.00^{b}	1.33 ± 0.33^{b}
No. of Nematodes in Roots	0.00 ± 0.00^{d}	18.13 ± 1.76^{a}	10.67 ± 1.45^{b}	5.67 ± 0.88^{c}	6.67 ± 0.64^{c}
No. of Nematodes in soil	0.00 ± 0.00^{d}	38.36 ± 1.10^{a}	20.68 ± 0.82^{b}	12.67 ± 1.20^{c}	13.38 ± 1.33^{c}

Means with the same superscripts along rows are not significantly different (P>0.05).

Key: T1 = Sterilized soil (negative control)
T2 = Sterilized soil + nematode inoculum (positive control)
T3 = Sterilized soil + nematode inoculum + cow dung
T4 = Sterilized soil+ nematode inoculum +chicken dropping
T5 = Sterilized soil + nematode inoculum + cow dung + chicken dropping

DISCUSSION

Results from the study revealed that treatment with both kinds of organic manures generally produced seedlings with significant better growth parameters ($p \leq 0.05$) than those of the inoculated and untreated control (positive control) but significantly lower than seedlings in the positive control (uninoculated and untreated). Seedlings of inoculated soils with chicken droppings treatment showed significantly higher plant height and number of leaves than those treated with cow dung and combination of both manures. Seedlings of uninoculated and untreated soils (negative control) however had significantly higher plant height and number of leaves than all other groups. This may be attributed to the fact that seedlings in this group were devoid of the parasitizing effect of the nematode and hence this allowed unhindered growth potential. Similar findings were reported by Chindo *et al.* (2012) which observed that growth parameters were negatively affected by root-knot nematode infestation.

Better growth performance observed in seedlings grown in soils treated with both organic manures separately and in combination compared to the positive control may be attributable to the presence of nematophagous bacteria and fungi which plays a role in improving soil structure, aid in water retention and provides nutrients that affect nematode population (Daramola *et al.*, 2015). Better growth performance observed in treatment with chicken droppings than that of cow dung or their combinations may be due to the fact that chicken droppings is more soluble and readily releases nutrients as opposed to cow dung which takes longer time to release nutrients and is less soluble (Akhtar and Malik, 2000), or that chicken droppings contains significant amount of urea, a readily available source of ammonia which is toxic to the nematode (Oka, 2010). However, contrasting findings were reported by Abubakar *et al*. (2004) which observed that treatment of soils with mixture of cow dung produced better growth parameters in root-knot nematode infested tomato than those treated separately with cow dung and urine.

Root length of seedlings decreased with increase in nematode population. Similar findings by Fanjimi and Fanjimi (2010) observed that infection of tomato plant by root-knot nematode lead to reduction in the plant-root system and the ability of the plant to absorb and transport water. Soil treatment with both organic manures separately and in combination lead to significantly higher root length of seedlings than those in inoculated and untreated soils, but lower than those in the negative control. Addition of manure to soil leads to a better environment for the growth of roots. This enhances the utilization of soil nutrients as a consequence of which the nematode damage might have been markedly reduced (Vander-Borgett *et al*., 1994).

The stem diameter was also directly proportional to the number of nematodes. This may be attributed to the reduction in efficient nutrient utilization in plant tissues occasioned by the presence of the parasite. Sandeepa (2011) similarly noted that root-knot nematode causes erratic stem diameter. The number of galls was also a function of the nematode population, lower in seedlings with manure treatments separately and in combination than those of the positive control. This was least in seedlings in soils with chicken dropping treatments. This is in tandem with the findings of Coyne *et al*. (2007) which reported that tomato seedlings attacked by root-knot nematode showed varying degrees of galling which in turn affects the plant's ability to absorb nutrients directly as evidenced by stunted growth. It could be deduced that combination of the two manures might have produced an antagonistic effect on the growth parameters resulting from their nematicidal activity and hence the lower observed growth parameters as compared to separate treatments. This contrasts findings of Abubakar *et al*. (2004) which reported superior increase in growth of tomato observed in plants treated with combined cow dung and urine over those treated separately by doses of urine and cow dung and attributed this to the availability of more nutrients to the plants for a longer period of time.

CONCLUSION

Root-knot nematode (*M. incognita*) significantly reduces the growth of tomato. Cow dung and chicken droppings significantly reduce the population intensity of root-knot nematode (*M. incognita*) of tomato individually. Combination of cow dung and chicken droppings significantly reduces the population of root-knot nematode (*M. incognita*) of tomato even though this may have some antagonistic activity on growth parameters of the plant. Chicken droppings shows great nematicidal potentials in the control of root-knot nematode (*Meloidogyne incognita*) of tomato.

Recommendations

It is highly recommended to assess for nematodes when crops are suffering from yield loss and exhibiting any of the suspected symptoms for timely management.

Farmers should make use of chicken droppings in their farms for control of root-knot nematode of tomato because of its high efficacy and environmental friendliness.

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