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Enhanced Nematicidal Effect of Cowdung Soil Amendment by Neem (*Azadirachta indica*)

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Abstract

Field experiment was conducted during the rainy season (summer) of 2014 to determine the effect of mixture cow dung of neem on population of root knot nematode infesting okra. A parcel of land highly endemic to population of root knot nematode was chosen for the experiment. Treatments include sole neem at 11.5 g, sole cowdung at 100 g and mixture of cowdung and neem at 111.5 g were applied to individual crop stand in plots of size 2.0 M by 2.0 M. Furadan, a chemical nematicide was applied as a standard check. Non amended plots in which no treatment was applied served as a control. Crop stands numbering 16 per plot were planted with okra. The experiment was carried out in randomized complete block design (RCBD) with three replications. Data were collected on nematodes population and plant growth parameters and subjected to analysis of variance (ANOVA) and means were separated using Fisher's least significant difference (LSD). Results obtained showed mixture of neem and cow dung produced 27.6 second stage juvenile which was the lowest population obtained, with a concomitant highest okra yield of yield of 2.4 tons/hectre (T/ha). Sole neem and cow dung suppressed nematodes population by 35.3 and 98.6 respectively with attendant okra yield of 1.9 and 1.4 T/ha respectively. Amendment of soil with mixture of neem and cow dung substantially suppressed *Meloidogyne* spp. infesting okra and may provide practical control of root-knot nematodes as part of sustainable nematode management system.

Keywords

***Meloidogyne* spp., Okra, Organic Amendments, Plant Parasitic Nematodes, Sustainable Agriculture**

Subject Areas: **Agricultural Science, Plant Science**

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1. Introduction

Okra (*Abelmoschus esculentus*), a very important crop in Africa and other tropical and subtropical areas of the world belongs to the family malvaceae. It is a nutritional significant crop as it contains 9.7% carbohydrate, 2.2% protein, 1% fibre, 0.2% fats and 0.9% ash, it also contains a considerable amount of minerals, protein and vitamins A, B and C [1]. Like most other crops in tropical and sub-tropical region of the world okra is host to many pest and diseases. It is infamous for its high susceptibility to southern root knot nematodes (*Meloidogyne incognita*) where nematodes infestation commonly causes very irregular growth, with reduction and/or delay in the crop's production [2]. In India, root knot nematodes are reported to suppress okra yield by 91% [3]. In Nigeria, [4] reported that most of the damage causes by *Meloidogyne hapla* on okra plants occurs early during the formation of tap root. High densities of nematodes at planting (several hundred/100 cm^3 soils) induced loss of weight of foliage and roots, severe galling of roots, extreme malformation of storage roots and total loss of the crop [5]. Use of synthetic chemical nematicides is the predominant method of nematodes population management. However, nematicides have been reported to have negative effect on the environment, man and bio-diversity. This necessitates the demand for environment friendly effective alternative control measure that is ecological sound and cost effective. Reductions in populations of plant parasitic nematodes in response to application of organic amendments have been reported in many studies. The natural product of plants, animals or microbial origin are vast source of bioactive substances which have been exploited only to a limited extend in the preparation of pesticide [6].

2. Materials and Method

The experiment was carried out at the Faculty of Agriculture Teaching and Research Farm, University of Maiduguri, Nigeria during the rainy season (summer) from July to September 2014. The area is located at latitude 13 S, 15 N and longitude13 E which lies in the semi-arid north east region in Nigeria. It is characterized by scanty and short rainy season of five month from June to October. The soil texture is sandy loam with 65% sand, 18% silt and 17% clay. A parcel of land highly endemic to population of root knot nematode and on which okra was grown for three consecutive seasons was chosen for the experiment. Plot of size 2.0 M × 2.0 M separated by 1.0 M inter plot spacing were demarcated. The experimental design was randomized complete block designed (RCBD) with five treatments each replicated three times. Neem seed was obtained from neem plantation at University of Maiduguri, it was shelled and the kernel obtained was dried under a shade and grinded manually using pestle and mortar. Cow dung manure was obtained from Livestock unit of the Department of Animal Science, University of Maiduguri and processed by drying, pulverizing and removal of all unwanted materials. Digital weighing machine was used to measure the appropriate quantity of the materials for application to each crop stand and then packed in polythene bag. The measured treatments include sole neem at 11.5 g, sole cow dung at 100 g and mixture of neem and cowdung at 111.5 g. These were applied to crop stand as the experiment treatments. Okra seed (Clemson variety) is obtained from registered seed suppliers and planted at rate of one seed per crop stand. Prior to treatments application and crop sowing, 250 cm^3 of soil was collected from each of the fifteen plots for initial nematodes population (Pi) analysis. The initial (before application of treatments)nematode population was determined by taking three core samples with a soil auger to a depth of 20 cm in a zig-zag pattern from each experimental plot, bulked and labeled. The soil samples collected from each plot was analyzed in the laboratory to determine the plant parasitic nematode population. The White-Head and Hemming method of nematode extraction was used.

Analysis of variance (ANOVA) was carried out with the data collected. The difference between treatments means was also calculated using the least significance difference (LSD) test at both 5% level of probability.

3. Results and Discussion

Table 1 showed no significant ($p < 0.05$) differences in nematode population prior to application of the various treatments to experimental plots. Organic soil amendment namely sole neem, sole cow dung and mixture of neem and cow dung were applied to crop stand at the rate of 11.5 g, 100 g and 111.5 g respectively. For the purpose of comparison chemical nematicide (Furadan) was applied at the rate of 1.0 g per crop stand. All treatments except cowdung hindered significantly ($p < 0.05$) the increase in population parameters of *Meloidogyne* spp. infesting okra. Combination of neem and cow dung applied at rate of 111.5 g per crop stand produce the best suppression of 27.6 second stage juvenile (J2) population, followed by neem applied at 11.5 g that produce

Table 1. Effect of sole neem, sole cowdung manure and combination of neem and cow dung on *Meloidogyne* spp. population infecting okra.

Treatment	Quantity (grams)	Initial population (Pi)	Final population (Pf)	Reproduction factors [Pf/Pi]	Gall index
Neem	11.5	155.3a	35.3ab	0.2	2.5a
Manure	100	135.0a	98.6a	0.7c	3.2c
N + M	111.5	157.3a	27.6c	0.1c	0.8ab
Chemical	1.0	115.3a	30.0ab	0.3a	1.33ab
Control	0	129.3a	71.6b	0.6a	1.33ab

Values are mean of three replications. Means followed by same letter within each column are not significantly different ($P < 0.05$) according to Fisher's least significant different (LSD) test.

35.3, cowdung produce 98.6. The non-amended (control) produced the lowest suppression of J2 with a population of 71.6. Reproduction factor (RF) and gall index (GI) followed similar trend to the second stage juvenile (J2) population of suppression upon application of the organic materials. This present observation is in accord with the work conducted by [7] where their result indicates that growing sunn hemp as a cover crop and applying certain organic amendments can improve okra production and suppress root-knot nematodes, which are very damaging to okra plants. In an earlier research, the nematicidal activity of ammonia releasing organic amendments or ammonium hydroxide (NH_4OH) was enhanced by adding nitrapyrin, which maintained the ammonia concentration in the soil for longer period [8]. However, nitrapyrin cannot be used in organic farms were organic soil amendments are used as fertilizers and for controlling nematode and soil-bone fungal diseases. Several medicinal and herbal plant, such as *Menthaspicata*, *Artemisia annua*, neem (*Azadirachta indica*) and karanja (*Pongamia glabra*), have been tested for their nitrification-inhibiting efficacy [9] [10]. In particular, karanja and neem extracts have been found to be relatively effective in inhibiting nitrification [9] [11]. In the present experiment neem is used as the nitrification inhibition agent.

The influence of the various organic amendments on the plant parasitic nematode was reflected in the decreased in population densities of *Meloidogyne* spp. at harvest as detected in similar study by [12]. The nematodes reproduction factor (RF) which is an indication of the relationship between initial (Pi) and final (Pf) nematodes population showed the mixture neem and cowdung produced the best nematodes suppression with an RF of 0.1.

Table 2 showed the growth and yield parameters of okra namely shoot height, root length, dry shoot weight, dry root weight and pod (fruits) weight has affected by the various treatments, Neem applied at 11.5 g, manure 1oo g, combination of neem and cow dung 111.5 g and carbofuran 1 g were significantly ($P < 0.05$) increase compare to control treatment. However manure exhibited significantly ($P < 0.05$). Highest mean shoot height of 42.4 cm, were seen in synergy followed by chemical, 36.3 cm and combination of neem and cow dung manure 34.2 cm compared to control treatment which gave significantly ($P < 0.05$) the lowest mean shoot height. Other growth parameters follow a similar trend. A combination of neem and manure produce the highest okra yield of 2.4 ton per hectare (T/ha), followed by sole neem and manure that produced 1.9 and 1.4 T/ha respectively compared with furadan that produced 2.0 T/ha. The control treatment produce the least yield 1.1 T/ha.

4. Conclusion

The effect produced by sole neem kernel powder, sole cow dung manure and mixture of neem and cow dung on control of *Meloidogyne* spp. on okra was established in this study. Results showed mixture of neem and cow dung produced the lowest population of second stage juvenile (J2) of *Meloidogyne* spp. in soil, with a concomitant highest okra yield of yield of 2.4 tons/hectre (T/ha). Sole application of neem and cow dung suppressed nematodes population but not as good as when the two are combined. Such combined practices show a significant potential for application in organic farming and sustainable agriculture systems in a tropical or subtropical region as alternative to synthetic chemical nematicide that is harmful to the environment, man and biodiversity. In addition, returning organic materials to the soil, especially agricultural wastes and agro-industrial by products, contributes to reducing the amount of waste to be treated, and to support environmental protection. This work has open room for further investigations into enhanced nematicidal effect of cowdung soil amendment by neem

Table 2. Effect of neem kernel powder, cow dung manure and combination of neem kernel powder and cow dung manure on the growth and yield of okra.

Treatment	Quantity	Shoot height	Root length	Dry root weight	Dry shoot weight	Yield
Neem (N)	11.5 g	34.4ab	14.9ab	11.8ab	5.0c	1.9c
Manure	1005 g	42.4a	15.5ab	11.9ab	5.3b	1.4c
N + M	111 kg	35.2b	18.6a	15.7a	9.0a	2.4a
Chemical	1 g	36.3ab	14.5ab	11.4ab	3.0c	2.0b
Control	0 g	37.7ab	11.4c	9.0b	2.0c	1.1c

Values are mean of three replications. Mean followed by same letter within each column are not significantly different ($p < 0.05$). According to Fisher Least Significant Different (LSD) Test.

(*Azadirachta indica*). It is recommended that further researcher should be carried out on different crops and different rates of cowdung and neem as soil amendments.

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