International Journal of Science and Advanced Innovative Research
ISSN: 2536-7315 (Print) 2536-7323 (Online)
Volume 4, Number 1, March 2019
http://www.casirmediapublishing.com

Control of Root-Knot Nematode Pest of Okra using *Ocimum gratissimum* Compost Technology

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ABSTRACT

A research work was carried out at Landmark University teaching and research farm Omu-Aran in 2016 and repeated at the same time in 2017 to evaluate the effects of various levels of *Ocimum gratissimum* compost on the growth and yield of root-knot nematode (*Meloidogyne incognita*) infested okra. A randomised complete block design experiment was conducted, comprising of 5 treatments made up of 3 levels of *Ocimum gratissimum*, one level of Cabofuran (a recommended synthetic chemical for nematode control) and an untreated control which acted as standard check. *O. gratissimum* composts was applied at 10, 15 and 20 t/ha while Cabofuran was applied at the rate of 3kg active ingredient per hectare (3kg/ai/ha) and the untreated control that acted as standard check. The findings from the experiment showed that *O. gratissimum* compost brought about a significant reduction in soil nematode population and levels of damage to root-knot nematode infested okra which resulted in significant increase in the performance of okra compared with the untreated control. The efficacy of *O. gratissimum* compost was comparable with that of Cabofuran in most cases. The efficacy of the compost treatment against root knot nematode was found to increase in line with the quantity applied. The result of the experiment confirmed *O. gratissimum* compost as a potent and effective soil amendment material that can be used for the control of root-knot nematode in infested soils and as a formidable protectant for susceptible crops to root knot nematode.

Keywords: okra production, Ocimum gratissimum compost, root-knot nematode, soil amendment, okra yield

INTRODUCTION

Okra, *Abelmuscus esculentus* is a vegetable crop that is very nutritious with a green tender and immature pod. Okra is a major source of carbohydrate, fat, protein, vitamins and mineral that are usually deficient in human basic food. It is also grown in the subtropical and tropical region of the world and important economical vegetable crop [Ariyo 2010]. Okra is an important soup condiment in Nigeria and it forms part of the Nigeria curry dishes. It is rich in vitamin A, mineral, low in calories and has several medicinal values. Agrawal et al 2010. Okro is mostly eaten in cooked or processed form and was reported to contain protein, oil, calcium, iron, magnesium, and phosphorus. Lah 2014. Okro is susceptible to a wide range of pest and pathogens. Prominent among them is the root-knot nematode (*Meloidigyne incognita*) which is major reason for significant yield reduction. (Adesiyan et al 1979, Izuogu and Oyedunmade 2009)

The best method of managing nematodes attack on susceptible crops is the use of synthetic chemicals in form of nematicides but this method exposes man and his environment to great danger because of the toxic effects of the chemicals and its residue on the environment and those biological components as they are exposed to serious danger which can be immediate or

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a prolonged period of time when the chemicals have achieved the desired effect on the organism under control. Report from the World Health Organization, showed that each year about 3000000 cases of pesticides poisoning and 220000 deaths are reported in developing countries. Katoli et al 2010. About 2.2 million people mainly belonging to developing countries are at increased risk of exposure to pesticides Diouf 1997. The use of pesticide have become a major threat to the environment, hence, these use of pesticide have can pollute available water, even at low application rate Riegel and Noel 2000. Lack of awareness and dissemination information on the types, toxicities, level poisoning, hazard and other safety precautions to be taken during the use of these pesticide to majorities of farmers. Due to these reason, majority of farmers usually use environmental and toxic chemicals to eradicate insect and pest which in turn leads to detrimental occupational exposure. These toxic chemicals used by the farmers affect the health status of human in a long term. Consequently, there is a need for prompt and constant dissemination of information to these farmer on the effects and danger associated with the use of toxic pesticides. Abolusoro and Abolusoro 2012.

Different non-chemical control measures are now being considered as a way of reducing the volume of synthetic pesticides in our environment so as to be able to reduce environmental pollutions and its associated damages. Different organic materials including manures have been used for managing root-knot nematode (Abolusoro 2012; Hick 2014). Also, neem in composted and un-decomposed forms, wild sunflower, sawdust, chicken dung have been used as an organic amendment in nematode control Hick 2014. This observation has therefore provoked the trial of other organic materials including *O grattissimum* for management of root knot nematode in endemic areas and as a suitable replacement for toxic synthetic chemicals that are currently been used for managing this pest. The objective of this research work is to examine the effects of *ocimum gratissimum* compost on the root knot nematode pest (*M.incognita*).

METHODOLOGY

Experimental site and procedures

The experiment was conducted at Landmark University teaching and research farm (TRF) in 2015 and was repeated at the same time in 2016 on well-drained sandy-loamy soil. The experimental design used was a randomized complete block design which comprises of five treatments and each replicated four times. The land was prepared into plots of 4 m x 1 m sites. Root-knot nematode susceptible okra NHAe-47-4 seeds were obtained from National Institutes for Horticultural Research and Training (NIHORT) Ibadan, Nigeria. Okra seeds were sown at 4 seeds per stand which was later thinned into two healthy and cropped three weeks after sowing. Eggs of a pure culture of *M.incognita* were obtained from *Celosia argentea* roots from previous greenhouse experiment according to the methods described by Hussey and Baker 1973.

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The Ocimum gratissimum compost was obtained by mixing 10 kg of freshly harvested Ocimum plant leaves with 2 kg of poultry manure in a polytene bag. 1 kg of wood ash was placed on the materials to neutralize acidity. The materials were thoroughly mixed every month for about four months until there was full decomposition. The decomposed material was air-dried and ground into powder form for use. At three weeks after planting each seedling on the field was inoculated with approximately 5000 *M. incognita* eggs. The experimental treatment was *ocimum gratissimum* at 10 t/ha, 15 t/ha, 20 t/ha, Carbofuran 3kg ai/ha and control. Each treatment except Carbofuran was applied as a soil amendment and incorporated into the soil at their respective doses two weeks before sowing while Carbofuran was applied two weeks after seedling emergence. From week four of the experiment till final harvest, data were collected on the number of leaves, height, number of fruits and fruit weights. Final nematodes population, root damage level (gall index) was taken following Taylor and Sasser 1978), on a 0-5 rating scale. Where 0= no gall,1=1-2%, gall; 2=3-10%, 3=11-30 galls; 4= 31-70% galls; and 5= 71-100% galls. All data generated from this study were subjected to analysis of variance using Duncan multiple range test at level of 5% probability.

RESULTS AND DISCUSSION

Table 1 is the Analysis of Variance on the number of leaves produced by *M. incognita* infested okra due to treatments (Ocimum compost and Carbofuran application). Significant differences were observed effective from week four to eight of the experiment in the two years of investigations. *Ocimum gratissimum* compost at various levels of application (10, 15 and 20 t/ha), as well as Carbofuran, significantly increased the number of leaves produced by the root-knot nematode infested okra compared with the untreated control. More leaves were recorded at a higher concentration of *O. gratissimum* than the lower concentrations in the two years of experimentation.

Table 1: Effects of *Ocimum grattissimum* compost on average number of leaves of *M. Incognita* infested okra

		2016			2017		
S/N	Treatment rate	4 WAP	6WAP	8WAP	4WAP	6WAP	8WAP
1	10t/ha	13.80^{ab}	25.40^{bc}	30.63^{c}	13.76^{b}	25.60^{b}	36.63^{d}
2	15t/ha	13.55^{ab}	22.38^{c}	32.38^{b}	13.60^{bc}	22.42^{c}	31.90^{c}
3	20t/ha	15.00^{a}	28.33^{a}	34.63^{a}	14.90^{a}	28.50^{a}	35.00^{a}
4	Carbofuran	14.43^{a}	25.38^{bc}	33.08^{ab}	14.50^{ab}	25.60^{b}	33.25^{b}
5	Control	12.33^{b}	26.38^{b}	$26.88b^{d}$	12.39^{c}	26.50^{b}	28.390^{b}

Means followed by the same letter(s) in the column are not significantly different at P= 0.05 using Duncan's multiple range test.

Table 2 is the Analysis of Variance on the height of okra infested with root-knot nematode *M. incognita.* Different levels of *ocimum gratissimum* compost brought about variation in the height of root-knot nematode infested okra. There were significant differences in the height of

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okra due to different levels of *O. gratissimum* application. More height that is significantly different from control and , as well as other lower levels of application, were observed especially at the eight weeks of the experiment in treatments which received the highest dose of *O. gratissimum* (20 t/ha) in both years of the experiment.

Table 2: Effects of *Ocimum gratissimum* compost on the height of *M. incognita* infested okra

		2016			2017		
S/N	Treatments rate	4 WAP	6WAP	8WAP	4WAP	6WAP	8WAP
1	10 t/ha	14.10^{a}	25.18^{ab}	25.33^{ab}	14.20^{a}	25.11^{ab}	25.37^{ab}
2	15 t/ha	13.80^{a}	25.30^{a}	25.39^{ab}	13.91^{a}	25.62^{a}	25.79^{a}
	20 t/ha	13.82^{a}	25.70^{a}	26.33^{a}	13.80^{a}	25.81^{a}	26.00^{a}
4	Carbofuran	13.90^{a}	25.15^{ab}	25.53^{ab}	13.61^{a}	25.22^{ab}	25.42^{ab}
5	Control	13.60^{a}	23.92^{b}	24.90^{b}	14.60^{a}	24.90^{b}	25.10^{b}

Means followed by the same letter(s) in the column are not significantly different at P= 0.05 using Duncan's multiple range test.

Table 3 is the Analysis of Variance on the yield of *M. incognita* infested okra due to the application of *O.gratissimum*. Application of different levels of *O .gratissimum* to a root-knot nematode infested okra brought about a significant increase in the yield of *M. incognita* infested okra compared with the control. Higher dosages of application increased the yield (fruit number and fruit weight) more than the lower dosages and were significantly different from the untreated control. The two high dosages (15 and 20 t/ha) were significantly better than Carbofuran in the two years of experimentation as more yields were recorded in those treatments compared with the control.

Table 3: **Effects of *Ocimum gratissimum on* the yield of *M. Incognita* infested okra**

			2016		2017
S/N	Treatment rate	Average No of fruits/plot	Average fruit yielded/ plot(g)	Average No of fruits/plot	Average fruit yielded/ plot(g)
1	10t/ha	22.52^{c}	407^{d}	21.00^{c}	494^{d}
2	15t/ha	24.50^{bc}	617^{b}	22.91^{c}	620^{b}
3	20t/ha	32.63^{a}	670^{a}	31.90^{a}	679.01^{a}
4	Carbofuran	25.90^{b}	574^{c}	26.20^{b}	602.00^{c}
5	Control	14.60^{d}	369.90^{e}	15.63^{d}	403.92^{e}

Means followed by the same letter(s) in the column are not significantly different at P= 0.05 using Duncan's multiple range test

Table 4 is the Analysis of Variance on the soil and root population of *M.incognita* due to *O. gratissimum* application. Application of *Ocimum gratissimum* compost as soil treatment against *M.incognita* brought about a significant reduction in the soil population of root knot nematode and consequently reduced the level of root damage. This activity increases with an increase in the level of *Ocimum* compost applied. The plots that received the highest dose of *O.gratisimum* brought about the highest reduction in soil *M. incognita* population and significantly different from the control and lower doses of *O. gratissimum*. The root damage was more reduced in higher doses of treatment than the lower doses in the two years of the experiment.

Table 4: Effects of *Ocimum gratissimum* compost on the soil population and root gall index of *M. incognita* infested Okra

		2016		2017	
S/N	Treatment rate	Mean root-knot soil population (200ml)	Mean root gall index	Mean root-knot soil population (200ml)	Mean root gall index
1	10t/ha	381^{a}	1.80	391^{a}	1.69
2	15t/ha	349^{b}	1.69	307^{b}	1.50
3	20t/ha	302^{c}	1.42	279^{c}	1.39
4	Carbofuran	290^{c}	1.39	275^{c}	1.33
5	Control	1629^{d}	4.07	1702^{d}	4.00

Means followed by the same letter(s) in the column are not significantly different at p= 0.05 using Duncan's multiple range test at p= 0.05.

The application of *O. gratissimum* compost brought about a significant reduction in the soil population of root-knot nematode(*M. incognita*) on okra in this experiment. This action subsequently brought about tremendous improvement in the performance of the okra plant in the experiment. The use of organic manures including compost has been reported by many researchers, (Omotesho et al 2007 Hick 2015) reported that soil amendment with organic manures including compost increases the activities of microorganism such as bacteria and fungi and some other parasitic micro-organism of nematodes. Furthermore, these will reduce the activities of these parasitic micro-organism of nematodes which will lead to increase in yield, growth and development of the plant (Riegel and Noel, 2000). Results from laboratory and field experiments have proved that compost applications stimulate the biological activities of soils, microflora, increasing the population of antagonistic organisms or pathogens such as *trichoderma viridi, pseudomonas fluoresecens and baccillus thuringinensis*, saprophagus and bacteriophagous nematodes and plant parasitic fungi (Sharma et al 2012;Adekunle 2011)

The activities of these micro-organisms consequent upon Ocimum compost application have serious biocidal effects on soil nematodes reducing their damage level on crop raised on that soil medium and consequently promoting the yield and development of the infected crop growing in soil medium.

CONCLUSION

The result from this experiment showed that *O. gratissimum* compost has a nematicidal property that helps in suppressing soil nematode population. Hence, the negative impact of nematode on the crop grown in the medium infested with nematode will be reduce to a great extent. The effectiveness of *O. gratissimum* on nematode increases with increase in quantity that is applied as can be observed from the experiment as better growth and fruit yield as well as reduced root damage were observed in all the treatments that received higher dosages of *O. gratissimum* compared with lower dosages and the untreated control. In most cases, *O. gratissimum* compost treatments performed better than the Carbofuran treatments (recommended synthetic chemical fornematode control) as observed in the experiment. Therefore, *Ocimum gratisimum* compost at 20 t/ha is recommended for use in the control of root-knot nematode *M. incognita* in all the endemic soils. This technology is hereby recommended to farmers growing nematode susceptible crops including okra in all nematode endemic soil.

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