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EFFECT OF ORGANIC AND ORGANOMINERAL FERTILIZERS ON GROWTH AND YIELD OF OKRA IN NEMATODE INFESTED SOIL OF OGBOMOSO NORTH LOCAL GOVERNMENT, OYO STATE, NIGERIA

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Abstract

Field and screen house trials were conducted during planting season of 2014 and 2015 to investigate the influence of organic and organo mineral fertilizers on okra grown in root knot infested soil. Okra variety Clemson spineless was grown with five levels of organo mineral fertilizer :(1.5,2.0,2.5,3.0,and 3.5 t/ha),five levels of organic fertilizer (1.5,2.0,2.5,3.0,and 3.5 t/ha) and the control. The experiments were laid in a randomized complete block design with four replications. Data analysis using ANOVA at 5% level of probability showed the applications of organic and organo mineral fertilizer to have enhanced plant growth and fruit production significantly: number of leaves, plant height, fruit yield, root gall index and soil nematode population were significantly affected by different level of organic and organo mineral fertilizer rates. The results of the okra fruit yield and yield components showed that application of 2.5 and 2.0 t/ha of organo mineral fertilizer produced the highest number of fruits of (2,274.7g) and (2,349.6) respectively. Applications of treatment reduce nematode population and associated damage. The study therefore recommends organic and organo mineral fertilizer rate of 2.0 t/ha for the production of okra in root knot nematode infested soils.

Key words**:** *fertilizers, nematode, Okra, organic, organo mineral*

INTRODUCTION

Okra (*Abelmoschus esculentus* L) is an important vegetable crop in Nigeria and it is widely cultivated throughout the tropics. It is found in almost all markets in Africa [14]. It is a good source of vitamin A, B, C and also rich in protein, carbohydrates, fats, minerals, iron and iodine [3]. Nutritionally therefore, the production of fruit vegetable like okra will help in alleviating the nutritional need of Nigerians
Nematodes have the greatest impact on crop productivity attacking the roots of seedlings immediately after seed germination [11]. Nematode feeding also creates open wounds that provide entry to a wide variety of plant pathogenic fungi and bacteria. These microbial infections are often more economically damaging than the direct effects of nematode feeding. A balanced soil ecosystem supports a wide variety of biological control organisms that helps keep nematode pest population in check.
Earlier researches conducted on the use of extracts of Neem (*Azadirachta indica*), Mistletoe (*Viscum album*), Lantana (Lantana spp.), Lemon grass (*Cymbogo nitrates*), Castor oil (*Ricinus communis* L), Mustard (*Brassica juncea*) were reported to be effective in the control of root-knot nematode [8]. Also, [9] reported that the addition of compost decrease nematode pest and resulted in increased crop growth and yield. There is substantial evidence that the addition of organic matter in form of compost or manure will decrease nematode pest populations and associated damage to crops [17; 7; 1; 16]. This could be as a result of improved soil structure and fertility, alteration of the level of plant resistance, release of nemato-toxins or increased populations of fungal and bacterial parasites and other nematode-antagonistic agents [2]. Reduced nematode damage from increased organic

matter in soil is likely a combination of these interactions. Higher organic matter content increases soil's water-holding capacity and supports thriving communities of the decomposers and predators that make up the soil's digestive system. Thus, the aim of this research is to assess the effectiveness of organic and organo-mineral fertilizers, in the control of soil borne nematodes pest of okra.

MATERIALS AND METHODS

The study include screen house and field trials conducted between 2014 and 2015 cropping seasons at the teaching and Research Farm and screen house of the Ladoke Akintola University of Technology, Ogbomoso, Nigeria. Ogbomoso lies on longitude 4'10^{0}E, latitude 8'10^{0}N and is located in the guinea savannah zone of Southwestern Nigeria. The temperature ranges from 28-33^{0}C with humidity of about 74% all year except in January when there will be dry wind blow. Rainfall distribution is bimodal and extends eight to nine months of the year. On the average the annual rainfall is about 1,286 mm [10].

Organic and organo-mineral fertilizers used as treatments was collected from Sunshine fertilizer company, Akure, Ondo state while the soil sample and root knot infested plant materials were collected from Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso, Nigeria. This soil had been earlier reported to be infected by root knot nematodes [9].

At planting and immediately after harvest, 250ml soil was collected from the experimental pots and field for nematode bio-assay. The soil was assessed for nematode using microscope, as described by [18] and [15]. Nematodes would be identified using CIH Nematode description guides of the UK. Also, pre and post harvest soil samples was taken per block at the depth of 0 -15 cm for physical and chemical analysis, nematode population assessment and soil nutrient status. The sample taken was bulked to form a composite sample. Root gall indices were scored after [13] scale of 1 - 5. Nutrient analysis of the experimental soil, organo-mineral and organic fertilizers were carried out.

The experimental design was randomized complete block (RCBD) with four replications and the treatments were five levels of organo mineral fertilizers; 1.5 (T_2), 2.0 (T_3), 2.5 (T_4), 3.0 (T_5), and 3.5t/ha (T_6), five levels of organic fertilizer; 1.5 (T_7), 2.0 (T_8), 2.5 (T_9), 3.0 (T_{10}) and 3.5 t/ha (T_{11}) and the control (T_1)

Greenhouse experiment: Each pot was inoculated with 5,000 nematode juveniles. Nematode susceptible okra seeds from Seed project, Kano were planted in each pot at 3-4 seeds per pot, which was later thinned down to 1 healthy plant per pot, and treatments (organo mineral fertilizer and organic fertilizer rates) were applied at two weeks after germination. Each treatment was replicated four times making a total of forty-four (44) pots. These were laid out in a randomized complete block design (RCBD). Control of insect pests was done by spraying with Neem based compost using hand sprayer according to [4].

Field experiment: The field experiments were carried out during the 2014 and 2015 cropping seasons. At planting, soil samples were taken and assessed for nematode population counts by the modified Baermann technique [18]. Nematode susceptible okra seeds from Seed project, Kano were planted at 3 -4 seeds per hole and later thinned down to 1(one) healthy seedling per stand at 1-week after germination. Treatments of organo mineral and organic fertilizers rates were applied in a randomized complete block design (RCBD) with four replications. The total experimental plot was 33 by 15m (495 m^2). Each treatment plot was of 3 by 3m plot size and each block was separated by a space of 1m. The crops were spaced out at a distance of 50cm by 1m. Control of insect pests was done by spraying with Neem based compost using hand sprayer according to [4].

Data were collected on plant height, number of leaves, fruit number and weight, root gall index, initial and final nematode population on the field and in the pot. Analyses of the data collected were carried out using ANOVA at 5% level of probability where the separated

means were subjected to Duncan Multiple Range Test.

RESULTS AND DISCUSSIONS

The analysis of soil, organic and organo mineral fertilizer (Table 1) showed the presence of organic carbon, organic matter, nitrogen, calcium, potassium, sodium, iron, magnesium, zinc, copper, lead and cadmium to be moderate in the soil and high in the organic fertilizer which shows good management during its production and storage. Chromium and nickel were present in organo mineral fertilizer but were absent in organic fertilizer.

Table 1. Result of the analysis of the soil, organo mineral and organic fertilizer

	SOIL	**OM**	**OF**
pH	6.7	5.8	5.5
Organic Carbon(%)	9.5	40.3	36.5
Organic matter(%)	16.38	69.48	62.93
Nitrogen(%)	1.74	4.4	3.7
Calcium($CmolKg^{-1}$)	0.38	1.48	0.48
Potassium($MgKg^{-1}$)	0.65	2.63	0.75
Sodium($CmolKg^{-1}$)	0.57	2.74	0.53
Iron($MgKg^{-1}$)	0.32	1.47	0.18
Magnesium($MgKg^{-1}$)	1.02	1.63	0.38
Zinc($MgKg^{-1}$)	1.18	1.8	0.12
Copper($MgKg^{-1}$)	0.24	0.36	0.13
Lead($MgKg^{-1}$)	0.1	1.23	0.02
Cadmium($MgKg^{-1}$)	0.13	1.3	0.02
Chromium($MgKg^{-1}$)	0.05	0.35	ND
Nickel($MgKg^{-1}$)	0.04	0.23	ND

OM = Organo mineral fertilizer, OF = Organic fertilizer

The application of organic and organo mineral fertilizer had significant effects on the vegetative parameters taken. The height of okra plant in the field and the green house was affected by the treatments at 10WAP and 6WAP respectively, where the addition of treatments at T3 , T4 T4 in field and T3 , T5 in green house produced significant taller plants when compares with other treatments (Table 2).

At 10WAP, application of organo mineral fertilizer at T3 and T5 produced significantly higher number of leaf. In the green house however, organo mineral fertilizer rate of T2 had significantly higher leaves number than other treatments.

The yield parameters of okra was significantly affected by the organic and organo mineral inputs in this study.

The addition of organo mineral at T3, T4 and organic fertilizer at T8 produced the highest number of fruits per plant (3.67) which was not significantly different from the addition of T2 (3.33). In the green house trial however, T2, T3 and T4 gave the highest number of fruits per plant (4.0).The mean weight of fruits was also significant in both experiments with treatments T2, T3 and T4 producing the highest mean fruit weight of 30.0 g, 32.01 g and 30.99 g respectively in the field and 48.69 g, 51.76 g and 40.52g respectively in the green house trial.

The okra fruit yield was most favoured with the application of organic and organo mineral fertilizers in these studies. The treatments T3 and T4 gave the yield of 2,349.6 kg/ha and 2,274 kg/ha in the field trial, respectively while in the green house the same trend was observed with the least yield from the control (Table 4).

Table 5 showed the effects of organic and organo mineral fertilizers inputs on the root gall index and nematode population in these study. The treatments had significant effects on the parameters taken. The root gall index decreased significantly due to the application of T7 in the field and T7, T8 in green house trial when compared with the control (untreated soil).

The population of the nematode was also reduced drastically as a result of the application

of organic and organo mineral fertilizers. In the field trial the addition of T7 and T9 significantly reduce the nematodes population while the treatments T4, T8 and T9 in green house trail when compared with other treatments. This agrees with [1]; [2] who reported the potential of some composted agro industrial wastes as a management option for suppression of plant-parasitic nematodes.

Such suppression was also demonstrated for organic amendments derived from forestry industry residues [6]. The effect of organic amendments on suppression of plant parasitic nematodes may be due to enhancement of the indigenous soil micro fauna and flora [12].

Table 2. Effect of organic and organo mineral fertilizer on the mean height okra

Treatments	Field				Greenhouse			
	4WAP	6WAP	8WAP	10WAP	4WAP	6WAP	8WAP	10WAP
T1	7.00a	7.67a	7.67a	8.00b	5.00a	4.67b	6.00a	7.33a
T2	7.33a	7.67a	8.67a	9.00ab	5.00a	5.67ab	7.33a	10.00a
T3	7.33a	7.67a	9.00a	9.33ab	4.67a	5.33ab	7.33a	9.00a
T4	7.33a	7.67a	9.00a	9.67a	5.00a	5.33ab	7.33a	8.00a
T5	7.33a	7.33a	9.00a	9.33ab	4.67a	5.00ab	7.00a	9.67a
T6	7.33a	8.00a	8.67a	9.33ab	5.66a	6.33a	7.66a	9.67a
T7	7.00a	7.33a	9.00a	9.33ab	5.00a	5.67ab	7.67a	10.00a
T8	7.00a	7.67a	8.33a	9.00ab	4.33a	5.00ab	6.00a	6.33a
T9	7.00a	7.33a	8.33a	9.00ab	5.33a	6.00ab	7.33a	9.33a
T10	7.00a	7.67a	8.33a	8.67ab	5.33a	5.33ab	6.33a	8.33a
T11	7.00a	7.67a	8.33a	8.67ab	4.67a	5.00ab	7.00a	9.33a
	NS	NS	NS		NS		NS	NS

Means followed by the same letter(s) along the same column are not statistically different at 5% probability level according to Duncan Multiple. Range Tests (DMRT).NS: Not significant at 5% probability level.

Table 3. Effect of organic and organo mineral fertilizer on the mean number of leaf of okra

Treatments	Field				Greenhouse			
	4WAP	6WAP	8WAP	10WAP	4WAP	6WAP	8WAP	10WAP
T1	10.33a	18.67a	27.57a	32.67d	20.83a	30.33ab	36.00c	40.33d
T2	10.00a	22.78a	31.57a	49.33ab	23.33a	39.33a	59.33a	67.33a
T3	10.50a	22.00a	29.23a	49.67a	19.50a	30.67ab	46.33abc	65.33a
T4	11.17a	22.33a	33.00a	48.33ab	22.03a	30.67ab	44.33abc	62.67ab
T5	11.33a	23.23a	33.90a	51.00a	20.27a	30.67ab	45.33abc	58.33abc
T6	10.00a	22.00a	31.67a	47.67ab	18.00a	31.67ab	51.00abc	60.67ab
T7	9.50a	20.67a	29.67a	47.67ab	22.50a	33.33ab	51.67ab	61.33ab
T8	10.17a	22.44a	30.44a	45.67abc	20.50a	30.00ab	40.00bc	54.00bc
T9	10.17a	20.33a	30.23a	47.67ab	20.50a	32.33ab	50.67abc	59.67ab
T10	10.50a	21.77a	29.57a	42.00bc	19.83a	30.00ab	41.00bc	48.33cd
T11	10.00a	21.00a	28.57a	39.67c	18.00a	29.00b	42.00bc	48.33cd
	NS	NS	NS		NS			

Means followed by the same letter(s) along the same column are not statistically different at 5% probability level according to Duncan Multiple Range Tests (DMRT). NS: Not significant at 5% probability level.

Table 4. Effect of organic and organo mineral fertilizer on the mean yield of okra

Treatments	FIELD			GREENHOUSE		
	No of fruit/plt	Mean Fruit Weight (g)	Yield (Kg/Ha)	No of fruit/plt	Mean Fruit Weight (g)	Yield (Kg/Ha)
T1	1.67b	16.87c	563.4d	2.00d	13.80g	552.0f
T2	3.33a	31.04a	2,067.3ab	4.00a	48.69a	3,895.2ab
T3	3.67a	32.01a	2,349.6a	4.00a	51.76a	4,140.8a
T4	3.67a	30.99a	2,274.7a	4.00a	40.52b	3,241.6b
T5	2.33ab	22.97bc	1,070.4cd	3.33abc	29.57cde	1,969.4d
T6	2.33ab	22.82bc	1,063.4cd	2.67bcd	24.99def	1,334.5e
T7	3.00ab	24.75ab	1,485.0c	3.67ab	29.96cde	2,199.1cd
T8	3.67a	29.24ab	2,146.3ab	3.67ab	32.62bcd	2,394.3c
T9	3.33a	28.95ab	1,928.1b	3.67ab	33.74bc	2,476.6c
T10	3.00ab	26.88ab	1,612.8bc	2.67bcd	22.34ef	1,193.0ef
T11	3.00ab	22.34bc	1,340.4c	2.33dc	20.67fg	963.3ef

Means followed by the same letter(s) along the same column are not statistically different at 5% probability level according to Duncan Multiple Range Tests (DMRT). NS: Not significant at 5% probability level.

Table 5. Effect of organic and organo mineral fertilizer on the root gall index and nematode population

Treatments	FIELD			GREENHOUSE		
	Mean Root Gall Index	Initial nematod population (200 ml soil)	Final nematode population (200 ml soil)	Mean Root Gall Index	Initial nematod population (200 ml soil)	Final nematode population (200 ml soil)
T1	4.00c	1,001	2,175d	3.33c	980	1,500c
T2	2.67bc	987	1,750bc	2.33bc	975	1,320bc
T3	2.00b	996	1,770bc	2.00b	950	1,250b
T4	3.67c	1,005	1,925c	1.67a	910	1,170a
T5	2.67bc	980	1,755bc	2.33bc	965	1,300bc
T6	2.67bc	991	1,700b	2.33bc	950	1,310bc
T7	1.67a	970	1,552a	3.00c	980	1,250b
T8	2.67bc	1,001	1,760bc	1.67a	900	1,180a
T9	2.33b	990	1,600a	1.67a	895	1,150a
T10	2.33b	1,004	1,650ab	2.00b	915	1,200b
T11	2.67bc	997	1,720bc	2.00b	940	1,155a

Means followed by the same letter(s) along the same column are not statistically different at 5% probability level according to Duncan Multiple Range Tests (DMRT). NS: Not significant at 5% probability level.

CONCLUSIONS

The addition of the different fertilizer types gave a significant increase in the height and number of leaves of okra plants as compared with the untreated control. This work agrees [5] who reported that application of organic manure gave vigorous development in plant which is indicated in plant length, number of leaves, stem as well as shoot dry weight. Similar result was reported by [10] that the growth parameters such as plant height and number of leaves showed increasing response in pepper when treated with two levels of nitrogen, phosphorus and potassium 15-15-15 fertilizer (NPK) (0 and 250 kg. ha^{-1}), five levels of organo mineral fertilizers (0, 2, 3, 4 and 5 t. ha^{-1}) and their various combinations.

There were significant reduction in the final nematode population and the root gall index in many of the treated okra plants as compared with the control. Based on the result of this study, it is obvious that root-knot nematode disease on okra can be effectively controlled and good yields obtained with the application of organic or organo mineral fertilizers.

REFERENCES

[1]Akhtar, M., Alam, M. M., 1993, Utilization of waste materials in nematode control: a review. Bioresource Technology 45: 1–7.
[2]Akhtar, M., Malik, A., 2000, Roles of organic soil amendments and soil organisms in the biological control of plant-parasitic nematodes: a review. Bioresource Technology. 74: 35–47.
[3]Baloch, A. F., Qayyum, S. M., Baloch M. A., 1990, Growth and yield performance of okra (*Abelmoschus esculentus L*) cultivars. Gomal University Journal Research 10: 191
[4]Egunjobi, O. A., Afolami, S. O., 1976, Effect of neem leaf extracts on populations of bradivirus and on the growth and yield of maize. Nematologica 22: 125-132.
[5]Ghoname, A., Shafeek, M. R., 2005, Growth and Productivity of Sweet pepper (*Capsicum annum L.*) grown in plastic House as affected by Organic, Mineral and Bio-N- fertilizers. Journal of Agronomy 4(4):369-372.
[6]Miller, P. M., Sands, D. C., Rich, S., 1973, Effects of industrial residues, wood-.bre wastes, and chitin on plant parasitic nematodes and some soil borne diseases. Plant Disease Research 57, 438–442.
[7]Oka, Y., Yermiyahu, U., 2002, Suppressive effects of composts against the root-knot nematode *Meloidogyne javanaica* on tomato. Nematology, Vol. 4(8): 891-898.
[8]Olabiyi, T. I., Gwazah, R. Y., 2001, Efficacy of Enema leaf powder in the control of the root-knot Nematode (*Meloidogyne incognita*) on soybean. African Scientist. Vol 2(3): 77-80.
[9]Olabiyi, T. I., Akanbi, W. B., Adepoju, I. O. 2007, Control of nematode pests with different organic manure on cowpea. American Journal of Agriculture and Environmental Science 2(5): 523-527.
[10]Olaniyi, J. O., Ojetayo, A. E., 2010, The effect of organo mineral and inorganic fertilizers on the growth, fruit yield and quality of pepper (*Capsicum frutescence*). Journal of Animal & Plant Sciences. Vol. 8 (3): 1070-1076.
[11]Ploeg, A., 2001, When nematodes attack is important. Califonia Grower. October. Pp. 12-13.
[12]Rodriguez-Kabana, R., Morgan-Jones G., Chet, I., 1987, Biological control of nematodes: soil amendments and microbial antagonists. Plant and Soil, 10: 237–247.
[13]Sasser, J.N., 1990, Plant parasitic Nematodes. The Farmers Hidden Enemy. North Carolina State University Press, Raleigh, NC.Pp 47-48
[14]Schippers, R.R., 2000, African indigenous vegetable an overview of the cultivated species. National Resources Institute (NRI), University of Greenwich, London, united Kingdom Pp 214
[15]Southfey, J.F., 1986, Laboratory methods for Work with Plant and Soil Nematodes. Min Agr. Fish. Food, HMSO, London, pp 202.
[16]Stirling, 1991, Biological control of Plant Parasitic Nematodes. CAB International Wallingford, UK. 275p
[17]Walker, G.E., 2004, Effects of *meloidogyne javanaica* and organic amendments, inorganic fertilizers and nematicides on carrot growth and nematode abundance. Nematologia Mediterranean. Vol 32, (2): 181-188
[18]Whitehead, A.G., Hemming, J.R., 1965, A comparison of some quantitative methods of extracting small vermiform nematodes from soil. Annals of Applied Biology 55: 25-38.