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COMPARATIVE EFFECTIVENESS OF VARIOUS FERTILIZERS IN CONTROLLING ROOT KNOT NEMATODE INFECTION IN OKRA (*Abelmoschus esculentus*) IN MAKURDI, BENUE STATE

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ABSTRACT

Root knot nematode infection poses a serious threat to Okra cultivation in Nigeria. A field research was conducted at the Teaching and Research Farm of the Federal University of Agriculture, Makurdi, Benue State to offer valuable insights into combating root-knot nematode infections on okra using different fertilizer types. The experiment was designed using a factorial design with three (3) varieties of okra and two fertilizer treatments at different intervals. The seeds were planted two (2) seeds per hole on a spacing of 50cm after which normal agronomic practices were carried out on nematode infested soil. The results indicate that both SuperGro liquid fertilizer and Geese dung have potential in suppressing root-knot nematode infections on okra. Specifically, the application of Geese dung at either 2 or 4 weeks interval demonstrated a notable reduction in root gall index (RGI), suggesting its effectiveness in mitigating nematode damage. Furthermore, the application of Geese dung led to improved yield, manifested through increased fruit size and quantity. However, it's crucial to note that the application of SuperGro fertilizer at a 4-week interval resulted in a significantly higher Root Gall Index (RGI) compared to other treatments. The research highlights the potential of organic fertilizers like Geese dung as a sustainable and effective means of nematode control in okra cultivation. Nonetheless, future studies are warranted to identify the active ingredients in Geese dung responsible for nematode suppression, which could provide valuable insights for refining treatment protocols and enhancing agricultural practices.

Keywords**:** Fertilizer, Okra, Nematode, Rootknot, SuperGro

INTRODUCTION

Okra, a popular crop in tropical and subtropical regions, holds significant agricultural and nutritional importance, particularly in Nigeria, where it ranks as a leading producer globally. However, its production faces challenges, notably from pests and diseases such as root-knot nematodes *(Meloidogyne* spp.), which can severely impact yields and crop quality (Akhtar et al., 2021; Akyol et al., 2020). Root-knot nematodes are prevalent in okra cultivation, causing symptoms like wilting, chlorosis, stunted growth, and root galling, ultimately

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leading to reduced productivity and crop failure. The management of these nematodes traditionally relied on synthetic nematicides, but their high cost and environmental concerns have prompted the exploration of alternative strategies (Goud & Chandrappa, 2020). Agricultural wastes, including organic materials like dry crop residues, livestock manures, and other organic matter, have emerged as promising alternatives for nematode management. Incorporating these organic materials into the soil can enhance soil fertility, improve physical and chemical properties, and indirectly or directly influence the population dynamics of nematode predators and parasites (Kumar et al., 2021).

Additionally, organic materials may release compounds that exhibit nematicidal properties, contributing to nematode suppression. This approach aligns with sustainable agricultural practices and offers a cost-effective and environmentally friendly solution to nematode management, particularly for smallholder farmers in developing nations. The proposed study aims to investigate the efficacy of different rates of organic and inorganic fertilizers in controlling root-knot nematodes in okra production. By assessing the impact of various fertilization strategies on nematode populations, crop growth, and yield, the research seeks to identify sustainable practices that can mitigate nematode damage while enhancing overall crop productivity (Pandey et al., 2021). Overall, the objective of this study is to address the pressing need for effective nematode management strategies in okra cultivation, emphasizing the potential of organic fertilizers and agricultural wastes in sustainable pest control and soil health improvement.

MATERIALS AND METHODS

Planting and Experimental Layout

Three (3) okra varieties, Lady finger (V1), Makurdi Local varieties (V2) and Ichua Local (V3), were obtained from Seed Store of the University of Agriculture, Makurdi, were used for the experiment. The seeds were planted two (2) seeds per hole on a spacing of 50cm after which normal agronomic practices such as weeding, fertilization, earthen up and pesticide application was conducted. The plot was 50m x 25m in dimension. The set up was 3x3 (variety x replicate) factorial experiment laid out in randomized complete block design (RCBD) with three (3) replicates and five (5) treatments. Treatments used were Geese dung and SuperGro Liquid inorganic fertilizers. Each treatment was designated into five (5) rows of ridges and the treatments were applied as: {T_1 SuperGro at 2weeks interval, T_2: SuperGro at 4 weeks interval, T_3: Geese dungs at 2 weeks interval, T_4: Geese dungs at 4 weeks interval, and T5: control (nothing was applied).

Sampling and Nematode Extraction

Three soil samples per replicate were collected from the rhizosphere of okra plant with a 5cm diameter soil auger, to the depth of 20cm. Each soil sample 100cm3 were collected in a polythene bag and appropriately labeled. Samples were kept in ice chest to prevent excessive heating in the samples using the modified Baermann tray techniques (Greco & Crozzoli, 2024). After 48hours

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of extraction, nematodes were fixed TAF (37% Formaldehyde 7.6ml, Triethylamine 2ml and distilled water 90.4ml). Nematode specimen were identified based on morphological characteristics and classed into tropical groups (Bacterivores, fungivores, omnivores, predatory and herbivores) according to Ramteke *et al*., (2024).

Data Collection

The following data were collected, Okra Germination percentage, Plant Height (cm), Number of leaves, Number of Fruits at Harvest, Weight of Fruits at Harvest, Root Length, Root Weight and Root Gall Index, and soil nematode number?

Statistical Analysis

Data collected was subjected to Analysis of Variance (ANOVA) using GENSTAT statistical software. Mean separation was done using Fishers Least Significant Difference (F-LSD).

RESULTS AND DISCUSSION

Soil Physical and Chemical Properties

The soil at the experimental site exhibits characteristics typical of sandy loam texture and good drainage (Table 1). However, several nutrient levels are suboptimal for crop growth. Available phosphorus and total nitrogen are both low, while exchangeable potassium is classified as moderate. Soil pH is slightly acidic (5.33), and the organic carbon content is also low (4.74%). These findings suggest that soil fertility may be a limiting factor for crop production at the site. Addressing nutrient deficiencies through appropriate fertilization strategies, such as the incorporation of organic materials, may help improve soil health and enhance crop yields. Additionally, measures to adjust soil pH and increase organic matter content could further optimize growing conditions for crops like okra.

Table 1. Nutrient analysis of the experimental field

Soil Parameter	Value
Clay (%)	3
Silt (%)	15
Sand (%)	82
PH	5.2
Organic C(g/kg)	4.74
Total N(g/kg)	0.84
Ca (cmol/kg)	1.48
Mg (cmol/kg)	1.12
Na (cmol/kg)	0.16
CEC (cmol/kg)	3.14
Available P(mg/kg)	7.48

Effect of Variety and Fertilizer Treatment on Growth of Okra In Makurdi, Benue State

The result on variety shows that, V3 (Ichua Local) has the highest significant ($P \leq 0.05$) 50% days to Flowering at 85.07% followed by V2 (Makurdi Local) (71.00%) and V1 (Lady Finger) (54.13%) as shown in Table 2. Also, the results on percentage emergency count (EC%) indicated that V3 (Ichua Local) (98.00%) was highest followed by V1 (92%) and V1 (Makurdi Local) (86.70%). The results on Vigour count (VC) shows that V1 (Lady Finger) (76%) has the highest vigour count followed by V2 (Makurdi Local) (72.70%) and V3 (Ichua Local) (68.70%). The results on the effect of variety on number of leaves shows that V2 (Makurdi Local) has the highest number of leaves at 4, 6 and 8 WAP represented as 7.27 cm, 14.53cm,

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26.40cm respectively while at V1 (Lady Finger) recorded significantly (P≤0.05) lowest number of leaves at 6 and 8 WAP as 10.27cm and 15.00cm respectively. The results on plant height shows that V2 (Makurdi Local) has the highest significant (P≤0.05) plant height at 4,6 and 8WAP (13.67cm, 34.07cm and 66.50cm) while V3 (Ichua Local) recorded the shortest significant (P≤0.05) plant height at 4WAP (9.73). However, there's no s significant (P≤0.05) difference in the height recorded between V3 (Ichua Local) and V1 (Ladyfinger) at 6 and 8 WAP.

The result on Fertilizer treatment shows that there is no significant (P≤0.05) difference in the various treatments on 50% days to flowering. The result on percentage emergency count (%EC) also shows no significant (P≤0.05) difference. Similar trend was observed and reorded for Vigour count, number of leaves and plant height

Table 2. Effect of variety and fertilizer treatments on the growth parameters of Okra in Makurdi

VAR	D50%F	EC (%)	VC (%)	Number of leaves			Plant Height (cm)		
				4WAP	6WAP	8WAP	4WAP	6WAP	8WAP
LadyFinger	54.13	92.00	76.00	6.40	10.27	15.00	11.27	22.93	44.90
Makurdi Local	71.00	86.70	72.70	7.27	14.53	26.40	13.67	34.07	66.50
Ichua Local	85.07	98.00	68.70	6.20	14.27	19.50	9.73	26.73	45.00
LSD(P≤0.05)	1.45	7.97	5.55	NS	2.86	3.04	2.54	4.23	6.42
FERT TRT									
T1	69.00	92.20	75.60	6.56	12.22	20.40	12.44	26.56	58.00
T2	68.89	91.10	73.30	6.89	13.89	20.60	12.00	27.33	54.40
T3	70.78	95.60	66.70	6.44	11.56	18.30	13.00	28.33	48.70
T4	70.89	86.70	75.60	6.67	14.11	22.60	13.78	30.67	50.20
T5	70.78	95.60	71.10	6.56	13.33	19.60	11.56	26.67	49.30
LSD(P≤0.05)	1.12	NS	NS	NS	NS	NS	1.96	NS	NS

NS – Not significant; D50%F – Days to 50% flowering; RGI – Root Gall Index; EC(%) – Percentage Emergence Count; VC(%) – Vigour Count, T_1:SuperGro at 2weeks interval, T_2: SuperGro at 4 weeks interval, T_3: Geese dungs at 2 weeks interval, T_4: Geese dungs at 4 weeks interval, and T5: control (nothing was applied), Wgt: Weight

Effect of Variety and Fertilizer Treatment on Yield and Control of nematodes of Okra in Makurdi, Benue state

The results on fruit weight (Table 3) shows that Ladyfinger (V1) gave the significantly (P≤0.05) highest fruit weight (75.50g) but Makurdi Local (V2) gave the significantly (P≤0.05) lowest fruit weight (50.5g). Similarly, the result on number of fruits per stand shows that Ladyfinger (V1) gave the highest significant (P≤0.05) number of fruit (5.13) and Ichua Local (V3) gave the significantly (P≤0.05) lowest number of fruit per stand (2.73). The application of Geese dungs at 2 and 4 weeks interval

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gave significant (P≤0.05) higher fruit weight (73.60) than other treatments. The application of SuperGro at 2 and 4 weeks interval gave a significant (P≤0.05) lowest fruit weight (49.30 and 46.30). There is no significant (P≤0.05) difference in the fruit weight recorded for the different fertilizer treatments. This is in line with the study carried out by Adepoju *et al* (2017) who reported that the application of organo-mineral fertilizers reduced nematodes population and increase okra fruit weight and thus yield of okra.

Table 3. Effect of variety and fertilizer treatments on the yield, root parameters and root gall index of Okra in Makurdi

VAR	Fruit Wgt (g)	No of fruits	RGI	Root Length (cm)	Root Wgt (g)
LadyFinger	75.50	4.13	3.00	26.60	200.00
Makurdi Local	50.50	3.07	3.07	33.20	293.00
Ichua Local	71.00	2.73	3.00	37.10	373.00
LSD(P≤0.05)	19.74	0.93	NS	7.46	80.70
FERT TRT					
T1	59.30	3.44	1.78	27.30	178.00
T2	113.60	4.11	2.00	35.80	256.00
T3	49.30	2.89	4.00	29.60	233.00
T4	46.30	2.67	2.89	32.10	356.00
T5	59.80	2.44	4.44	26.80	422.00
LSD(P≤0.05)	53.89	NS	0.97	NS	104.10

NS – Not significant; D50%F – Days to 50% flowering; RGI – Root Gall Index; EC(%) – Percentage Emergence Count; VC(%) – Vigour Count, T_1:SuperGro at 2weeks interval, T_2: SuperGro at 4 weeks interval, T_3: Geese dungs at 2 weeks interval, T_4: Geese dungs at 4 weeks interval, and T5: Control (nothing was applied), Wgt: Weight

The result on Root Gall Index showed that the different cultivars showed no significant (P≤0.05) difference. Ichua Local (V3) however recorded the highest significant (P≤0.05) root lenght (37.10cm) while Ladyfinger (V1) has significantly (P≤0.05) lowest root length. The result on root weight showed that Ichua Local (V3) has the significantly (P≤0.05) highest root weight (373.00g) with Ladyfinger (V1) also recording the significantly (P≤0.05) lowest (200g) root weight. Result from the different fertilizer treatments showed that Control gave the significantly (P≤0.05) highest root weight (422g) while Geese dung at 2 weeks interval gave the lowest fruit weight (178g). Similar trend was observed in the records obtained for the Root Gall Index (RGI) where the control recorded the significantly (P≤0.05) highest root gall index (4.44) and Geese dung at 2 weeks interval recorded the significantly (P≤0.05) lowest root gall index (1.78).

The data from the experiment indicate that both organic (Geese dung) and inorganic (SuperGro Liquid Fertilizer) fertilizers have a suppressive effect on root-knot nematodes in okra production (Ogunlade *et al*., 2020). Interestingly, despite increasing nematode activity in the soil, both fertilizers provided significant protection

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to the okra roots from infestation (Akhtar *et al*., 2021; Goud and Chandrappa, 2020).

This finding aligns with previous research by Etim *et al*. (2023), who observed a reduction in root galls with the application of poultry manure, indicating a decrease in the impact of root-knot nematodes. Similarly, Tanimola and Akarekor (2014) reported a 65% reduction in root gall index with the use of poultry manure, highlighting its efficacy in controlling root-knot nematodes.

CONCLUSION

Organic fertilizers, such as Geesedung, demonstrated superior effectiveness in reducing the impact of root-knot nematodes, as evidenced by the lower Root Gall Index compared to other treatments (Singh and Tiwari, 2021). This underscores the potential of organic fertilizers as a sustainable and effective means of nematode control in okra production.

Encouraging the incorporation of Geese dung into the soil among okra farmers in nematode-infested areas could help mitigate nematode damage and improve crop yields (Rana *et al*., 2020, Olusesan *et al.*, 2022). However, further research is warranted to identify the active ingredients in Geese dung responsible for nematode suppression (Prasad *et al*., 2021). Understanding these mechanisms could facilitate the development of targeted and optimized nematode management strategies in okra cultivation.

Overall, these findings underscore the importance of considering organic fertilizers as part of integrated pest management approaches in agriculture, particularly in addressing the challenges posed by root-knot nematodes in okra production.

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