EVALUATION OF DIFFERENT FERTILIZER TYPES IN THE SUPPRESSION OF ROOT KNOT NEMATODE INFECTION ON SWEET POTATO (*Ipomoea batatas*) IN MAKURDI, BENUE STATE

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ABSTRACT:

A field experiment was conducted at the Agronomy Teaching and Research Farm, South-Core of the Federal University of Agriculture Makurdi in the 2020/2021 planting season to evaluate the effects of different fertilizer types in the control of root knot nematode of sweet potato. The experiment was laid out in a randomized complete block design (RCBD). The treatments were Liquid fertilizer (Super gro) and poultry dropping and control which were replicated three times. Before the treatments were applied, soil samples were collected for nematode extraction and the nematodes were extracted in the laboratory using the modified Bearmann tray technique. Super gro and geese droppings were applied at 2 weeks interval and 4 weeks interval. The result shows a significant ($p<0.05$) reduction of root gall index, significant increase in root length, weight of roots and number of roots on the plots treated with fertilizer. This research work recommends the application of poultry droppings for the management of root knot nematode in sweet potato (*Ipomoea batatas*).

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KEYWORDS: Fertilizer, Infection, Rootknot Nematode, Suppression, Sweet Potato

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INTRODUCTION:

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Sweet potatoes offer significant potential for increasing food production and income thereby reducing poverty and improving food security level in Nigeria. Sweet potatoes are consumed without much processing in most parts of the tropics (Ahmad *et al.*, 2014). It commands diverse industrial uses, some of which are potentially highly profitable, such as edible and fermentable syrups, industrial alcohol, dye, acetone, lactic acid, vinegar, yeast, baby foods, flakes and snacks (Adewumi *et al.*, 2008). Sweet potatoes are adaptable to adverse environmental conditions; they can help increase food security in times of drought and famine, particularly in post-conflict areas for displaced persons. (Andrade *et al.*, 2009). Sweet potatoes produce carbohydrates much faster and require less labour than other crops. It can be used to restore access to food for resetting populations and alleviate future agro-climatic or political shocks.

Despite the economic importance of the crop sweet potato production has faced several pest problems, one of which stems from Root knot nematode (*Meloidogyne spp*). This has caused economic loss to its production. Root- knot disease caused by root –knot nematodes, *Meloidogyne spp.* is a well-known disease of many tropical and subtropical crops (Bridge and Starr, 2007). It is distributed worldwide in areas with warm or hot climate and short or mid-winter and in greenhouse. They attack more than 2000 species of plants including almost all cultivated crops and on an average reduce the crop production by 5% in the world (Agrios, 2005a).

Meloidogyne spp. is the most important nematode pest of sweet potato which occurs in most sweet potato growing regions where it causes damage. *Meloidogyne spp.* has been implicated in yield reduction of sweet potato (Adepoju and Oluwatayo, 2016). Although the use of nematicides has been found to be effective for nematode control, but due to high toxic residual effect of chemicals on environment, particularly on non-target organisms. There is need to develop alternative nematode control measures, which poses minimal residual effects on the crop and consequently improved crop growth and yield.

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MATERIALS AND METHODS:

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Experimental site:

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This experiment was conducted under semi-field condition at The Agronomy Teaching and Research Farm, South Core, Federal University of Agriculture, Makurdi. It is located on Latitude 07^0 45'N to 07^0 50'N, Longitude 08^0 45'E to 08^0 50'E, 98m above sea level in 2020 cropping season. The location fall within the southern guinea savanna agro-ecological zone of Nigeria.

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Planting material:

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The planting material used was one variety of sweet potato vine. Other material used were organic manure (geese droppings), inorganic fertilizer (liquid super-agro), insecticide (Cypermethrin), hoe, cutlass and pegs.

Source of Material:

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The variety of sweet potato cuttings was obtained commercially from Local market situated at Daudu, Guma L.G.A of Benue State. Organic manure (geese droppings) was obtained from Federal housing, North bank, Makurdi. The inorganic fertilizer (super-agro) and insecticide (cypermethrin) were obtained commercially from Wurukum market, Makurdi, Benue State.

Experimental Layout

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The total land area for experiment was 25m x 25m ($625m^2$) in dimension. The set up consist of five (5) treatments which were laid out in Randomized Block Design (RCBD) with three (3) replications and five treatments.

Agronomic Practices:

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Land preparation was done manually right from bush clearing to heap preparation using hoe and cutlass. Cuttings were planted manually by burying three (3) nodes below the ground surface. These were planted on the heaps which were 1m apart. Weeding was done in the interval of four (4) weeks and two (2) times during the experiment beginning from 5WAP.

Treatments:

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The applied treatments are organic manure (poultry droppings) and inorganic fertilizers (super-agro). Each treatment were designated into five (5) rows of heaps and application was done in the following order:

Treatment one (T1): Liquid fertilizer (super-agro) at two (2) weeks interval.

Treatment two (T2): Liquid fertilizer (super-agro) at four (4) weeks after planting

Treatment three (T3): 8kg of organic manure (poultry dropping) at two (2) weeks interval.
Treatment four (T4): 16kg of organic manure (poultry dropping) at two weeks interval.
Treatment five (T5): this is none application of treatment (control)

Insecticide application:
Insecticide was applied at two (2) weeks interval. This was done with the use of knapsack sprayer.

Sampling and nematode extraction:
Three soil samples per replicate were collected randomly from the rhizosphere of potato plant, with a 50cm diameter soil auger, to a depth of 20cm. each soil sample (100cm3) was collected in a polythene bag appropriately labelled. Samples were kept in iced chests to prevent heating.

In the laboratory, nematodes were extracted from the soil samples using the modified Bearmann tray technique (Olabiyi *et al.*, 2016). After 48 hours of extraction, nematode were fixed in TAF (37% formaldehyde 7.6ml, Triethylamide 2ml and distilled water 90.4ml). Nematode specimens were then identified on morphological characteristics and classed into tropic groups (Bacterivores, fungivores, omnivores, Predatory and Herbivores) according to (Mekete *et al.*, 2012).

Data collection:
Data collection during the spam of the experiment include the following;

Sprouting count: sprouting count was taken to over 50% which resulted to the acceptable plant establishment

Plant height: the vines of the plants were measured and recorded

Number of leaf: the number of leaves per plants were counted and recorded

Percentage vigor court: percentage vigor of plants were counted and recorded

Weight (kg) of tuber: weights of sweet potato tuber was measured with the aid of a weighing balance which reads in kilogram (kg)

Tuber length after harvest: tuber lengths were measured and recorded.
Gall index: the galls index was obtained by physically observing and counting of galls on the plant roots thereby rating the galls.

RESULTS:

Soil Physical and Chemical Properties: The result of the physical and chemical properties of the soil (0.30 cm) of the experimental site is presented in Table 1. The texture of the experimental site presented was sandy loam and well drained. Available phosphorus of 11.16mg/kg plus a uniform soil total nitrogen of 0.84% were low (Bray and Kurtz, 1945). Exchangeable potassium was 0.16mg/kg which was classified as moderate (Anderson and Ingram, 1993). Soil PH was strongly acidic (5.23). The value of organic carbon percentage was low (4.74%).

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Comment [U24]: RESULTS AND DISCUSSION

Table 1: Nutrient Analysis for Experimental Field

Soil parameter	Makurdi
% clay	3
% silt	15
% sand	82
PH	5.2
Organic C (g/kg)	4.74
Total N (g/kg)	0.84
Ca (c mol/kg)	1.48
Mg (c mol/kg)	1.12
K (c mol/kg)	0.16
Na (c mol/kg)	0.50
CEC (c mol/kg)	3.14
Available P (mg/kg)	7.48

Table 2: Effect of Fertilizer Treatment on the Growth Parameter of Sweet Potato in Makurdi

TREATMENTS	% Sprout	% Vigor	Vine length (cm)				Number of branches			
	4 WAP	6 WAP	4 WAP	8 WAP	10 WAP	12 WAP	4 WAP	8 WAP	10 WAP	12 WAP
T1: super gro at 2wks	92.58	92.58	48.00	91.44	113.00	140.33	3.44	5.00	5.44	7.22
T2: super gro at 4 wks	94.43	94.43	44.22	80.44	109.55	133.44	3.33	5.44	5.78	8.00
T3: poultry dropping at 8kg	85.10	85.10	47.66	96.44	75.11	140.44	2.78	5.11	5.44	6.77
T4: poultry dropping at 16kg	88.88	88.88	47.33	94.22	112.00	132.66	2.77	5.78	5.66	8.66
T5: control	94.36	94.36	48.88	93.88	115.69	142.89	2.66	4.78	5.22	9.67
MEAN										
F-LSD (P≤ 0.05)	**NS**	**NS**	**NS**	—	**NS**	**NS**	**NS**	**NS**	**NS**	—
F. Pr	0.05	0.01	0.09	0.04	0.15	0.10	0.20	0.17	0.09	0.05

T1= Super gr oar 2wks
T2 = super gro at 4 wks
T3 = poultry dropping at 8kg

T4 = poultry dropping at 16kg

T5 = control

Percentage Sprout Count: The effect of fertilizer treatment on the control of root Knot nematode on percentage sprout count of sweet potato at 4WAP show no significant ($P \leq 0.05$) difference. Although, the highest sprout count of potato was recorded in T2 which was not significantly different from those recorded in T5. T3 recorded the least sprout count. (Table 2)

Percentage Vigour Count: Percentage vigour count of sweet potato as influence by the effect of fertilizer treatment on the control of root knot nematode of sweet potato in Makurdi showed no significant ($P \leq 0.05$) difference. From the results in Table 2, T2 produces the highest plant vigor while T3 produced the least. Although no statistical difference was observed among the treatments (Table 2)

Vine Length (cm): As observed from the results (Table 2), the effect of fertilizer treatments on the control of root knot nematode on vine length showed no significant ($P \leq 0.05$) difference at 4WAP, 10WAP and 12WAP respectively. Although, fertilizer treatment on the control of root knot nematode in sweet potato plant was significant on sweet potato vine length at 8WAP.

Number of Branches: The effect of fertilizer treatment on the number of leaves of sweet potato plant in Makurdi was significantly different at 5WAP probability level at 12WAP. Although no statistical significant difference was observed at 4WAP, 6WAP, 8WAP and 10WAP respectively. It was observed during the field study that the vine number increases steadily from 4WAP to 12WAP before harvesting was done.

4.6.1 **Table 3: Effect of Fertilizer Treatment on the Yield Parameter of Sweet Potato**

TREATMENT	Root length (cm)	Root gall index	Weight of roots (kg)	Number of harvested roots
T1: Super gro at 2 wks	35.99	3.33	4.36	11.33
T2: Super gro at 4 wks	39.33	2.32	3.23	12.00
T3: Poultry dropping at 8kg	44.36	1.11	3.86	12.66
T4: Poultry dropping at 16kg	51.55	1.00	4.30	13.33
T5: Control	28.77	5.77	4.16	10.00
MEAN				
F-LSD (P≤ 0.05)	—	—	NS	NS
F. Pr	0.05	0.04	0.12	0.12

T1= super gro at 2wks
T2 = super gro at 4 wks

T3 = poultry dropping at 8kg

T4 = poultry dropping at 16kg

T5 = control

Root Length (cm): Root length of potato plant as influence by different fertilizer sources is statistically significant ($P \leq 0.05$). T4 produced the highest root length followed by T2, T1 and T3 in that order. The least root length was produced by T5, (Table 3)

Root Gall Index: The effect of fertilizer treatment on root gall index for the control of root knot nematode in sweet potato was significant. Table 3. Shows that T5 (control) gave significantly the highest root gall but was not statistically different from those produced by T3 (Poultry dropping at 8g) (Table 3).

Weight of roots (kg): The effect of fertilizer treatment on the weight of potato fruit shows no significant ($P \leq 0.05$) different among the treatments. Although T1 produced the heaviest weight but was not statistically significant from those produced by T4 and T5. While T2 recorded the least weight of the harvest fruits. (Table 3)

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Number of roots: The number of fruits as influenced by different sources of fertilizer on the control of root knot nematode was significantly ($P \leq 0.05$) different. T5 (control) gave significantly the highest number of fruits while the lowest number was obtained T2 but this was not statistically different from those produced by T3, T1 and T4 respectively. (Table 3)

Discussion:

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The result of this experiment has demonstrated that organic fertilizers (poultry droppings) and inorganic fertilizers (super-gro) are effective and can be used in the management of root knot nematode affecting sweet potato as they significantly reduced and controlled the nematode on treated plants as compared to the untreated plants. This results agrees with the report from Efthimiadou *et al.,* (2009) that Plants grown in soil that is high in organic matter are often less damaged by nematodes than plants grown in untreated soil. It also agrees with Farahat *et al.,* (2012) who found that organic and inorganic fertilizer treatment was effective in controlling *M. incognita* and improving tomato yield.

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Statistically, poultry dropping and inorganic fertilizers exhibit similar nematicidal effect on root knot nematode. This goes in line with the generally postulate that the adverse influence of organic amendment and inorganic fertilizer on parasitic nematode is referred to increasing host resistance to nematode infection and enhancement of growth performance (Doeschl-Wilson & Kyriazakis 2012).

It was observed that organic fertilizer at 8kg suppressed root knot nematode better than other treatments exhibiting the highest root length. This is in compliance with Akhtar and Malik (2000) who reported that, nematode population levels under organic fertilizer treatments might have changed due to changes in soil properties, nutrients released to plants, increase in predators and parasitic microorganisms, toxic metabolites released from organic amendments breakdown, or health of the host crop. This is also in agreement with Jatak (2002) who reported that root and soil population of root knot nematode (*M. incognita*) is reduced by organic manure amendment on soils. Wang *et al.,* (2004) reported that the incorporation of organic amendments has been shown to be detrimental to plant parasitic nematodes due to release of ammonium (NH_4), formaldehyde, phenol and volatile fatty acids.

In terms of gall index (root damage), inorganic fertilizer and poultry droppings perform better than untreated. Inorganic fertilizer efficacy has been confirmed by many workers against plant parasitic nematode including *Meloidogyne species* (Radwan *et al.*, 2007). Gall index show that treated plants with poultry dropping or inorganic fertilizer had lesser galls when compared with untreated plants. However, inorganic fertilizer had the least productive factor. Inorganic fertilizer reduced significantly gall index, when compared with untreated plants. This confirms with nematicidal efficacy of inorganic fertilizer on *M. incognita*. Reproduction rate of *M. species* was least in sweet potato plants treated with inorganic fertilizer because of its nematicidal potency (Radwan *et al.*, 2007).

Surprisingly inorganic fertilizer treatment at 2WAP exhibited the lowest number of harvested potato roots which was not significantly different from that of untreated plot (control). Comparing this result by inorganic treatment alone at 2WAP, it was found inorganic treatment at 2WAP was no sufficient to control Root Knot Nematode and increase yield in potato. This result may be attributed to the incompatibility of the biological control agents and the inorganic fertilizer. The successful management of plant parasitic nematodes, keeping the population below economic threshold levels, depending on the compatibility between the biological agents and the complex environment of soil. According to Walker, (2004) and Wang *et al.*, (2003), biological control of nematodes has mainly been achieved by conservation of existing biological agents and building of beneficial organism through the use of various soil amendments.

Conclusion and Recommendations:

Comment [U28]: CONCLUSION AND RECOMMENDATIONS

Conclusion:

The result of this study reveals that poultry dropping and inorganic fertilizer exhibited potential activity against the root-knot nematode and enhance growth criteria for potato irrespective of their origin and concentration. Root-galling, the number of egg masses, egg production and subsequently the population of Root knot nematode has been significantly suppressed by the tested materials. However, the inorganic fertilizer seemed to have higher toxic action on the nematode than poultry droppings.

Recommendation:

This result has shown clearly that inorganic fertilizer (super-gro) was more effective in the control of root knot nematode as compared with organic fertilizer (poultry droppings). However, poultry droppings has a higher number of fruits as compared to super-gro, it also offers an eco-friendly and significant protection to the target crop against plant parasitic nematode and will be effective for organic farming. Therefore, poultry droppings is recommended. In order to improve its potency, the concentration should be increased.

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Comment [U29]: REFERENCES

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