POTENTIAL OF SOME SELECTED FERTILIZER TYPES IN THE SUPPRESSION OF ROOT KNOT NEMATODE (*Meloidogyne incognita*) INFECTIONS ON EGGPLANT

Supported by tetfund TERTIARY EDUCATION TRUST FUND

Adepoju Isaiah Olusesan[*1] Oluwatayo Juliana Iye[2] , and Okrikata Emmanuel [3]
[1]Department of Crop Production and Protection, Federal University, Wukari, Taraba State
[2]Department of Crop and Environmental Protection, Federal University Of Agriculture, Makurdi, Benue State
[3]Department of Biological Science, Federal University, Wukari, Taraba State
*Corresponding Author: +2348060010905 E-mail: leosessy@yahoo.com
Received: March 20, 2022 **Accepted:** June 18, 2022

Abstract: This study investigated the potential of some selected fertilizers to suppress root-knot nematodes (Meloidogyne incognita) on eggplant. Treatments consisted of two spraying periods of liquid fertilizer (Super Gro) at 2 and 4 weeks apart, 20 kg/ha and 40 kg/ha Organic manure (geese dropping) at 2 week intervals and untreated plants (control). This was established in a randomized complete block design (RCBD) and repeated three times. The result obtained was subjected to analysis of variance (ANOVA) and tested for statistically significant differences between treatment methods using the least significant difference (LSD) at a probability level of 0.05. The results of this study showed that the use of selected fertilizer types enhanced the eggplant productivity index. The organic manure at 40 kg/ha gave the highest significant ($P \leq 0.05$) number of fruits (18.10 and 13.63) and fruit weight (0.44 and 0.38 kg/ha). The treated plants also recorded the longest significant root length ($P \leq 0.05$) and lower root gall index compared to the treated eggplant (Control). The results of the study indicate that the organic fertilizer applied at 40 kg/ha was suitable for the soil in the study area and able to improve eggplant yield parameters and effective in suppressing root knot nematode infection.
Keywords: Eggplant, Infection, Nematode, Organic manure, Yield

Introduction

Pests and diseases are constraining vegetable production worldwide whose impacts are exacerbated by climate change and variability (Phophi, 2017). *Meloidogyne* is the most important genus of plant parasitic nematodes that infect many plant species (Abu Gharbia, 2010), and the losses it causes exceed 50% and are estimated at $100 billion annually. Root knot nematodes have been found as a major problem in the cultivation of eggplant and tomato (*Solanum lycopersicum* L.) (Gharabadiyan *et al.*, 2013). This pathogen is responsible for serious root damage that leads to stunting, chlorosis and a significant reduction in yield (Abolusoro *et al.*, 2015). In Nigeria, eggplant is known to be highly susceptible to root-knot nematode infection which also makes it more susceptible to other diseases (Abdul-Gawad, 2014). Symptoms of plants infected with nematodes according to Osman *et al.* (2018) include greenish, water-soaked spots that often pinch the stem causing the plants to wilt and die. Leaf spots are often water-soaked and irregularly shaped, later becoming light brown. The fruits will show similar spots, often enlarged to cover the entire fruit, which later dries up and becomes mummified. Control of root-knot nematodes is difficult; soil chemical nematicides are expensive, not always effective and harmful to the environment (Bird and Kaloshian, 2003). The use of organic soil amendment is a traditional cultural practice to improve soil fertility and structure, but several research articles have confirmed the efficacy of compost in managing soil pathogens including root knot nematodes associated with improved plant growth and crop yield (El-Sherif *et al.* 2010 and Abolusoro *et al.* 2012). Some studies have suggested that plant parasitic nematodes may be affected by soil fertilization (Khan *et al.*, 2012; Mansourabad *et al.*, 2016; Santana-Gomes *et al.*, 2013). Soil organic amendments have been reported to have similar reductive effects on plant parasitic nematodes as organic fertilizer materials which were found to have a nematotoxic effect on the plant-parasitic nematode population (Edwards *et al*., 2007; Pathma and Sakthival, 2012; Sultana *et al.*, 2011). The aim of this research is to evaluate the potential of some selected fertilizer types in suppressing root knot nematode infection on eggplant.

Materials and Methods

This research was carried out at the Agronomy Teaching and Research Farm, Federal University of Agriculture Makurdi, Benue state of Nigeria during the 2020 growing season. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications. Each replication has 5 plots at spacing of 1m apart with 2m alleys between replication. Each plot measured 2m x 2m giving an area of $4m^2$. The fertilizers used are (Super gro and Organic manure). The fertilizer treatments were applied at 5 levels as indicated below:

T1: Liquid fertilizer (super gro) at 2 weeks interval.
T2: Liquid fertilizer (super gro) at 4 weeks interval.
T3: Organic manure (geese dropping), 20Kg/Ha at two weeks interval.
T4: Organic manure (geese dropping), 40Kg/Ha at two weeks interval.
T5: Control (No fertilizer)

***Cultural Practices*:** Eggplant (*Solanum melogena*) variety "Ethiopian" was selected for this experiment. Land preparation was done manually by clearing and ridges were constructed. Weeding was done with the use of cutlass and hoes, respectively. Seedbed size 2mx2m was made for the nursery. The seeds were broadcasted on the seedbeds and dry leaves were used in mulching. Seedlings were transplanted to the ridges as at when due. The seedlings were irrigated occasionally in an elongated absence of rain. Weed control was achieved manually using small hoe and cutlass. Weeding was done 3 weeks and 6 weeks after transplanting. Fertilizer application was done as shown in the treatment while the unfertilized plots served as the control. Harvesting was carried out manually by hand plucking.

Data Collection: Using the observation method of data collection, Plant heights were measure using measuring tape and number of leaves were counted and recorded. Root length and gall index were also recorded. Numbers of fruits were recorded alongside with the percentage vigor counts.

Data Analysis: Agronomic data were subjected to analysis of variance using GENSTAT package (2015) and the means were compared using Fishers least significant difference and probability.

Results and Discussion

Soil Physical and Chemical Properties

The result of the physical and chemical properties of the soil (0-30cm) of the experimental site is presented in Table 1. The texture of the experiment site was sandy loam and well drained.

Available phosphorous of 11.16Mg/KG-1 plus a uniform soil nitrogen of 0.84% were low (Bray and Kurtz, 1945). Exchangeable potassium was 0.16Mg/Kg-1 which was classified as moderate (Anderson and Ingran, 1993). Soil ph was strongly acidic (5.23). The value of organic carbon percentage was low (4.74%).

Table 1: Nutrient analysis of the experimental field

Soil Parameter	Quantity
% 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)	0.12
K(Cmol/kg)	0.16
Na(Cmol/Kg)	0.50
CEC(Cmol/kg)	3.14
Available p (mg/kg)	7.48

Table 2: Effect of selected fertilizer types on the growth parameter of eggplant

Treatment	EC (%)	Vigor count @6 WAP	D50%f	Plant height (cm)				Number of leaves			
				4WAP	6WAP	8WAP	10WAP	4 WAP	6 WAP	8 WAP	10 WAP
T1	78.60	66.70	72.70	12.33	17.33	28.00	40.67	4.67	12.53	18.33	23.33
T2	88.00	71.40	61.00	12.80	18.23	28.87	40.67	4.30	14.20	19.20	24.57
T3	83.30	69.00	60.30	12.67	18.43	30.23	40.43	4.43	14.33	19.33	23.80
T4	76.20	66.70	58.70	13.67	18.63	29.23	40.00	5.00	13.37	18.43	24.57
T5	81.00	73.88	60.30	9.77	17.47	28.90	40.70	4.40	13.67	19.33	24.67
F-LSD (P≤0.**05)**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

T1: Liquid fertilizer (super gro) at 2 weeks interval.
T2: Liquid fertilizer (super gro) at 4 weeks interval.
T3: Organic manure (geese dropping), 20Kg/Ha at two weeks interval.
T4: Organic manure (geese dropping), 40Kg/Ha at two weeks interval.
T5: Control (No fertilizer)
EC (%) – Percentage emergence count;
D50%F – Days to 50% flowering;
WAP – Weeks after Planting;
F-LSD – Fisher's least significant difference at 5% level of probability; NS – Not Significant

Percentage Emergence Count

The result obtained on the percentage emergence count of eggplant showed no significant (P≤0.05) difference among the treatments. However, T2 recorded the highest emergence count and T4 recorded the least emergence count.

Percentage Vigour Count

Eggplant percentage vigour count shows no significant (P≤0.05) difference across the treatment from the result shown in the table 1. However T5 has the highest percentage vigour count and T1 and T4 recorded the least percentage vigour count.

Plant Height

As shown in table 1, the plant height of eggplant showed no significant (P≤0.05) difference between the treatments at 4WAP, 6WAP, 8WAP and 10WAP respectively. At 4WAP, T4 recorded the highest plant height, while T5 recorded the lowest plant height. At 6WAP, T4 recorded the highest plant height and T1 recorded the lowest plant height. At 8 WAP, T3 recorded the highest plant height while T1 recorded the lowest plant height. At 10 WAP, there was no significant (P≤0.05) difference between T1 and T2, T1 has the highest plant height while T4 recorded the lowest plant height.

Number of Leaves

At 2 WAP, T4 recorded the highest number of leaves and T2 showed the lowest number of leaves. Although at 4WAP, there was a slight difference between T2 and T3 in the number of leaves as shown in table 1. At 6 WAP, T3 had the highest number of leaves while T1 had the least number of leaves, there was however a slight difference between T2 and T3 (Table 1). At 8WAP, there was no significant (P≤0.05) difference between T3 and T5 which recorded the highest number of leaves, while T1 recorded the lowest number of leaves. At 10 WAP there is also no significant (P≤0.05) difference between T2 and T4, T3 recorded the highest plant height while T1 recorded the lowest plant height (Table 1).

Days to 50% Flowering

Result obtained on the Number of Days to 50% flowering showed no significant difference (P≤0.05) among the treatments. However, the days to 50% flowering ranged from 58.7 days for T4 to 72.7 days for T1 sprayed plants (Table 2).

Table 3: Effect of selected fertilizer types on the yield and root parameters of egg plant

Treatments	Number of fruits 1st harvest	Number of fruits 2nd harvest	Weight fruit(Kg/Ha) 1st harvest	Weight of fruit(Kg/Ha) 2nd harvest	Root length (Cm)	Root gall index
T1	10.60	13.07	0.33	0.32	20.30	3.47
T2	14.40	12.63	0.35	0.30	18.90	3.00
T3	10.20	12.30	0.35	0.32	24.10	4.17
T4	18.10	14.63	0.44	0.38	23.20	4.17
T5	7.30	5.53	0.12	0.20	16.40	4.87
F-LSD (P≤0.05)	1.03	4.08	0.17	0.12	NS	0.53

T1: Liquid fertilizer (Super gro) at 2 weeks interval.
T2: Liquid fertilizer (Super gro) at 4 weeks interval.
T3: Organic manure (Geese dropping), 20Kg/Ha at two weeks interval.
T4: Organic manure (Geese dropping), 40Kg/Ha at two weeks interval.
T5: Control (No fertilizer)
EC (%) – Percentage emergence count;
D50%F – Days to 50% flowering;
WAP – Weeks after Planting;
F-LSD – Fisher's least significant difference at 5% level of probability;
NS – Not Significant

Number of Fruit

Table 3 showed the effect of the selected fertilizer sources in the suppression of root knot nematode on the number of fruits. Data obtained at first harvest showed that T4 recorded the highest significant (P≤0.05) number of fruit followed by T2. The lowest significant number of fruit was recorded in the T5 (Control). For second harvest, T5 recorded the highest significant (P≤0.05) number of fruit while T5 (Control) recorded the significant (P≤0.05) lowest number of fruits.

Weight of Fruit

The effect of the selected fertilizer sources in the suppression of root knot nematode on the weight of fruit was significantly (P≤ 0.05) different. At first and second harvest T4 recorded the highest significant (P≤0.05) fruit weight while T5 recorded the significant (P≤0.05) lowest weight respectively.

Root Length

T4 gave the significant (P≤0.05) longest root length while T5 gave the significant (P≤0.05) shortest route length.

Root Gall Index

Data obtained on the root gall index shows that T5 (Control) significantly gave the highest root gall index. While T4 (Organic Manure at 16g @ 2 weeks interval) recorded the significant (P≤0.05) lowest root gall index. T2 and T3 recorded the same number of root gall index.

The result obtained from this research show that eggplant treated with higher dosage of organic fertilizer shows lower root gall index than plant with lesser dosage of organic fertilizer. It was also observed that eggplants treated with higher dosage of fertilizer performed better than those with lower dosage. All treated eggplants recorded higher number of fruits weight of fruits and root length. This shows that fertilizer application supplies the nutrient needed for nematode resistance and improved yield.

The above findings agreed with Regnault-Roger *et al.* (2002); Sikora and Fernandez (2005) and Abolunsoro *et al.*(2018) that improved plant nutritional status can lead to disease escape or improved resistance against nematode However, variation in control efficiency of organic fertilizer could be due to interaction with microbial population preexisting in the soil and free living nematode as noted by Thoden *et al*.(2006) and Everts *et al* (2006). Nahar *et al.* (2006) propose that raw manure may be more effective because they could reduce nematode population and simultaneously increase beneficial species and microbial activities. Similarly, summers (2011) strengthens these findings by noting that organic amendments stimulate the multiplication of micro-organisms like fungi and bacteria. Some of these micro-organisms are parasites of nematodes. This will bring about biological suppression of parasitic nematodes in soil, hence promoting growth and development of the plants.

Conclusion and Recommendation

This study shows that both organic and inorganic fertilizer have their roles to play in suppressing root-knot nematode of eggplant. Considering the economic implication in sourcing inorganic fertilizer and their effect on the environment, decreasing rate of application of inorganic fertilizer plus increasing rate of organic manure is recommended for eggplant production in nematode infested soils. This research further confirms the significant role of organic manure in increasing crop productivity and suppressing nematode infection on eggplant. Further studies should be carried out in identifying the toxicological activities responsible for the suppression observed in this study.

References

Abolusoro SA, Abolunsoro PF. & Mathew FO (2012) Effects of organic and inorganic manures on the growth attributes of root-knot nematode (*Meloidogyne incognita*) infected Ethiopian eggplant (*Solanum aethiopicum). Libyan Agric Res center J internat* (5):224-228.

Abolusoro SA, MO Abe & NB Izuogu (2015).Control of nematodes disease of eggplant (*Solanum aethiopicum*) using manure. *Archive of phythopathology and plant protection* volume 48.

Abolusoro SA, Izuogu NB, Abolusoro PF., Ige S & Adebiyi, OTV (2018). Toxic Effects of Bitter Leaf Powdered (*Vernonia amygdalina*) Del, on Root-Knot Nematode (Meloidogyne Incognita), Affecting Tomato (*Lycopersicon esculentum*). *Science Plant in Advancements of Journal*, *1*(2).

Abu-Gharbiah, WI Ahazmi AS Stephen & AA Dawarbar (2010), Plant nematodes in Arab countries, Wael publication house, 1142pp.

Anderson, JM and Ingram JSI. (1993). A handbook of methods. *CAB International, Wallingford, Oxfordshire*, *221*, 62-65.

Bird DM & Kaloshian I (2003). Are roots special? Nematodes have their say. *Physiological and molecular plant pathology* 62,115-123.

Bray, RH, & Kurtz, LT (1945). Determination of total, organic, and available forms of phosphorus in soils. *Soil science*, *59*(1), 39-46.

Edwards, CA, Arancon, NQ, Emerson E, & Pulliam R (2007). Suppressing plant parasitic nematodes and arthropod pests with vermicompost teas. *Biocycle*, *48*(12), 38-39.

El-Sherif AG. & Ismail AFA (2010)Integrated management of meloidogyne incognita infecting sunflower by certain organic amendments, *Bacillus thuringiensis* and oxamyl with reference to NPK and total cholorophy status. *Egypt J Agronematol* 9(1):40-51

Everts, KL, Sardanelli, S. Kratochi, RJ, Arementrat DK & Gallghan, LE (2006) Root-knot nematode and root lesion nematode suppression by cover crops, poultry litter compost. *Plant diseases* 90,487-492.

Gharabaddiyan F, Jamalis, Ahmadiyan Yazdi A & Eshandri A (2013). Source of resistance to root-knot nematode (*Meloidogyne javanica*) In tomato cultivars. *Journal of agricultural technology* 8:2011-2021.

Khan,NA, Habib G, Altaf-u rehman; Suleman, M & Ullah G (2012). Evaluation of leaves as a crude protein and energy supplement to the low quality diets of dairy goats. In Abdullah et al.(E.D.S)Pro.1st Asia dairy goat,Kualar lumpur:88.90.

Mansourabad AM, Bideh AK & Abdollahi M (2016) Effects of some micronutrients and macronutrients on the root-knot nematode, Meloidogyne incognita, in greenhouse cucumber (Cucumis sativus cv. Negin). *Journal of Crop Protection*, *5*(4), 507-517.

Nahar, MS, Grewal, PS, Miller, SA, Stinner, D, Stinner, BR, Kleinhenz, MD & Doohan, D (2006). Differential effects of raw and composted manure on nematode community, and its indicative value for soil microbial, physical and chemical properties. *Applied Soil Ecology*, *34*(2-3), 140-151.

Osman, HA, Ameen, HH, Mohamed, M, El-Mohamedy, R, & Elkelany, US (2018). Field control of Meloidogyne incognita and root rot disease infecting eggplant using nematicide, fertilizers, and microbial agents. *Egyptian Journal of Biological Pest Control*, *28*(1), 1-6.

Pathma J & Sakthival N (2012).Microbial diversity of vemi compost bacteria that exhibits useful Agricultural traits and waste management potential. Springer plus http://doi.org/10.1186/2193-18-01-126.

Phophi, MM (2017). Constraint to vegetable production resulting from pest and disease induced by climate change and globadization. Published by Canadian center of science and education.

Regnault-Roger C, Philogene & Vincent. C (2002). Bio pesticides dorigine vegetable, Tec et doc Paris (fra). Rudolph Mathee (2016). Pattern of food consumption. Online publication DOI 10.1093/Oxford hh/9780199935369.013.13

Santana-Gomes de Melo, S, Dias-Arieira, CR, Roldi, M, Santo Dadazio, T, Marini, PM., & de Oliveira Barizatilde, DA (2013). Mineral nutrition in the control of nematodes. *African Journal of Agricultural Research*, *8*(21), 2413-2420.

Sikora, RA & Fernandez. (2005). Nematodes parasites of vegetable/N.LIUC, M, Sikora,R.A Bridge J.(Eds) plant parasitic nematodes in subsoil and tropical Agriculture. CAB International Walling ford (GBR) PP.36, 460-471

Sultana,N, Akhtar M, Khan RA ,Afza N, Tareen RB. & Malik,A (2010). Nematicidal natural products from the aerial parts of Buddies crispa. *Nat prod Res* 24(9):783-788.

Summers, H. (2011). Effects of organic manure on nematode control. *Journal of diseases and pests control in tropics*, 7(2):190-191

Thoden,TC, Korthels GW, & Temorshiizen AJ (2011). Organic amendment and their influences on plant parasitic and free living nemtodes. *Journal of Nematology* volume 13(2) 133-155.