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Effect of organic amendments on soil nematode community composition, nematode infectivity and plant growth

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Effect of organic amendments on soil nematode community composition, nematode infectivity and plant growth

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Abstract

Purpose: The effect of organic amendments on soil nematode community composition and pathogenicity on *S.melongena* L.was evaluated by comparing the nematode faunal composition in an amended soil with non-amended soil.

Methodology: Prior to soil enrichment, the undisturbed plot was assessed to determine the endemic nematode community composition. Organic amendment was administered to the undisturbed plot and nematode population dynamics was determined. Planting was done 14 days after application of organic amendment after which soil samples were collected from the experimental plot at 30, 60 and 90 days intervals. Root samples of the *S. melongena* L. were also collected at the same interval. The modified Bearmann's extraction technique was used to determine the soil and endophytic population of nematodes. Soil samples were collected from two different depths, 0-5cm and 6-10cm depths.

Findings: There was variability in depth related occurrence of nematode genera and species, with abundance and species diversity declining as depth increased prior to amendment ($p>0.05$). This variability was replicated in the experimental plots after amendment ($p<0.05$). The study revealed that the soil enrichment strategies have a great influence on the spatial and temporal distribution of nematode community composition. In this study, the application of organic amendments stimulated trophic affiliation of nematodes such that the fungivores; *Aphelenchoides* spp., *Aphelenchus* spp., *Tylenchusi spp. and Ditylenchus* spp. were common at 0-5cm depth along with the specialist plant feeders (parasitic nematodes). The presence of *K*strategists such as *Xiphinema* spp.indicated maturity and stability of the environment.

Keywords: *Soil enrichment, abundance and species diversity, trophic affiliations, spatial and temporal distribution.*

1.0 INTRODUCTION

Eggplant, *S.melongena* L. is a species of the Nightshade plants known by various names such as Brinjal, Melongene, Guinea squash orAubergines. It is one of the most delicious and nutritive vegetable crops globally (Karmani *et al*., 2011). The eggplant is ranked fourth amongst the universally economically important vegetables after tomato, pepper and potato. The crop is a delicate, tropical perennial often cultivated as atender or half-hardy annual in temperate climates (Sasanelli*et al*., 2009). It grows 40-150cm tall, with large, coarsely lobed leaves that are 10-20 cm long and 5-10 cm broad during fruit bearing (Bohme., 2006; George, 2006 and Mumtaz, 2006). Eggplant suffers from different types of infections howeverplant parasitic nematodes stand out as economically important etiologic agents. Various species of plant parasitic nematodes such as *Meloidogyne*spp., *Pratylenchus*spp., *Rotylenchus*spp., *Tylenchorynchus*spp., *Xiphinema*spp., *Longidorus*spp., *Tylenchus*spp. *and Tylodorus*spp. decline yields in cultivation(Banglapedia, 2006 andKarmani *et al*., 2011).

Nematodes are known to damage the root system of plants thereby hampering the vascular functions of crops. Beside nematode pests, other pests of economic importance of eggplant include;*Empoascaflavencesns* (leaf hopper), *Leucinodesorbaralis* (fruit and shoot borer), *Heliothisarmigera* (army worms), *Trialeurodesvaporariorum* (white fly), *Cercospora* spp. (leaf spot), bacterial wilt, vascular wilt and leaf viral (Gangopaday*etal*., 2009). Pests attack lead to damage in root system and vascular system distortion which affects water and mineral uptake resulting in serious yield reduction (Karmani *et al*., 2011).

The use of synthetic nematicidehave proved to be effective in managing and controlling plant parasitic nematodes, however, their utility is now limited due to environmental unfriendliness, non-availability, costliness, residual effect, bio-accumulation and impact on nontargetorganisms(Ranganatha, 2001). These numerous problems posed by synthetic nematicides to the environment and human health have discouraged their usage world over (Nzeako *et al*., 2013).

Organic soil amendments had been a cultural practice for improving the physical and chemical properties of the soil as well as the soils'nutrients. A variety of organic amendments ranging from animal and green manure, undecomposed or decomposed materials are variously used in the agro-ecosystem world over(Vannacci & Gulino, 2000; Atungwu, 2005; Riga, 2011). Incorporation of organic materials to the soil helps to restructure the soils' microflora and microfauna including soil nematodes. Nematodes, are the most ample and diverse group of soil fauna (Vannacci & Gulino, 2000; Riga, 2011). They are ubiquitous in all terrestrialhabitats and soil types with soaring population densities (Atungwu, 2005; Riga, 2011). The changes in the soil physicochemical properties can results in increase in the number of beneficial nematodes such as the bacteriovores and fungivores and the suppression of economically important plant parasitic nematodes.

The enrichment of the soil with organic amendments supplies nutrients to the crop, impacts communities of soil organisms, seldom stimulate organisms that are antagonistic to nematodes and suppressive on plant parasitic nematodes (Orisajo *et al*., 2007 and Orisajo *et al*., 2008). This research work is aimed at determining the effects of organic amendments on the soil nematode population dynamics, growth of eggplant, *S. melongena* and their pathogenicity on the eggplant.

2.0 MATERIALS AND METHODS

2.1 Study Location

The experiment was carried out in a 15x30 meters plot of land laying between (Lat. 4.895993^{o}N and Long. 7.017002^{o}E) in Port Harcourt, Rivers State, Nigeria. Port Harcourt city falls within the rainforest zone with a short dry season. The area experiences an average annual rainfall range of 1500mm to 3000mm and with average temperature range of 24^{o}C to 28^{o}C. The annual relative humidity ranges between 60-90%. The region has two seasons; dry season from November to March and wet season from March to October. The soil is a loamy sand soil (70.2% sand, 11.2% silt and 18.6% clay, pH 6.16, total organic content (TOC) 2.01, total organic matter (TOM) 3.46 and total hydrocarbon content (THC) 0.005) (Black, 1965).

2.2 Experimental Design

The experimental design adopted for the study was the Complete Randomized Block Design (CRBD) of five treatments and five replicates.

2.3 Land Preparation and Soil Sterilization Procedures

2.3.1Pre-planting Collection of Soil Samples

Forty (40) soil samples were randomly collected with the use of a modified soil auger at 0-5cm and 5-10cm depths of a designated undisturbed land. Collected soil samples were put in properly labeled polythene bags and transported to the University of Port Harcourt Parasitology laboratory to determine the initial nematode population in the soil. **2.3.2 Determination of Physicochemical Properties the Soil.**

The soil particle size was evaluated using the Bouyoucos Hydrometer Method by Bouyoucos (1951), pH of the soil was determine using the electronic method by Black (1965)while the Total Organic Matter (TOC) was according to the method proposed by Anderson and Ingram, (1989), Total Nitrogen (TN) was according to Linder and Harley(1942), Total Hydrocarbon Content (THC) was according to Anderson and Ingram(1989). The Oil and Grease (O and G) component of the sampled soil was in line with Bouyoucos(1951), Electric Conductivity according to Day(1953), Total Organic Matter (TOM) was in line with Davidson(1953). However, Sulphate (SO_4^{2-}) ion determination was according to Black(1965), Nitrate (NO^3) ion according to Jackson(1962), Phosphate (PO_4^{3-}) ion was according to Jackson(1962), Chloride (Cl^-) ion by Jackson(1962), Available Phosphorus (AP) was by Jackson(1962) method, sodium (Na^+) ion according to Black(1934) and Potassium (K^+) ion was according to Black(1934).

2.3.3 Removal of Natural Vegetation and Preparation of Beds

The primary vegetation of the planting plot (Experimental plot) was removed with local implements such as cutlass and hoes.The experimental land (30m x 15m) was partitioned into five plots. These were labeled plots A-E. In each plot, five beds were made with a dimension of 5m length by 50cm breadth by 60cm height. Furrows were 90cm apart and served as drainages for water as well as walk way for the researcher.

2.3.4 Compost Preparation

Poultry dung, dry leaves and fresh leaves were used to prepare the compost. To enhance composting, leaves were chopped into small pieces. These were piled in layers and stored in 200litre container with perforated sides to increase aeration in the container.

2.4 Planting

2.4.1Source of Seed

Eggplant seeds were sourced from Songhai farm at Bunu, Tai Local Government Area of Rivers State, Nigeria.

2.4.2 Sterilization of Soil for Nursery

Garden soil were collected at depths of 1-10cm, sieved with a 2mm aperture sieve and sterilized with steam at a temperature of 40-50^{o}C for a period of 50 minutes and air cooled. The sterilized soil was used in building the nursery on perforated plastic troughs.

2.4.3 Raising Seedlings in the Nursery

The seeds were planted by broadcasting on the sterilized soil in the nursery chamber and observed for three weeks before transplanting. The seedlings were thinned in the nursery to avoid overcrowding. The watering can was used to water the seedlings twice daily.

2.4.4 Transplanting

Seedlings were transplanted three weeks after germination with the hand trowel. 80cm planting distance was observed, with each bed havinga total of 20 plants. The plants were watered at 12 hour intervals while weeding was done on daily basis (hand picking).

2.4.5 Application of Organic Amendment (Compost**)**

All the plots were amended with organic fertilizer except plot D as control and E (standard). Plot D has no organic amendment while Plot E was treated with inorganic fertilizer. Organic amendment was applied as surface mulch using the hand fork at the rates of 50kg, 37.5kg and 25kg for A, B, and C respectively. These were left to mineralize for a period of two (2) weeks transplanting. The control was not amended with Organic materials while the artificial fertilizers served as a standard control (Abolusoro*et al*., 2013).

2.5 Post-planting Soil Sampling

Soil samples were collected 30, 60 and 90 days after planting from each bed at the depths of 5cm and 10cm making a total of 50 samples. Soil samples were collected randomly close to the rhizosphere of the eggplants, put in a designated sterile polythene bags and transported to the laboratory for nematode assay.

2.5.1 Extraction of Nematodes from Root and Identification

The root bioassay was carried out at intervals of 30, 60 and 90 days to determine the endophytic nematode population according to Nzeako *et al*., (2011). The Light compound microscope was used to identify the worms according to Golden (1985) and Goodey and Goodey(1963).

2.5.2 Determination of Gall Index and Egg mass Index

Gall index was determined using the method by Hertmann and Sasser, (1987)

2.5.3 Analysis of Plant Parameters

Assessment of growth parameters and plant yield was done using the methods proposed by Harish (2009), Vijaya and Seethalakshmi (2011) and Habib *et al*., (2012)

2.5.4 Diversity Index and Evenness Indices

The Shannon Weirmers' diversity (H'), Evenness' index (E), Simpsons Index (S), Species Index and Dominance Index were used to evaluate the rhizosphere nematode population.

2.5.5 Weed and pest control

Hand picking was adopted as the weed control strategy. Physical barriers were created around the perimeter of the experimental plot while the soluble fractions of goat dung were used as aerosol on the plants to repel insects.

Chemical fertilizer

2.6 Statistical Analysis

The data obtained from the study were analyzed using Analysis of Variance (ANOVA) to evaluate the effect of compost on eggplant as well as the spatial and temporal distribution of nematode in the soil along with aforementioned population dynamics indices.

3.0 RESULTS

3.1. Nematode population in the undisturbed site.

A total of 504 nematodes made up of 14 genera were recovered from the sampled sites. Out of this population, 327(64.9%) were obtained from the 0-5cm depth while 177(35.1%) were obtained from 6-10cm depth (Table 1).Amongst the individual genera of nematodes, *Tylenchus* spp. had the highest prevalence of 81 (16.1%), followed by *Ditylenchus* spp. with a prevalence of 77(15.3%) and *Meloidogyne* spp. 66(13.1%). Others were *Pratylenchus* spp. recording 47(9.4%), *Hemicycliophora* spp. with 40(8.0%), *Aphelenchoides* spp. had 31(6.2%), *Longidorus* spp. had 31(6.2%), *Paratylenchus* spp. had 25(5.0%), *Xiphinema* spp. with 24(4.8%), *Helicotylenchus* spp. with 22(4.4%) and *Aphelenchus* spp. having 18(3.6%). Others were*Gracilacus* spp. with 16(3.2%), *Hemicriconemoides* spp. recording 14(2.8%) and *Rotylenchus* spp. having 10(2.0%).

There was great variability in the distribution of nematode species in the undisturbed site, *Rotylenchus* spp. 10(2.0%) had the least prevalence while *Tylenchus* spp. 77(15.3%) had the highest prevalence (Table 1).

At the 0-5cm depth, 327 nematodes recovered comprising 18(5.5%) for *Aphelenchoides*spp., 10(3.1%) for*Aphelenchus*spp., 64(19.6%) for*Ditylenchus*spp., 9(2.8%) for*Gracilacus*spp. *and* 14(4.3%) for*Helicotylenchus* spp. 8 (2.4%) was recorded for*Hemicriconemoides* spp., and 24(7.3%) was for*Hemicycliophora*spp.,. Others were 24(7.3%) for*Longidorus*spp., 38(11.6%) for*Meloidogyne*spp., 15(4.6%) for*Paratylenchus*spp., 31(9.5%) wasfor *Pratylenchus*spp., 4(1.2%) for *Rotylenchus*spp., 56(17.1%) was for *Tylenchus*spp., and12(3.7%) was recorded for *Xiphinema*spp. (Table 1).

At the 6-10cm depth, a total of 177 nematodes were recovered. However, there was variability in the occurrence of nematodes at this depth, of which 13(7.3%); belonged to the *Aphelenchoides* spp., *Aphelenchus* spp. had 8(4.5%);*Ditylenchus* spp. had 13(4.0); *Gracilacus* spp. had 7(4.0%); *Helicotylenchus* spp. had 8(4.5%); *Hemicriconemoides* spp. had 6(3.4%); *Hemicycliophora* spp.,had16(9.0%); *Longidorus* spp. had 9(5.1%); *Meloidogyne* spp. had 28(5.8%); *Paratylenchus* spp. had 10(5.6%); *Pratylenchus* spp. had 16 (9.0%); *Rotylenchus* spp. had 6(3.4%); *Tylenchus* spp. had 25(14.1%);while *Xiphinema* spp. had 12 (6.8%). *Tyelnchus* spp. 25(14.1%) had the highest prevalence and the lowest was *Rotylenchus* spp. with 6(3.4%) (Table, 1.).

The trophic affiliation of the nematodes showed no occurrence of bacteriovores, omnivores and predaceous nematodes however, 23(14.3%) of the nematodes recovered were fungivores and 12(85.7%) were plant parasitic. The fungivorous ones were *Aphelenchoides* spp., and *Ditylenchus* spp, while the herbivores also known as plant parasitic were *Gracilacus* spp *Helicotylenchus* spp., *Hemicriconemoides* spp., *Hemicycliophora* spp., *Longidorus* spp., *Meloidogyne* spp., *Paratylenchus* spp. *Pratylenchus* spp., *Rotylenchus* spp., *Tylenchus* spp., and *Xiphinema* spp. (Table 4.1).The c-p value of the 14 genera and species were identified into three groups, *Aphelenchoides* spp., *Aphelenchus* spp.,*Ditylenchus* spp.,*Gracilacus* spp.,*Paratylenchus* spp. and *Tylenchus* spp. had a c-p value of 2, *Helicotylenchus* spp., *Hemicriconemoides* spp., *Hemicycliophora* spp., *Meloidogyne* spp., *Pratylenchus* spp. and *Rotylenchus* spp. had a c-p value of 3 while *Longidorus* spp. and *Xiphinema* spp. had a c-p value of 5 (Table 1).

Data Showed that there was a significant difference ($p<0.5$) between the populations of nematodes recovered from different soil depths. However, there was no significant difference ($p>0.05$) on the depth related biodiversity in the study (Table 1).

3.2. Pre-planting nematode population after application of organic amendment (PAOA). A total of 453 nematodes made up of 13 genera and species were recovered from soil prior to planting. Out of this population, 228(50.3%) were obtained from the 0-5cm depth while 225(49.7%) were obtained from the 6-10cm depth. Amongst the individual genera of nematodes, *Xiphinema* spp. had the highest prevalence of 113(24.9%), followed by *Longidorus* spp. with a prevalence of 90(19.9%) and *Hemicycliophora* spp. 52(11.5%) while *Aphelenchoides* spp., *Paratylenchus* spp. and *Tylenchorynchus* spp. had the least prevalence of 13(2.9%), 10(2.2%) and 10(2.2%) respectively. The prevalence of the others are; *Crypthodera* spp. 32(7.1%), *Ditylenchus* spp. 30(6.6%), *Pratylenchus* spp. 30(6.6%), *Tetylenchus* spp. 25(5.5%), *Meloidogyne* spp. 18(4.0%), *Dorylaimus* spp. 15(3.3%) and *Tylenchus* spp. 15(3.3%) (Table, 2.).

At the 0-5cm depth, a total of 228 nematodes were recovered belonging to 13 genera and species. Out of which 13(5.7%) belonged to the *Aphelenchodes* spp., 17(7.5%) were *Crythodera* spp., 10(4.4%) were *Ditylenchus* spp., 5(2.2%) were *Dorylaimus* spp., 20(8.8%) were *Hemicycliophora* spp., 35(15.4%) were *Longidorus*spp.,10(4.4%) were *Paratylenchus* spp., 25(11.0%) were *Pratylenchus* spp., 10(4.4%) were *Tylenchorynchus* spp., 15(6.6%) were *Tylenchus* spp. and 68(29.8%) were *Xiphinema* spp.,. There was great variability in terms of distribution of the nematode species in the site 14 days PAOA. *Xiphinema* spp. had the highest prevalence of 68(29.8%) while *Dorylaimus* spp. had the least prevalence of 5 (2.2%) at this depth (Table 2).

Furthermore, a total of 225 nematodes were recovered from the 6-10cm depth belonging to 13 genera and species. Out of these 15(6.7%) belonged to the *Crypthodera* spp., 20(8.9%) were *Ditylenchus* spp., 10(4.4%) were *Dorylaimus* spp. and 32(14.2%) were *Hemicycliophora* spp., while 55(24.4%) were *Longidorus* spp.,18(8.0%) were *Meloidogyne* spp., 5(2.2%) were *Pratylenchus* spp.,25(11.1) were *Tetylenchus* spp., and 45(20.0%) were *Xiphinema* spp., Out of all these, *Longidorus* spp. had the highest prevalence of 55 (24.4%), followed by *Xiphinema* with a prevalence of 45(20.0%) while *Pratylenchus* spp. had the least prevalence of 5(2.2%) (Table 2).

The 13 genera of nematode recovered were identified into 3 trophic groups namely fungivorous, herbivorous (plant parasitic) and omnivorous-predaceous. Of which 2 (15.4%) were fungi feeders (*Aphelenchoides* spp. and *Ditylenchus* spp.), 10 (76.9) were plant feeders (*Crythodera* spp., *Hemicycliophora* spp., *Longidorus* spp., *Meloidogyne* spp., *Paratylenchus* spp., *Pratylenchus* spp., *Tetylenchus* spp., *Tylenchorynchus* spp., *Tylenchus* spp.and *Xiphinema* spp. while 1(7.7%) were omnivorous-predaceous (*Dorylaimus* spp.) (Table2).The 13 genera were identified into four c-p values. *Longidorus* spp. and *Xiphinema* spp. were identified into c-p value of 5, *Crypthodera* spp. and *Dorylaimus* spp. had a c-p value of 4, *Meloidogyne* spp., *Paratylenchus* spp., *Pratylenchus* spp., and *Tylenchus* spp. were identified into c-p value of 3 while *Aphelenchoides* spp., *Ditylenchus* spp., *Tetylenchus* spp. and *Tylenchorynchus* spp. were identified into c-p value of 2 (Table 2).

Data showed that there was no significant difference between the number of nematodes populations recovered from 0-5cm depth and 6-10cm depth at the significance level of ($p>0.05$), however, there was a significant difference in terms of occurrence, biodiversity and variability. In overall, data showed that there was no significant difference (p>0.05) on the depth related biodiversity and depth variability in the study (Table 2).

3.3. Response of nematodes to organic amendment.

A total of 176 nematodes in 1ml of aliquot were recovered from the roots of *S. melongena* after 30 days of transplanting. Data showed that in all the three treatment levels; 42 (23.9%), 38 (21.7%) and 36 (20.4%) nematodes were extracted while the non-amended (NOA) and fertilizer (IOF)plots were 36 (20.4) and 24 (13.6) respectively. After 60 days, a total of 810 nematodes were recovered from the amended plots and they are follows 232 (28.6), 154 (19.0) and 160 (19.8) while 156 (19.3) and 108 (13.3) were recovered from the NOA and IOF sets respectively. At 90 days, total of 744, nematodes recovered of which 174 (23.4), 170 (22.9) and 128 (17.2) were recovered from the amended levels while 132 (17.7) and 140 (18.8) were recovered from the NOA and the IOF sets respectively (Table 3).

Data showed that 50kg treatment level encouraged the multiplication of nematodes with multiplication peaking at the 60 days interval. However, there was a significant different (p<0.05) between the amended sets and the NOA and IOF sets in the study (Table 3)

3.4. Response of eggplant to organic amendment

At 30 days post application of organic amendment (PAOA), the mean stem height (MSH) of the amended crops were 22.4cm, 15.0cm and 18.2cm at 50kg, 37.5kg and 25kg treatment levels respectively. However, the control sets of NOA recorded 12.6cm and IOF had MSH of 12.6cm. The mean leaf length (MLL) of the amended crops at 50kg, 37.5kg, 25kg, were 17.6cm, 18.8cm, and 18.2 cm respectively while the NOA and IOF were 12.2 cm and 14.3cm respectively. The mean plant girth (MPG) obtained from the amended crops were 0.27 cm, 0.26cm and 0.20cm at 50kg, 37.5kg and 25kg respectively while 0.17cm and 0.19cm were recorded for the NOA and IOF respectively. Also, the mean number of leaves (MNL) for the crops was 6 in all treatment levels. The mean branch number (MBN) was 1 for all the treatment levels.

At 60 days PAOA mean stem height (MSH) at treatment levels of 50kg, 37.5kg and 25kg were 100cm, 98cm and 92cm respectively while (MSH) for the NOA and IOF were 80 and 80 respectively. The Mean leaf lengths (MLL) of the crops at the three treatments were 42, 43 and 41respectively while that for NOA and IOF were 33 and 33 respectively. Also, the Mean leaf numbers (MLN) of the crops at the three treatment levels were 46, 54 and 51 respectively, while that of the NOA and IOF were 32 and 40 respectively. Plant branch (MPB) at all treatment levels were 8, 11 and 11 while that for the NOA and IOF were 6 and 8 respectively. The mean plant weight (MPW) of the crops at three treatment levels were 389.7g, 253.7g and 297.6g respectively while that of NOA and IOF were 25kg 91.1g and 127.7g respectively. The mean plant girths (MPG) of the crops at all treatment levels were 0.6, 0.5 and 0.44 while that of NOA and IOF were 0.37 and 0.38 respectively. The Mean root weight (MRW) of the plants at the three treatment levels were 89g, 70g and 78g while that of the NOA and IOF were 49g and 58g respectively.

At 90 days PAOA, the mean stem height (MSH) at treatment levels of 50kg, 37.5kg and 25kg were 171cm, 167cm and 148cm while for NOA and IOF were 132 and 158 respectively. The mean leaf lengths (MLL) were 41, 35 and 31 for treatment levels of 50kg, 37.5kg and 25kg respectively while 20cm and 37cm were for NOA and IOF respectively. The mean plant girths (MPG) for treatment levels of 50kg, 37.5kg and 25kg were 4cm, 3.4cm and 3.6cm while 1.4cm and 2.1cm were for NOA and IOF respectively. The mean leaf number (MLN) were 142cm, 124cm and

115cm for treatment levels of 50kg, 37.5kg and 25kg respectively while 88cm and 102cm were for NOA and IOF respectively. Furthermore, the mean plant branch (MPB) for treatment levels of 50kg, 37.5kg and 25kg were 26, 29 and 21, while 18 and 19 were MPB for NOA and IOF respectively. The mean plant weight (MPW) were 1580g, 1360g and 1500g for treatment levels of 50kg, 37.5kg and 25kg respectively while 675g and 814g were MPW for NOA and IOF respectively. The mean root weight (MRW) were 214g, 166g and 208g for treatment levels of 50kg, 37.5kg and 25kg respectively while 56g and 116g were MRW for NOA and IOF respectively. Furthermore, the mean fruit number (MFN) for treatment levels of 50kg, 37.5kg and 25kg were 108, 82 and 125 while 17 and 34 were MFN for NOA and IOF respectively. The mean fruit weight (MFW) in grams for treatment levels of 50kg, 37.5kg and 25kg were 37, 37 and 39 while 30 and 33 were MFW in grams for NOA and IOF respectively.

Data showed that there was significance difference ($p>0.05$) in plant growth and nematode population in relation to organic amendment. At 30 days PAOA, the mean stem height (cm), mean leaf length (cm), mean plant girth (cm), mean wet plant weight (g) and mean wet root weight (g) were significantly increased in the case soil amended with varied dosages of organic manures as compared to the subsets without organic manure or synthetic fertilizers. However, more nematodes were extracted from the roots of plants grown in 50kg dosage than others. Although, the population nematode recovered were not significant at this period. At 60 days PAOA, the mean stem height (cm), mean leaf length (cm), mean plant girth (cm), mean plant branch number, mean leaf number, mean wet plant weight (g) and mean wet root weight (g) were significantly increased in the case soil amended with varied dosages of organic manures as compared to the set without organic manure or synthetic fertilizers.

The number of nematodes recovered from the root were significantly higher at $p>0.05$ in all concentrations compared to those without amendment soil.

At 90 days PAOA, the mean stem height (cm), mean leaf length (cm), mean plant girth (cm), mean plant branch number, mean leaf number, mean wet plant weight (g), mean wet root weight (g), mean fruit number, mean fruit girth (g), and mean fruit weight (g) were significantly increased in the case soil amended with varied dosages of organic manures as compared to those without organic manure or synthetic fertilizers. Furthermore, nematode population in the roots were significantly increased (Table 1). This increment is specifically due to high organic amendment applied rather than diversity of the vegetation.

4.0 Discussion and conclusions

4.1 Discussion

This study showed that the diversity and abundance of nematodes in the undisturbed site was more than in the amended soil. Depth related occurrence of nematodes in the study declined as depth increased which was in conformity with Nzeako *et al*., (2014, 2015 and 2016). However, this trend was not consistent in the amended soil where there was homogeneity in diversity and species abundance. The homogeneity observed in the study was strongly due to the tilling of the soil and addition of organic amendment which enhanced availability of nutrients (table 2).The nematode species abundance at the 0-5cm depth in the undisturbed (pre planting) was associated to humus litter deposits on the soil surface. Nematodes such as *Ditylenchus* spp. accounted for 19.6% of recovered nematodes where litter were broken down and mineralize (table 1). *Tylenchus* spp.; a specialist feeder and strong biotroph assemblage occurred at this depth accounting for 17.1% of the recovered nematodes (table 1). However, at the 6-10cm depth, the population of these two nematodes were not statistically significant (p>0.0). (table 1).

In this study it was observed that the population of the dagger nematode, *Xiphinema* spp increased greatly after the application of organic amendment in 0-5cm and 6-10 cm depths respectively (Table 2). The population theses nematode genera and species decreased after AOA, due to the increased temperature of the soil environment owning to the organic amendment and removal of natural vegetation. It was also observed that 14 day after incorporation of organic amendment some genera of nematodes were delineated while new ones such as *Dorylaimus* spp., *Tetylenchus* spp. and *Tylenchorynchus* spp. emerged (Table 2) owing to succession pull occasion by variability in physicochemical and biological characteristics of the soil (Nzeako, 2013, Nzeako, 2016).The variability in spatial and temporal distribution of nematodes in the study was attributed to organic matter concentration on the surface of the soil. Agricultural practices such as tilling and constant weeding as well as physic-chemical parameters in the terrestrial environment (Bulluck III *et al*., 2002 and Karmani *et al*., 2011) a factors stated to influence the population dynamics of soil meiofauna.

The disparity in the nematode species richness in the study site reveals the impact of anthropogenic influence on flora and fauna integrity in the habitat (Ruston *et al*., 2004; Breure *et al*., 2005).Muldera (2005) opined that nematode species usually display increased ecosystem stability in conditions of poor ecosystem management. Ferris e*t al*. (2001), stated that the enrichment opportunist nematodes usually respond positively to disturbances in environment irrespective of the health integrity of the environment thereby making them very important indicators of soil fertility and not of pollution (Muldera 2005).

Growth parameters such stem height (cm), leaf length (cm), mean plant girth (cm), wet plant weight (g), wet root weight (g), plant branch number, leaf number, fruit number, fruit girth (cm), and fruit weight (g) were significantly influenced at the various levels of amendment 30, 60 and 90 days PAOA compared to the control (No organic amendment and synthetic fertilizer). This agrees with El-Zawahry (2000) and Umar and Jada (2000) reported that organic amendment resulted to increase in plant growth and reduction in nematode population. However, Ibrahim and Ibrahim (2000) observed that organic amendments of the soil with farmyard mixed with poultry manure resulted in plant vigor and reduced penetration of the roots by plant parasitic nematodes.BulluckIII *etal*., (2002) reported that soil amendments had a large impact on nematode community structure and diversity. This was buttressed by Devi and Hassan (2000) who showed a 100% improvement on the growth attributes of crops planted in soils enriched with farmyard and poultry manure.Karmani*et al*., (2011) reported that organic amendment in all doses significantly increased the shoot and root weight, increased in soil nematodes but suppressed parasitic in the roots.

4.2 Conclusion

The variability of nematode species, abundance and diversity in relation to depth as well as to disturbances is associated with nutritional availability, the degree of anthropogenic inferences, physiological characteristics of the parasites (i.e. hydrobiosis), physico-chemical parameters of a Specific area in the study sites. Enrichment of the agro-ecosystem with organic soil amendment influenced nematode trophic dynamics and nematode community structure.

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Table 1 Initial nematode population in the undisturbed site

			0-5cm	6-10cm	(%)
Aphelenchoides spp.	2	FF	18 (5.5)	13 (7.3)	31 (6.2)
Aphelenchus spp.	2	FF	10 (3.1)	8 (4.5)	18 (3.6)
Ditylenchus spp.	2	FF	64 (19.6)	13 (7.3)	77 (15.3)
Gracilacus spp.	2	FF	9 (2.8)	7 (4.0)	16 (3.2)
Helicotylenchus spp.	3	PF	14 (4.3)	8 (4.5)	22 (4.4)
Hemicriconemoides spp.	3	PF	8 (2.4)	6 (3.4)	14 (2.8)
Hemicycliophora spp.	3	PF	24 (7.3)	16 (9.0)	40 (8.0)
Longidorus spp.	5	PF	24 (7.3)	9 (5.1)	31 (6.2)
Meloidogyne spp.	3	PF	38 (11.6)	28 (15.8)	66 (13.1)
Paratylenchus spp.	2	FF	15 (4.6)	10 (5.6)	25 (5.0)
Pratylenchus spp.	3	PF	31 (9.5)	16 (9.0)	47 (9.4)
Rotylenchus spp.	3	PF	4 (1.2)	6 (3.4)	10 (2.0)
Tylenchus spp.	2	PF	56 (17.1)	25 (14.1)	81 (16.1)
Xiphinema spp.	5	PF	12 (3.7)	12 (6.8)	24 (4.8)
Total (%)			**327 (64.9)**	**177 (35.1)**	**504**
Genera/Species	C-P Scale	Trophic Group	Depth related occurrence (%)		Overall Occurrence

Key: FF: Fungi feeders. PF: Plant feeders, C-P Scale: colonizer-persister Scale

Table 2 Pre-planting nematode population after application of organic amendment

Genera/species	C-P Scale	Trophic Groups	Depth related occurrence (%)		Overall occurrence (%)
			0-5cm	6-10cm	
Aphelenchoides spp	2	FF	13 (5.7)	0 (0.0)	13 (2.9)
Crythodera spp.	4	PF	17 (7.5)	15 (6.7)	32 (7.1)
Ditylenchus spp.	2	FF	10 (4.4)	20 (8.9)	30 (6.6)
Dorylaimus spp.	4	OM/PR	5 (2.2)	10 (4.4)	15 (3.3)
Hemicycliophora spp	3	PF	20 (8.8)	32 (14.2)	52 (11.5)
Longidorus spp.	5	PF	35 (15.4)	55 (24.4)	90 (19.9)
Meloidogyne spp	3	PF	0 (0.0)	18 (8.0)	18 (4.0)
Paratylenchus spp	2	PF	10 (4.4)	0 (0.0)	10 (2.2)
Pratylencus spp.	3	PF	25 (11.0)	5 (2.2)	30 (6.6)
Tetylenchus spp.	2	PF	0 (0.0)	25 (11.1)	25 (5.5)
Tylenchorynchus spp	2	PF	10 (4.4)	0 (0.0)	10 (2.2)
Tylenchus spp.	3	PF	15 (6.6)	0 (0.0)	15 (3.3)
Xiphinema spp.	5	PF	68 (29.8)	45 (20.0)	113 (24.9)
Total (%)			**228 (50.3)**	**225 (49.7)**	**453**

Key; FF: Fungi feeders, PF: Plant feeders, OM/PR: Omnivores or predaceous ,C-P Scale: colonizer-persister scale

Table 3 Response of nematodes to organic amendment

Nemato des in eggplant root						
Days/OAC	**50kg**	**37.5kg**	**25kg**	**NOA**	**IOF**	**TOTAL**

30 days	42 (23.9)	38 (21.7)	36 (20.4)	36 (20.4)	24 (13.6)	**176**
60 days	232 (28.6)	154 (19.0)	160 (19.8)	156 (19.3)	108 (13.3)	**810**
90 days	174 (23.4)	170 (22.9)	128 (17.2)	132 (17.7)	140 (18.8)	**744**

Table 4 Response of *S.melongena* to organic amendments at 30, 60 and 90 days intervals.

30 days post application of organic amen dment					
Organic amendment concentration (OAC)	50kg	37.5kg	25kg	NOA	IOF
Stem height (cm)	22.4	15.0	18.2	12.6	12.6
Leaf length (cm)	17.6	18.8	18.2	12.2	14.3
Plant girth (cm)	0.27	0.26	0.20	0.17	0.19
Leaf number	6	6	6	6	6
Plant branch number	1	1	1	1	1
60 days pos t application of organic amen dment					
Organic amendment concentration (OAC)	50kg	37.5kg	25kg	NOA	IOF
Stem height (cm)	100	98	92	58	80
Leaf length (cm)	42	43	41	33	33
Plant girth (cm)	0.6	0.5	0.44	0.34	0.38
Leaf number	46	54	51	32	40
Plant branch number	10	11	11	6	8
Plant weight (g)	389.6	253.7	298	91	128
Root weight (g)	87	70	78	49	58
90day post application o f organic amend ment					
Organic amendment concentration (OAC)	50kg	37.5kg	25kg	NOA	IOF
Stem height (cm)	171	167	148	132	158
Leaf length (cm)	41	35	31	20	37
Plant girth (cm)	4	3	3	1.4	2.1
Leaf number	142	124	115	88	102
Plant branch number	26	29	21	18	19
Plant weight (g)	1580	1360	1500	675	814
Root weight (g)	214	166	208	56	116
Number of fruits	108	82	125	17	34
Fruit weight (g)	37	37	39	30	33
Fruit girth (cm)	5	5	5	3	4

Nematode in Root and soil = Population of nematodes in 1ml of aliquot, F = flower, OAC = Organic Amendment Concentration in (kg), NOA = No organic amendment, IOF = Inorganic fertilizer